NEW ZEALAND
DIGITAL SKILLS FORUM

DIGITAL SKILLS AOTEAROA

Digital Skills For Our Digital Future

An updated analysis of the Digital Skills landscape of New Zealand.

digitalnation.nz

Acknowledgments

NZTech and The Digital Skills Forum would like to acknowledge the following contributors;

Sarah Hindle and **Graeme Muller** from NZTech for collating data and writing the report, and **Andrea Molloy** from NZTech for editing the report.

Paul Matthews and the team at IT Professionals NZ for providing content and insight regarding tertiary education pathways, the original skills pipeline graphic and editorial feedback.

Ross Young and **Marie Efstathiou** from Google for their editing, feedback and insights through the process, and for highlighting many initiatives already in the market.

Maciej Surowiec and the team at Microsoft, **Robyn Henderson** and the team at the Ministry of Business, Innovation and Employment, **Victoria MacLennan** from NZRise, **Barry Soutar** from T3W, **Kim Connolly-Stone** from InternetNZ, **Ben Dakers** from Datacom, **Liz Meleisia** and the team from AbsoluteIT and **Trent Mankelow** from Summer of Tech for support and feedback through the writing.

We would also like to acknowledge and thank **Patrick McKibbin** and the team from the Ministry of Education for helping pull together the education data and providing essential information and feedback as the report was developed.

Thank you to the many stakeholders who have provided valuable feedback during the preparation of this report.

NEW ZEALAND DIGITAL SKILLS FORUM

The New Zealand Digital Skills Forum is a focused coalition of industry associations and Government organisations that work together to identify key issues and opportunities across information communication technologies (ICT), hi-tech and digital skills. The Forum uses their insights, resources and influence to help address the ever present digital technology skills shortages. By taking a practical, information and evidence-based approach, the Forum focuses on harnessing collaborative efforts to address significant issues.

NZTech

NZTech is the voice of the New Zealand technology ecosystem, representing 20 technology associations funded by over 1,500 member organisations, who collectively employ more than ten percent of the New Zealand workforce. These organisations are redefining the world we live in.

Our goal is to stimulate an environment where technology provides important social and economic benefits for New Zealand. NZTech's vision is a prosperous New Zealand underpinned by technology.

Contents

Tables

Figures

Introduction

Digital Skills for our Digital Future

05

Thank you to all our Project Supporters

Project Partners

NZTech

Google

MINISTRY OF BUSINESS, INNOVATION & EMPLOYMENT
HĪKINA WHAKATUTUKI

MINISTRY OF EDUCATION
Te Tāhuhu o te Mātauranga

Microsoft

absolute IT
RECRUITMENT

IT Professionals
NEW ZEALAND

ORION HEALTH
THINKING SOFTWARE FOR LIFE

xero

Spark

DATACOM

Media Design School

intergen

Auckland Unlimited
An Auckland Council Organisation

AUCKLAND

ChristchurchNZ™

internetnz

Supporters

SUMMER OF TECH
INTERNSHIP PROGRAMME

NZRise

INTRODUCTION

NZTech

The success of the digital technology sector is critical for New Zealand. It is one of the fastest growing parts of the New Zealand economy, generating billions of dollars in exports, creating thousands of jobs and enabling the digitalisation of the rest of the economy. Underpinning this growth and economic value are people with digital skills.

Digital Skills Aotearoa was commissioned by the Ministry of Business, Innovation and Employment (MBIE) with NZTech, to help inform the direction of the skills workstream within the Government's Digital Technology Industry Transformation Plan.

For the first time, data has been aggregated across the entire digital skills pipeline, from school to tertiary education, from education to employment, from within the market and from immigration. Overall, the story the research data tells is one of opportunity.

Disappointingly, it also paints a picture of lost opportunity. When NZTech and the Digital Skills Forum undertook similar research in 2017, *Digital Skills for a Digital Nation*, a series of recommendations were proposed. For example, suggestions included 'make sure every child is exposed to digital technology pathways' and 'actively encourage a more diverse group of Kiwis into digital technology'. However, three years later, we find decreasing participation in digital technology in education and a less diverse workforce.

We have found system wide challenges that require urgent national attention. Research shows a lack of coordinated effort, an industry reporting dramatic skills mismatches and heavily relying on immigration, while under investing in the development of its own workforce. Meanwhile, the tertiary education system has had to focus on international students to cover its costs, masking the decline in domestic participation.

Graeme Muller
Chief Executive,
NZTech

NZTech

Surprisingly, thousands of graduates struggle to gain an internship or even an entry level job.

In a world where digital technology underpins every part of our society and economy, we must not risk our digital future. Without investment and a coordinated national effort, including public and private sector partnerships and industry commitment to better integrate with education for upskilling and entry level development, we risk falling behind. Let's not look back in another three years with regret. The research clearly illustrates how the digital skills issue is manageable, it's not an insurmountable problem. So, let's collaborate and solve it together, today!

FOREWORD

New Zealand Government

Digital skills have never been more important. New Zealanders of every age and background increasingly need to be capable in using digital technologies in many day-to-day transactions and interactions.

Beyond this, in order to grow our vibrant technology sector in New Zealand, we need an equally vibrant pipeline of skills. This isn't a new phenomenon; I wrote a foreword in the previous version of this report in 2017. In that, I noted that the key challenge was to understand digital skills gaps to improve the flow of talent into the tech sector and other sectors of the economy.

Many things have changed since the publication of that report. Not least, the implications of COVID-19 have heightened the role of technology in all our lives, and have, for the medium term at least, diminished our ability to continue to import talent from overseas.

This report is a timely update to the 2017 digital skills survey. While the need for digital skills throughout our economy continues to grow, the challenge in 2021 is one of better matching digital skills with the organisations that need them, and how we encourage those organisations to invest in their talent from entry level, right through to senior level roles. We must also do more to foster greater inclusion of different groups within the tech sector – in particular Māori, Pasifika and women - to ensure that the opportunities available for business enterprise and career development can be realised by all.

This report contributes to our work with NZTech, IT Professionals NZ and others on a Digital Technologies Industry Transformation Plan (ITP). The ITP is a partnership between industry and government, and is looking to ensure that our technology sector is a strong contributor to New Zealand's economy in future years.

Carolyn Tremain
Te Tumu Whakarae mō Hikina Whakatutuki
Secretary for Business, Innovation & Employment and Chief Executive

MINISTRY OF BUSINESS, INNOVATION & EMPLOYMENT
HĪKINA WHAKATUTUKI

ITPs are also about ensuring that we create meaningful and quality jobs for all New Zealanders. As noted in this report, encouraging greater diversity in the technology sector remains an area we all need to work on – in government and in industry.

I want to thank NZTech for leading this important work to shine a light on the landscape for digital skills in Aotearoa. This landscape is constantly changing, and our response needs to be adaptable as well. Only by working in partnership will we resolve the challenges of today to ensure that we can thrive tomorrow. I look forward to continuing our partnership over the months and years ahead.

FOREWORD

Google

Back in March 2020, when the team of five million went into lockdown, I was at home with two energetic preschoolers. Like many businesses across New Zealand, we closed the Google office and supported our staff as they worked from home.

We also ramped up our online support for teachers who shifted to distance learning overnight; launched new tools to help our customers move their businesses online; and worked closely with the New Zealand Government to support their response to the pandemic. We're proud that Google technology enabled health authorities to share information and that it helped them understand an evolving and complex situation.

COVID-19 was a huge challenge for New Zealand—but we rose to meet it, securing our borders, reducing community transmission and saving jobs.

Our next test is economic recovery, after the largest fall in GDP in our history. Tourism, international education, retail and hospitality have all been hit hard, and unemployment has increased. To help meet this economic challenge we need to equip more New Zealanders with digital skills.

Just as technology was critical in fighting COVID-19, it will be equally vital as we work to rebuild. A digitally-skilled workforce and innovative home-grown businesses can help create jobs, improve services, tackle social challenges and power our economic growth in the years ahead. But only if we make the right decisions and investments today.

Caroline Rainsford
New Zealand
Country Director
Google

This report identifies New Zealand's digital skills challenge and recommends steps for action. I hope you find it helpful in your work. And I look forward to Google continuing to play a part in shaping our nation's digital future in the post-COVID world.

Executive Summary

Globally, demand for people with advanced digital skills is greater than the supply of qualified employees and the gap continues to grow.

By 2025, as many as 149 million new digital technology jobs are expected to be created worldwide. This demand is driven by the increased uptake of digital technologies across all sectors of the global economy. As demand for digital skills has grown, many countries have begun to modify their education systems to improve the teaching of foundational skills and competencies required for a digital future. However, there are still common challenges including shortages of qualified teachers, low levels of student interest in digital career pathways and low levels of participation by girls and underrepresented minority groups.

New Zealand is no different - during the past decade, the tech sector has experienced strong job growth and approximately 2,000 new jobs, on average, have been created every year. In fact, for the past five years, IT occupations have been steadily increasing, growing 4.7 percent a year to 98,583 jobs across all sectors by 2019. Meanwhile, the education system has introduced digital technology teaching across all year groups. However, the education system is also experiencing similar challenges with shortages of qualified teachers, low levels of student interest and a lack of diversity among participants.

New Zealand is facing a specific digital skills challenge - this research clearly shows an issue of a skills mismatch *rather than a skills* shortage.

The number of new digital technology roles created each year is not an insurmountable challenge. New Zealand requires in the range of 4,000 - 5,000 new digital technology professionals each year, only a small percentage improvement across the pipeline.

In 2019, 4,462 new digital technology jobs were created. In the same year, 5,745 students graduated from tertiary information technology (IT) courses (3,265 graduated with degrees in either computer science, information systems or software engineering). Added to this was another 3,863 immigrants who were granted visas for IT occupations and approximately 200 people who reskilled through organisations such as the Dev Academy. According to this data, New Zealand should have an excess supply of digital skills, rather than a shortage.

However, other measures seem to indicate that there is a skills shortage. At all times, a large number of jobs are being advertised, salaries are high and industry reports difficulty finding the required skills. The industry research conducted as part of this study found that the majority of roles being recruited are for senior or experienced individuals, with very few entry level positions available. This indicates a skills shortage for senior experienced capabilities and an oversupply of underskilled graduates. To solve this problem, organisations have increasingly relied on immigration to access the required digital skills at the required time.

An increasing reliance on immigration and low levels of investment in upskilling staff has created slow career progression and high levels of employee turnover as individuals actively seek new opportunities.

In recent years, immigration has become the preferred pathway for organisations recruiting

for digital technology roles. The strong demand for people with advanced digital technology skills has resulted in very favourable immigration settings for New Zealand employers. This, plus global interest in New Zealand, has provided organisations with relatively good access to a global talent pool. In 2019, the 3,863 approved visas for people working in digital technology jobs in New Zealand accounted for 83 percent of new digital technology jobs created. However, the data shows that firms were not solely recruiting experienced, senior talent via immigration. Jobs requiring less experience, for example software testing and web development, have also been recruited through immigration.

There is also a very low level of investment in the development of IT staff in New Zealand organisations. Less than 10 percent of large organisations and Government agency training was spent on digital technology upskilling. The default method of obtaining new skills for most organisations appears to be recruiting from an international talent pool. Rather than investing in upskilling staff, organisations are going to market for their required new skills. This is compounding the issue and resulting in a high (19 percent) annual churn (or turnover) rate for IT professionals. LinkedIn analysis found that IT workers receive twice as many InMails from recruiters, than in other verticals. Software engineers receive two and a half times as many. Research found that the main reason IT employees leave their current job is for career advancement and the main thing they look for before joining a new company is a stronger career path.

To further exacerbate the digital skills mismatch, a declining number of secondary school students are enrolling in technology courses and other pathway subjects like mathematics (maths). Participation in National Certificate of Educational Achievement (NCEA) technology standards has been declining at minus two percent compound annual growth rate. Maths standard participation has also been declining at minus one percent during the same period. This decline is then flowing into tertiary study. Since 2015, there has been a minus two percent decline in enrolments for IT courses.

The decline in tertiary enrolments has primarily been in lower level courses, for example, Level 1 to 4 IT Certificates, which have been declining at -20 percent. Degree level enrollments have been growing at three percent CAGR, but this has been driven by an eight percent growth of international students, masking a flat growth of domestic students. In 2019, only 1,850 domestic New Zealand students enrolled in an IT degree level course.

Better connections between industry and education are required to improve diversity and pathways into digital technology careers.

Compared to other sectors where numbers are increasing (for example, construction) the key difference appears to be industry integration and partnership with education. This includes strong marketing and clear messaging to students, defined pathways, easy access to career information, and the ability to earn while learning.

The challenge of diversity can also be vastly improved through better connections between industry and education. Cultural diversity has been driven by high levels of immigration, however like all other countries, digital technology study and careers are not attracting women and underrepresented minorities. In New Zealand the

diversity challenge begins in education with only 39 percent of technology standards participants being girls, 14 percent Māori and 9 percent Pacific peoples. This flows through all levels of study and into the workforce where only 27 percent of digital technology employees are women, 4 percent Māori and 2.8 percent Pacific peoples.

The declining participation of New Zealanders in digital technology career pathways, especially women, Māori and Pacific peoples is of great concern. There is an increasing risk that New Zealand culture will not be captured in the code being developed, in the algorithms and user interfaces of future digital tools.

To ensure New Zealand's digital future, work is required at all stages of the digital skills pipeline.

New Zealand is in an excellent position to ensure its digital future. While there are currently digital skills challenges, unlike many other countries, there is not a systemic skills shortage. The following practical recommendations are provided as a starting point toward improving New Zealand's digital skills for a digital future.

Recommendations

1. Build the Digital Skills Pipeline

- Promote digital technology to students, parents and whanau.
- Increase investment in educators confidence and upskilling.
- Develop clearer pathways into digital roles.
- Work with women, Māori and Pasifika communities to improve participation rates.
- Develop consistent data for workforce planning.
- Create and deploy targeted international talent attraction.

2. Support the Transition to Work

- Launch a national education to employment and workforce planning platform.
- Develop digital apprenticeship pathways.
- Simplify and expand internship grants.
- Expand the Government's GovtTechTalent graduate programme.

3. Upskill and Reskill

- Fund and coordinate specialisations across the ICT Graduate Schools.
- Encourage industry accreditation.
- Recognise and incentivise industry certifications.

In summary, it is vitally important that New Zealand continues to attract the best digital talent the world has to offer, bringing new ideas and market connections into the local New Zealand workforce. However, more focus, collaboration and investment is essential now to build a strong local pipeline of talent, to support the transition from education to digital technology careers and to help those already working to upskill or reskill with in demand digital skills.

NEW ZEALAND'S DIGITAL SKILLS LANDSCAPE

Demand for digital skills is still high

114,450
people employed in the tech sector in 2019.

98,583
people employed as IT professionals (across all sectors) in 2019.

$92,250
national median salary for digital technology workers in 2019.

4,462
new IT jobs created in 2019, growing at 4.7% CAGR over five years.

4,948
new digitally skilled employees required in two years by 190 survey respondents.

3,683
visas approved for IT professionals to immigrate to New Zealand in 2019.

More focus needed on education, upskilling and reskilling

30%
of senior secondary school students took technology standards in 2019.

-2%
declining numbers of students taking technology standards over the past five years.

only 1,850
students moved into IT degree courses from secondary school in 2019.

15,325
students were enrolled across all levels of tertiary IT courses in 2019.

3,265
students graduated with computer science, IT or software engineering degrees in 2019.

only 352
students were able to get internships in 2019 after 2,699 registered for the opportunity

< 10%
of training budgets spent on digital technology upskilling.

19%
of IT professionals changed jobs in 2019 primarily for career growth not salary growth.

<200
people undertook reskilling into digital technology careers in 2019.

Lack of diversity in digital technology roles starts at education

only 27%
of the IT workforce are female, starting from only 39% taking NCEA technology at school.

only 4%
of the IT workforce are Māori, starting from only 14% taking NCEA technology at school.

only 2.8%
of the IT workforce are Pacific peoples, starting from only 9% taking NCEA technology at school.

= SKILLS MISMATCH

Part One

The Digital Skills Landscape

15

What are Digital Skills

Digital skills are the skills needed to find, evaluate, utilise, share and create content using information technologies and the Internet.

Digital skills can be basic, such as the ability to use email or online banking, through to more advanced skills such as programming. These are skills that are needed everywhere and in every industry. It is predicted that nine out of 10 jobs will require digital skills by 2030.[1]

COVID-19 has accelerated digitalisation globally, necessitating a mass upskilling of basic digital literacy skills by the entire population. More now than ever before, digital literacy skills are essential for everyday life, whether banking online, seeking employment, scanning a QR code for COVID-19 tracing or participating in collaborative online meetings.

For the purposes of this study, we focus on advanced digital skills, not basic digital literacy skills. As noted in the 2017 study[2], these skills were traditionally the domain of information communications technology (ICT) professionals. However, with the rapid adoption of technology through businesses and the creation of entirely new industries such as agritech and fintech, it is no longer just ICT professionals requiring these advanced skills.

Defining Advanced Digital Skills

For consistency, we have retained the advanced digital skills definition used in 2017. Advanced digital skills are those required to control and create with digital technologies. These skills include software programming, developing algorithms, managing and analysing large amounts of data, implementing and managing digital hardware and networks, and information security.

Advanced Digital Skills

are the skills required to control and create with digital technologies.

Why are these skills critical for New Zealand?

In previous decades, advanced digital skills were primarily the domain of the IT sector. Today, digital technology impacts almost every sector. Digitalisation and the convergence of technologies is creating entirely new industries, for example, agritech, fintech and healthtech. Together, this is creating a huge demand for digital skills.

Digital skills are a ticket to play: without a digitally skilled labour force, New Zealand will be unable to harness digital technology opportunities and the broader digitalisation of the economy. Digital technologies enable New Zealand to overcome the challenge of geographical distance, through weightless digital exports, ultimately providing strong productive growth, higher wage employment and the creation of large, exporting organisations.[3] If New Zealand doesn't improve the digital skills of its workforce we will continue to have low levels of productivity and ultimately more expensive, less competitive products competing in global markets.

Automation technologies, in particular (machine learning, robotics and artificial intelligence), could offer small and medium enterprises (SMEs) that make up 97 percent of New Zealand businesses, the ability to extend their reach and increase their productivity. As we will see in the next section, all other countries are grappling with the challenges of digital skills, so addressing these challenges quickly may provide new opportunities for New Zealand.

The Global Skills Landscape

Growing Demand Creating Skills Shortages

In 2017, *Digital Skills for a Digital Nation* identified the digital skills gap, where demand for digital skills was already high and forecast to continue growing. Meanwhile, the supply of skilled digital workers was low. The digital skills gap has resulted from a shift towards digitalisation, the emergence of new professions and the displacement of other roles, creating a need for continued digital training.

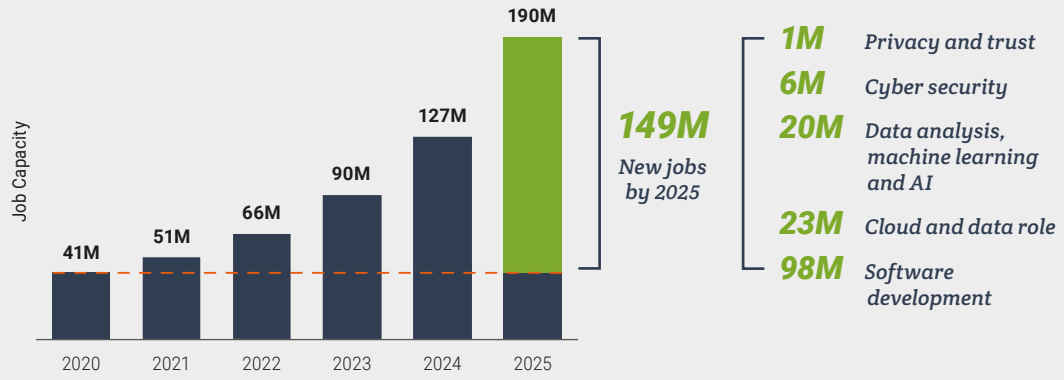
The two key factors are the lack of digital skills amongst the existing workforce and the scarcity of experienced professionals to fill demand in complex digital technology roles.

Globally, demand for people with advanced digital skills is greater than the supply of suitably qualified employees and the gap continues to grow. The future of work will see a shift away from traditional office support positions, machine operators and other low skill professions towards technology professionals such as computer engineers and ICT specialists.[4] Leading global organisational consultancy, Korn Ferry, has calculated that by 2030, the global digital skills shortage will reach 4.3 million workers.[5] This is equivalent to 59 times the number of employees of Alphabet, Google's parent company. However, this may now be an underestimate, given the dramatic economic and social impact of COVID-19. Microsoft Data Science is predicting that global lockdowns will accelerate digitisation and create an additional 149 million digital technology jobs globally by 2025.[6]

149 million

New digital technology jobs are predicted to be created globally by 2025.

FIGURE 1: Predicted digitisation of the world economy



Sources: Microsoft Data Science utilising LinkedIn data, Microsoft, August 2020.

The global lack of attention to upskilling will continue to create a gap between workers and jobs. The World Economic Forum (WEF) predicts that most jobs will require digital skills by 2030, yet even in advanced societies like Europe, 44 percent of 16-74 year olds lack even basic digital abilities. The WEF projects the looming skills gap will lead to 1.67 million unfilled vacancies for ICT professionals by 2025 in Europe alone, demonstrating an opportunity for targeted upskilling.[7]

Australia

As a result of COVID-19, Australia's tech workforce is expected to contract. The Australian Computer Society (ACS) Digital Pulse report predicted the impact of COVID-19 would result in 35,000 fewer technology workers between March and December 2020.[8] This is despite Australia's hardware and networking sector growing, amid increased tech demands. A shortage of talent on the ground is fostering a high degree of internal mobility within the tech sector.

Meanwhile, forecast demand for technology workers in all sectors will grow by 100,000 between 2018 and 2024, with the technology workforce increasing to 792,000 workers.[9] The fastest growth sector is forecast to be healthcare, whose technology workforce will grow by over 50 percent. This continued strong demand comes after 2.5 percent average annual growth, significantly more than the overall Australian labour market of 1.7 percent.[10] While the pipeline is gradually improving in Australia, there remains a time lag. In its first year, Australia's global tech talent visa attracted more than 4,000 migrants. The offer of fast-tracked permanent residency is aimed at talent likely to earn more than A$150,000 each year working in one of seven 'future-focused fields' including cybersecurity, fintech and quantum computing.[11]

Australia is investing

$585 million

in its 2020 budget on delivering skills for today and tomorrow.

As part of the Australian Government's 2020 budget a $585 million Delivering Skills for Today and Tomorrow package was announced. This includes the establishment of a Skills Organisation pilot for the digital technology sector. The Digital Skills Organisation (DSO) will shape the national training system, testing innovative solutions to ensure that digital training meets the skills needs of employers. The DSO will work on identifying these needs, developing agile qualifications, improving the quality of training delivery and assessment. It will engage with other reforms occurring across the national training system where relevant.[12]

Asia

The Asia Pacific region is facing an imminent labour shortage of 47 million by 2030 and an annual opportunity cost of US$4.2 trillion.[13] The scale of the challenge is catalysing a number of significant initiatives across the region:

- **Go Digital ASEAN:** aims to equip micro and small-medium enterprises across member stages with the digital skills to help bridge the digital gap and turbo-charge economic recovery from COVID-19. This will see 200,000 individuals from across

Southeast Asia retrained with crucial digital skills. Led by ASEAN (the Association of Southeast Asian Nations) in partnership with Asia Foundation and supported by a US$3.3m grant from Google.org.[14]

- **Microsoft, LinkedIn and GitHub** launched a new global digital skills initiative this year to help those impacted by COVID-19. In Asia alone, more than 1.5 million learners have been reached through the initiative at opportunity.linkedin.com. The most popular in-demand learning paths being Software Developer, Customer Service Specialist and Data Analyst.[15]
- **SkillsFuture, Singapore:** this credit initiative provides Singaporeans aged 25 and over, with an opening credit of S$500 and the Government provides periodic top-ups to help engaged lifelong learners accumulate more platform funding to continue their education. In its first year, 126,000 Singaporeans used the credit to enhance their digital careers.[16]
- **Human Resources Development Fund:** is a Malaysian Government initiative with a number of programs focused on accelerating human capital development. It offers tailored educational solutions to organisations, providing e-learning, industrial training, computer-based training, coaching and mentoring. The initiative aims to contribute a 35 percent increase in the skilled Malaysian labour force and generate 1.5 million jobs by 2020.[17]

In 2021, New Zealand is the chair of the Asia-Pacific Economic Cooperation (APEC) forum and this presents an opportunity for New Zealand to take a leadership role in digital skilling that could benefit the entire region.

China

The annual KPMG CIO Survey[18] found that in China, the COVID-19 pandemic accelerated digital transformation and the adoption of emerging tech including artificial intelligence (AI), machine learning, the Internet of Things (IoT) and intelligent automation. However, according to the survey, the digital skills shortage in China is at an all-time high, with 96 percent of mainland China's Chief Information Officers (CIOs) suggesting a skills shortage prevents their organisation from keeping up with the pace of change.

Currently, China accounts for 42 percent of global e-commerce, boasts one-third of the world's most successful tech startups and conducts 11 times more mobile payments than the United States per year.[19] However, almost half (49 percent) of Chinese CIOs report that an insufficient depth and breadth of digital skills is the most significant barrier to achieving their objectives.[20]

The success of local internet giants including Baidu, Alibaba and Tencent in China is a double-edged sword. Due to a substantial compensation gap, talented graduates and professionals are more likely to pursue a career at one of these large organisations, rather than joining a traditional enterprise. Consequently, there is a lack of digital skills flowing into traditional Chinese enterprises.

According to LinkedIn China, over the past five years, professionals with digital skills have increased nearly threefold, but demand continues to outstrip supply. For example, in 2019, 40 percent of Chinese candidates listed data skills as a talent, compared with just 13 percent in 2015. Clearly, the gap between demand and the supply of digital talent is widening. Recently, LinkedIn also noted that China's demand for talent with digital skills rose nearly sevenfold in the past five years.[21]

Europe

Europe has recently adopted a collaborative approach across European Union (EU) member states to facilitate the exchange of good practice, frameworks, research, recommendations and other tools. It is part of a package which includes two initiatives to strengthen the contribution of education and training to the EU's recovery from COVID-19 and help to build a green and digital Europe.

The EU released a digital strategy this year, *Shaping Europe's Digital Future*,[22] with a vision that digital transformation is working for people, businesses and the planet, in line with EU values. A core pillar within this strategy is the Technology that Works for People workstream which includes the new *Digital Europe Programme*.[23] This programme has a planned overall budget of €8.2 billion including €600 million dedicated to advanced digital skills. The stated aim is to expand the digital talent pool with around 256,000 additional people who will be able to deploy the latest technology in business throughout Europe. It will focus on three types of actions:[24]

1. Master's Programmes in cutting-edge digital technologies developed together with EU excellence centres in artificial intelligence, cyber and high-performance computing. The aim is to offer 160 new master programmes training 80,000 digital specialists.
2. Short-term specialized training courses in advanced digital technologies for around 150,000 job seekers and employed people especially in SMEs. The aim is to equip them with the competences that will enable the deployment of digital technologies across all sectors of the economy.
3. 35,000 job placements in companies or research centres where advanced digital technologies are developed or used. The aim is to give people the opportunity to learn specialists' skills working with the latest available technologies.

Meanwhile, only 39 percent of educators in the EU felt well or very well prepared for using digital technologies.[25] The EU's revised Digital Education Action Plan[26] released in September 2020 emphasises Europe-wide enhancement of connectivity, infrastructure and cooperation providing digital skills for all. Some experts have been critical of the lack of connection to

actual jobs in the Plan, which further highlights the importance of collaboration with industry.

The United Kingdom

The United Kingdom (UK) is one of the most digitally advanced nations in Europe according to data from the European Union.[27] It is already home to a large number of big tech businesses and the UK has more tech 'unicorns' (startup businesses valued at $1 billion or more) than any other European country.[28]

According to Tech Nation, a UK network focused on accelerating the growth of digital businesses across the country, employment in the digital tech economy increased by 40 percent between 2017 and 2019, to 2.93m people and there has been a 150 percent increase in demand for roles within the digital technology sector over the past four years.[29]

The digital skills shortage is being felt across all sectors with 56 percent of organisations reporting that skills shortages have already negatively impacted on performance, and 50 percent expect profitability to be negatively impacted in the next four years.[30] Nine out of ten organisations in the UK currently lack some sort of digital skills. While almost 30 percent are looking to 'hire in' digitally skilled talent, 85 percent of senior leaders in the UK agree that a lifelong learning will be the model of the future.[7]

Demand for roles within the UK digital tech sector increased

150%

over the past 4 years.

The United States of America

Currently one of the world's leading technology markets, the United States of America (USA) can expect to lose US$162.25 billion by 2030, due to digital skills shortages in the tech sector alone.[31] This is partly being driven by a demographic shift as older generations are expected to retire from the workforce by 2030. However, not enough younger people are entering training in time to take many of the high-skilled jobs left behind. This demographic challenge is not limited to the tech sector. Management consultancy, McKinsey, reported that not only is the government struggling to acquire emerging digital talent, it is also on the cusp of losing decades of institutional knowledge, expertise and experience to civil service retirements. As of 2018, approximately 4.5 times as many civil servants in IT roles were over age 60 than under age 30 — a gap that has more than doubled in the past decade.[32]

Life Long Learning

The constant acquisition of knowledge and skills over a lifetime driven by constantly changing skills needs, especially digital skills.

Flexible learning, where and when you need it.

Agile micro-qualifications for skills in demand.

Adaptable for new career pathways and opportunities.

The median annual wage for computer and IT occupations in the USA is US$88,240, more than double the level for other jobs.[33] This is attracting graduates, with a record number of bachelor's degrees in computer science and engineering over the past five years. In 2018, colleges and universities in the USA awarded roughly 365,000 undergraduate STEM degrees, up 60 percent from a decade earlier, according to calculations based on data from the National Center for Education Statistics.[34] Of this total, 92 percent went to Americans and permanent residents.

However, it appears that employers have been using immigration to fulfil their digital roles. This has resulted in concerns that many major tech firms and other large employers of IT professionals have been using the H-1B visa scheme to drive down employment costs. Sixty percent of H-1B positions certified by the U.S. Department of Labor are assigned wage levels well below the local median wage for the occupation.[35]

Global Approaches to Skills Supply

As demand for digital skills has grown, many countries have begun to modify their education systems to improve the teaching of foundational skills and competencies required for a digital future.

To better prepare students for the future, computer science has been identified, by many countries, as a critical element in strengthening existing education models. Computer science is the study of both computer hardware and software design. This includes theoretical algorithms, artificial intelligence and programming. It also includes elements of computational thinking - a problem solving process using decomposition, algorithms, abstraction and automation.[36] It is important to note that computer science is distinct from computer literacy. Computer science involves computer design, rather than computer or device use. For example, coding is a skill often

learnt in computer science, while creating a document or slideshow presentation using an existing program is computer literacy.

During 2020, the nonprofit public policy organisation, Brookings Institution, published an analysis of aggregated evidence from multiple countries, on the expansion of computer science education in their schooling systems.[37] They found that most countries have been slow to adopt computer science or digital technology courses into their primary and secondary (K-12) school systems. From 219 countries, only 20 percent mandate that schools offer computer science courses as an elective or required course. Meanwhile, 73 percent (or 160 countries) are only piloting programmes or have no evidence of in-school computer science education. As seen in Figure 2, New Zealand sits alongside Australia, China, Japan, Russia and the UK in introducing computer science education. Successfully developing these skills within a country is no longer considered just a competitive advantage, they are essential skills for global market competition.

Common challenges

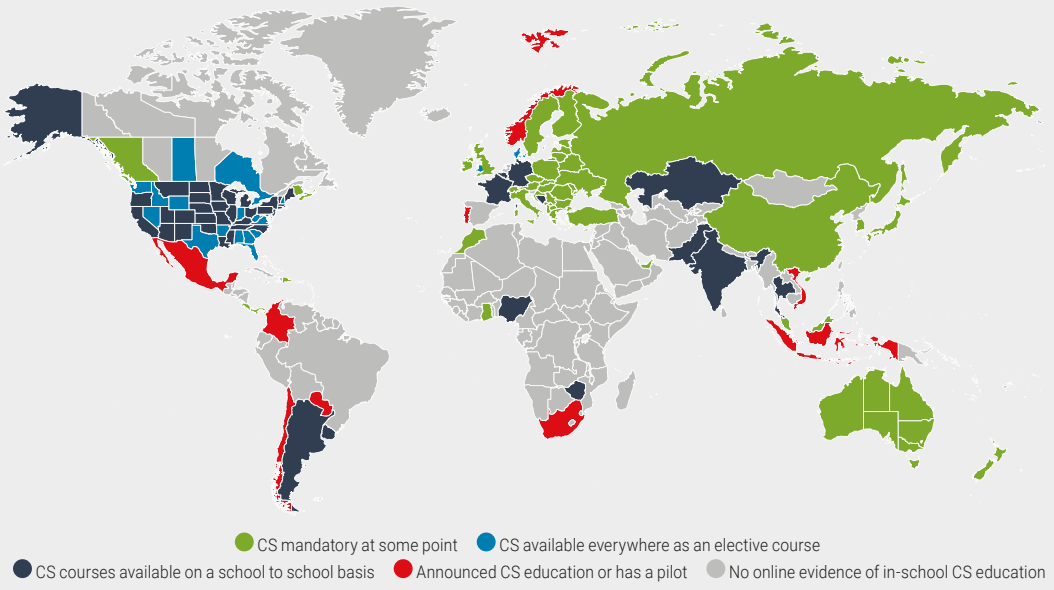
The research noted that few countries have offered computer science education long enough to evaluate the effectiveness of their education processes. However several common challenges have emerged including:

- shortages of qualified teachers who understand computer science concepts and instructional methods.
- low levels of student interest in computer science subjects.
- low levels of participation of girls and underrepresented minorities.
- difficulty in developing material and assessments tailored to differing education settings.

An Organisation for Economic Cooperation and Development (OECD) study found that in countries where curriculum incorporates ICT skills, teachers reported a need for further training.[38] For example, a review of the UK's ICT curriculum highlighted several gaps;

1. The teaching profession needed to be more attractive for professionals with ICT skills.
2. Current teachers needed relevant continuous training.
3. There was a need to create qualifications recognising immediate levels of ICT skills.[39]

FIGURE 2: Global adoption of computer science education



Sources: Brookings Institution, 2020.

Girls and underrepresented minorities

The Brookings research also noted that globally, girls and racial minorities are underrepresented in computer science education.[40] This lack of diversity becomes a barrier to entry for other prospective students who miss the opportunity to enter career paths to highly paid digital technology jobs. Research indicates that the diversity gap in digital technology (careers and education) is due to a disparity of access to computer science content,[41] [42] widely held cultural perceptions, and poor representation of women and underrepresented minorities in media depictions.[43]

Addressing the challenges

Governments, often with the support of nonprofit organisations, have been addressing these challenges in various ways. Investments are being made to ensure continuous professional development (PD) and to introduce certification programs and computer science credentials within teaching degrees. Students are also being encouraged to participate in short coding classes, after school clubs and summer camps. Attention is also being paid to inspiring girls and minority groups into programmes specifically designed for these cohorts. Education practitioners are innovating the design of instructional methods for computer science education, ranging from block-based non digital programming activities to kinesthetic lessons.

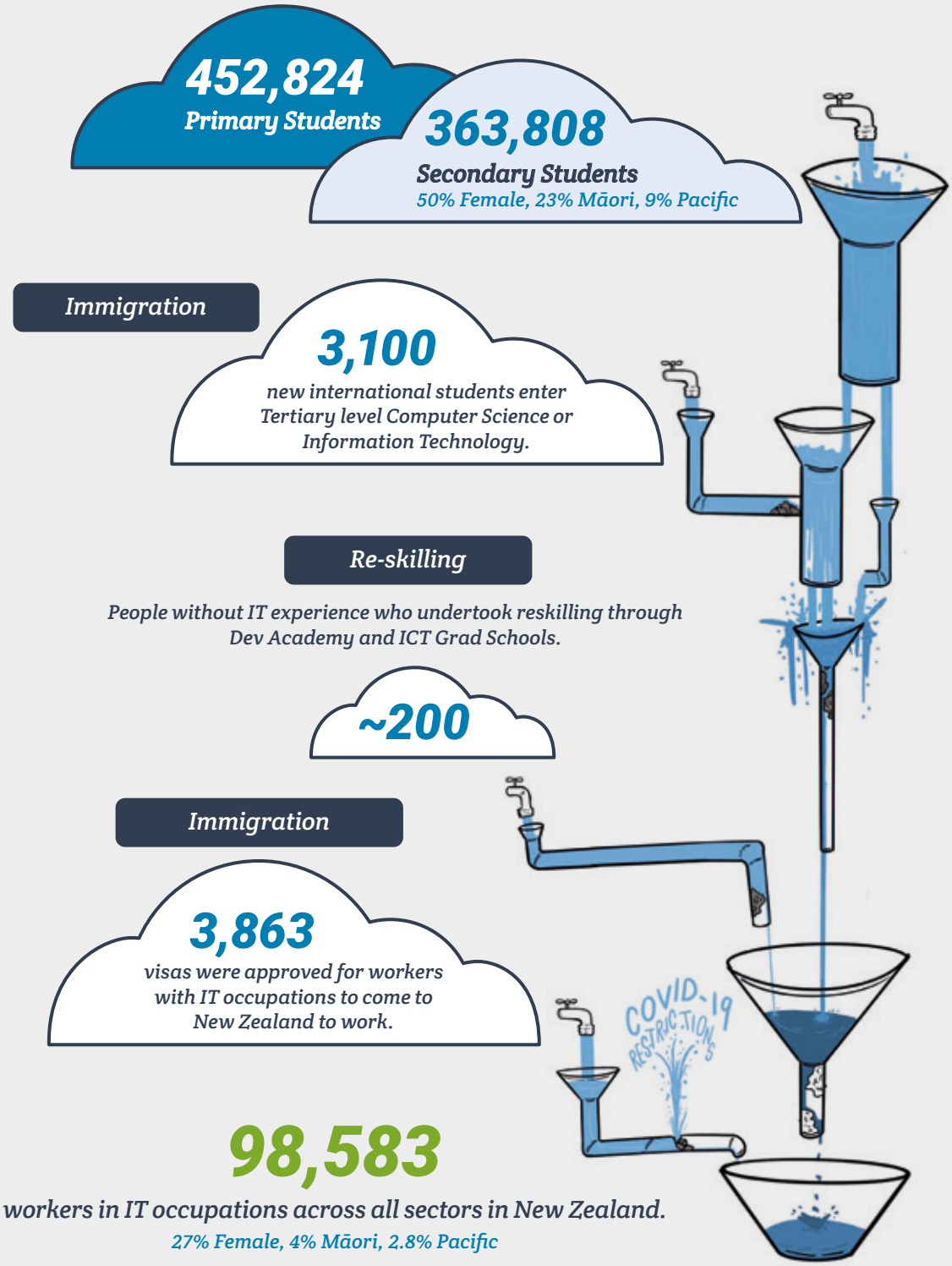
The New Zealand Landscape

This report consolidates data and insights from Government, industry and education to provide a complete picture of the digital skills landscape in New Zealand.

This includes data collected on secondary and tertiary education participation from the Ministry of Education and immigration and occupation data from the Ministry of Business, Innovation and Employment. Additional data has been collected on the transition from education to employment (internships), a workforce survey and other sources on the current employment landscape.

As shown in Figure 3, it is possible to better understand the complexity of the digital skills pipeline. This one year snapshot from each part of the pipeline allows us to clearly identify opportunities for support, intervention or investment. In 2019, as the data shows, a manageable number of new IT roles were created, however they were predominantly for senior specialists. Consequently, the immigration pathway was the dominant source of supply. The supply data shows that the pipeline from education is narrow with very few, relative to the total number of students, flowing through education into the workforce. Those that do, find it difficult to access jobs due to limited entry level opportunities. There is also a concerning, significant lack of diversity throughout the education pipeline and subsequent digital roles. There are opportunities to greatly improve transitions from education to employment, plus upskilling or re-skilling to better access the New Zealand workforce.

FIGURE 3: The New Zealand digital skills pipeline in 2019



School

40,369 Year 13 students took NCEA Maths and...

15,999 took NCEA Technology standards.

Only **5,102** took NCEA Digital Technology standards

Tertiary Study

3,455 Students from Secondary School entered Tertiary study in Computer Science, Information Technology or Software Engineering.

1,850 enter Degree Level courses.
24% Female, 9% Māori, 6% Pacific

10,400 domestic and **4,925** international students enrolled in Degree Level qualifications in Computer Science, Information Technology or Software Engineering.

Education to Employment

5,745 students graduated from tertiary courses at all levels in Computer Science, Information Technology or Software Engineering.

3,265 graduated at Degree Level in Computer Science, Information Technology or Software Engineering.
22% Female, 10% Māori, 5% Pacific

2,699 students registered for a Summer of Tech internship.

Only **352** students were provided internships via the Summer of Tech internship programme.

Demand for IT Specialists

4,462 new IT occupation jobs were created across all sectors.

Shortage of Senior Specialists

Shortage of highly skilled, experienced senior specialists **2,020** senior IT roles open on LinkedIn (in Nov 2020 alone).

Sources: Ministry of Education, Ministry of Business, Innovation and Employment, Immigration NZ, NZTech, IT Professionals New Zealand, LinkedIn, ICT Graduate Schools and Summer of Tech.

In 2019, New Zealand had

98,583

workers in IT occupations.

Digital Skills Demand Continues to Grow

There is evidence of continuing growth in need for tech skills across most sectors of the New Zealand economy.

The tech sector continues to create strong new job growth in New Zealand, generating 2,148 new jobs in 2019, up two percent from 2018. Tech companies have been creating approximately 2,000 new jobs a year on average for the past 10 years. In 2019, 555 new companies were created in the tech sector alone, up three percent from 2018.[44]

In fact, IT occupations have been growing steadily across all sectors for the past five years. There were 4,462 new IT jobs created in 2019, taking the total number of IT occupations across all sectors to 98,583.[45] The 190 organisations that responded to the 2020 New Zealand Digital Skills Survey forecast an additional 4,948 digitally skilled employees within the next two years, compared to the 3,248 forecast in the 2017 survey.[46]

Immigration used to fulfil demand for experienced specialists.

At the time of the survey, 147 of the respondents were actively recruiting for 746 open digital roles with the majority seeking people with experience or advanced skills such as enterprise architects, software engineers and senior developers. At the time of the survey, in November 2020 alone, LinkedIn was advertising 2,020 senior information technology positions. This need for advanced skills and experience means immigration pathways have previously been used as a source for experienced talent with 3,683 ICT workers entering New Zealand on work visas in 2019.[47] This is equivalent to 83 percent of the new ICT occupations created that same year. The impact of COVID-19 on immigration is expected to result in numbers dropping into the hundreds creating a domestic shortage of senior specialists. For tech exporters with offshore offices, this is expected to result in a transfer of work from New Zealand to wherever they can access the talent.

It will take time to build a solid pipeline of local skilled workers so we must maintain an appropriate immigration pathway or risk slowing the economy's digital transformation due to a lack of experienced professionals. A five year plan will be needed to change the balance and reduce reliance on immigration.

Strong demand for advanced digital skills resulting in high pay.

The overall supply and demand mismatch means that digital and ICT roles continue to be some of the highest paid jobs in New Zealand. While the median annual income from wages and salaries across all jobs in New Zealand was $52,832 in 2019 [48], the national median base salary for ICT employees was $92,250.[49]

National median base salary for digital technology workers in New Zealand in 2019

$92,250

In addition to higher pay rates, ICT employees continue to receive excellent benefits with the vast majority having the option to work flexibly and remotely, 31 percent offered a phone allowance, 28 percent paid healthcare and most are eligible for bonuses - all increased from 2017.[50]

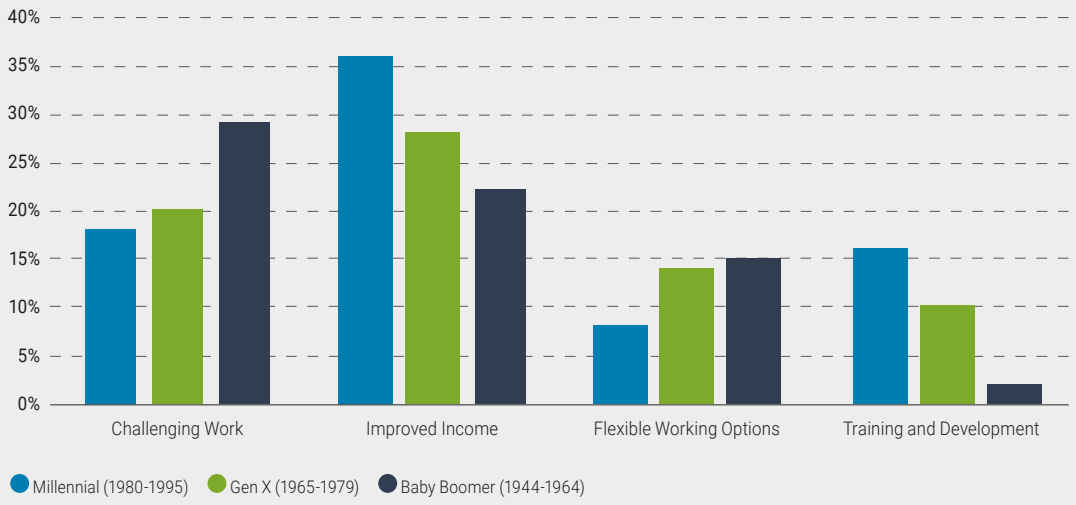
High pay and strong demand appear to be impacting job mobility. Sixty four percent of IT professionals are considering a new workplace in 2020, an eight percent increase compared to 2019.[51] When asked what their top motivators were for changing jobs, the survey respondents indicated that career development was the primary driver. It was a similar case in 2019, where career development or a project coming to an end were the primary motivators for wanting to change jobs. Improved income was the third most important factor, but there are some generational differences as shown in Figure 4 below.

Diversity continues to be a challenge across the digital landscape.

The respondents to the 2020 Digital Skills Survey indicated that only 27 percent of their digital teams were women.[52] While this is a slight improvement from the 2017 survey, women are still significantly underrepresented in digital roles compared to national population demographics.

The theme of under-representation persists across other non-dominant sectors of the population and their presence in IT roles. Māori make up just 4.1 percent of staff in IT teams and Pacific staff make up only 2.8 percent. This means 54 percent of survey respondents have no Māori staff and 59 percent have no Pacific staff.

FIGURE 4: Primary deciding factor for changing jobs by generation



Sources: Tech Digital Remuneration Report, Absolute IT, July 2020.

Underrepresented in the digital workforce:

27% Women
4% Māori
2.8% Pacific

Multiple Pathways into Digital Roles

In one sense, with employees from throughout the world, digital technology teams are diverse, as are the organisations employing them and the occupations they work in. The pathways into digital roles are also diverse, ranging from traditional education via primary and secondary school exposure to digital technologies, through a variety of tertiary education pathways including opportunities for reskilling. Most pathways encourage some form of work experience or internship opportunity but these are consistently hard to place. Regardless of the variety of pathways available, the numbers of New Zealand students undertaking digital technology education has remained low and has now started declining.

Slow start for the digital technologies curriculum and declining NCEA participation impacts the digital skills pipeline.

The introduction of the new Digital Technologies and Hangarau Matihiko (DT) content into The New Zealand Curriculum[53] should, in theory, help address the early pipeline challenges by encouraging more students across all age groups to engage with digital technology education. According to the Ministry of Education, its goal was to ensure all learners have the opportunity to become digitally capable individuals. This signalled the need for greater focus on students building their skills so they can be innovative creators of digital solutions, moving beyond solely being users and consumers of digital technologies.

The revised technology learning area curriculum content was updated to include DT in 2017. The Ministry of Education mandated that schools and kura teach the new DT content to all students, from years 1–10, commencing January, 2020. The adoption in many schools has been significantly impacted by Covid-19 and this is likely to see implementation delayed until 2021 or 2022. Many schools still don't have plans for their Digital Technologies curriculum adoption.

During the course of their first ten years, students will learn all five technology areas, including the two new digital technology areas of 'computational thinking for digital technologies' and 'designing and developing digital outcomes'. Learners will have the opportunity to specialise in different technology areas in years 11–13.

It is still too early to determine the downstream impacts, however it appears that schools are implementing the DT curriculum content in different ways, with a variety of outcomes.[54] An early study by the Education Review Office in

The Number of students taking NCEA Technology standards has declined since 2015 by

-2% CAGR

2019,[55] found that only seven percent of teachers reported having enough knowledge and skills to implement the curriculum, which led to the introduction of additional professional learning development for 34,000 teachers through to 2021.

In addition, the National Monitoring Study of Student Achievement (NMSSA), tasked with assessing and understanding learner achievement across the curriculum is reviewing the technology learning area. Their national assessment of year 4 and year 8 learners will inform understanding of the capability being demonstrated in progression in technology learning. These findings will be reported in 2021.[56]

The $38 million investment to support the introduction of digital technologies within the New Zealand curriculum[57] has included development of new Achievement Standards for Digital Technologies which were registered for use in 2018 and 2019 and, combined with the new Digital Technologies curriculum content, should improve participation rates.

Overall the number of students taking the National Certificate of Education Achievement (NCEA) technology achievement standards has been declining with students entering fewer standards overall, at a compound annual growth rate (CAGR) of -2 percent over the past 5 years.[58] It must be noted that this decline is in the context of an overall decline of -0.4 percent CAGR in the numbers of students taking NCEA standards across the same period. In response to these trends, the Ministry of Education has announced reforms of NCEA, which includes redeveloping the Achievement Standards within the Technology Learning Area and developing a Vocational Entrance Award to support strengthened vocational pathways.

Manaikalani Helping Kiwi Teachers Learn Digital Skills

In 2013, Google New Zealand partnered with the Manaiakalani Education programme on initiatives to help digitise education. In late 2019, Google announced the continued support of the Manaiakalani Digital Fluency Intensive (DFI) which is rapidly upskilling large numbers of teachers in schools across New Zealand.

While eight in ten New Zealand principals say that digital technologies are positively impacting student achievement,[59] 72 percent also believe that professional development among staff presents either a "major barrier" or "somewhat of a barrier" to the use of digital technologies in schools.[60] This has driven Google to help Manaiakalani reach more schools and combine effective teaching techniques with digital enablement to accelerate children's learning.

Since 2018, the DFI has delivered over 1600 days of training to Kiwi teachers in 91 schools. The Ministry of Education continues to partner with Manaiakalani supporting the Manaiakalani Outreach Programme, which includes delivery of the DFI programme.

Only a small number of students progress from secondary to tertiary technology education.

While there has been a small decline in participation in NCEA technology standards, it is the drop off between secondary and tertiary education that is most marked. Participation in NCEA technology standards dropped from from 52,504 in 2015 to 48,024 in 2019.[61] However, only 3,455 went on to some form of tertiary study in information technology and only 1,850, or 11 percent of year 13 students that passed NCEA technology courses progressed to take an IT degree course the following year.[62]

This is tempered by many industry entrants coming through a non-IT degree pathway. For example, some study at a sub-degree Diploma level, and others study at a degree level in related fields such as Engineering, Maths, Design, Commerce or other areas that either have, or are studied alongside, a significant level of advanced digital content.

In 2019, there were 15,325 domestic and international students enrolled in degree level qualifications in computer science, information technology or software engineering courses. Typically, between 2,500 to 4,000 students graduate with degree level qualifications from these courses each year. In 2019, 1,730 graduated with computer science degrees, 1,510 with information systems, 410 with information technology and 385 with software engineering.

Simplification of the IT qualifications landscape in alignment with industry needs.

As part of the Targeted Review of Qualifications process, a formal review of all 224 sub-degree, tech-related qualifications on the New Zealand Qualifications Framework was instigated by IT Professionals New Zealand and the New Zealand Qualifications Authority (NZQA), in 2014. The review found gaps between many of the qualifications' outcomes and the needs of industry. Consequently, a new landscape of qualifications was mapped to industry need and following consultation in 2015, these were approved and listed. This resulted in 12 new qualifications, which replaced the pre-existing 224 sub-degree, tech-related qualifications. Each new qualification was clearly mapped to an industry outcome focussed on current and future needs. In 2017, industry and training providers identified the need for additional diplomas in cybersecurity and IT testing and new qualifications were released in 2018.[63]

A formal review of the initial suite of 12 qualifications was completed in 2019, to ensure relevance and currency. This resulted in a series of changes to meet industry needs, including merging some qualifications, a greater emphasis on current and emerging technology and a stronger focus on areas of greatest shortage. The updated suite is listed on the New Zealand Qualifications Framework. Existing qualifications on offer will be updated to meet the new requirements, as well as all new qualifications.

Creation of ICT Graduate Schools results in growth in the provision of students with much needed advanced skills.

As noted in the 2017 report, the Government invested $28.6 million over four years, from 2015, to develop three ICT Graduate Schools in Auckland, Wellington and Christchurch.[64] The objective of the ICT Graduate School programme was to deliver industry focused education and research to create connections between tertiary education providers and hi-tech firms.

The ICT Graduate Schools have increased the pool of postgraduate students graduating locally with advanced information technology and computer science skills. Across the three schools, 255 students graduated in 2019 with post-graduate diplomas or Masters qualifications.[65] This has resulted in a 59 percent growth in graduates with these qualifications between 2017 and 2019.[66]

When ICT Graduate Schools were established in 2015 they were provided with government funding until 2020. As signalled in Budget 2019, funding agreements will not be renewed in 2021. However, the tertiary institutions involved have indicated that some of the existing ICT Graduate Schools will continue to operate, albeit not as standalone entities. It is hoped that now that links with employers and industries have been established, universities and polytechnics can continue to work in partnership with them to maintain and grow this important work.

Internships are hard to come by, but interns convert well into employees.

One of the key channels to work for students and graduates seeking technology roles is internships. Most degree level courses have some element of work placement or internship to help ensure alignment of students' skills with industry needs. These are now mandated for IT degree programmes through international industry degree accreditation operated in New Zealand by IT Professionals NZ, and facilitated by a range of mechanisms, including the education providers (for example, many universities and the ICT Graduate Schools manage their own placement programmes) or by external providers, the most significant being Summer of Tech.

Internships are hard to secure, with most tech firms having limited entry level positions.[67] In 2019, Summer of Tech placed 352 students in paid internship positions and the ICT Graduate Schools placed a further 181 paid interns.[68] Each year, the Summer of Tech internship programme regularly has over 3,000 students register and undertake preparatory work via boot camps. However, Summer of Tech reports that only one-in-six to one-in-seven students are placed in an internship, in any given year. This is broadly consistent with other industry findings, including the 2020 Digital Skills Survey, where only 42 percent of organisations have taken on an intern in the past year.[69]

However, according to Summer of Tech, the rate at which interns are on-hired by their employer is very high at 83% in 2018 and 73 percent in 2019. Both interns and employers report satisfaction and value in internships.

Tertiary education is not the only pathway into tech roles.

Naturally, tertiary is not the only pathway into ICT professions. The impacts of COVID-19 have accelerated the uptake of online learning generally and the crisis provides a powerful test of the potential of learning online.[70] Online courses provided by Udemy, Udacity, Acumen and Harvard Business School to name a few, report continued growth. These pathways offer alternatives for people who, for whatever reason, do not want to, or cannot participate in tertiary education. The platforms provide competitive pricing, targeted, compact and convenient alternatives. This could present a real opportunity in terms of access and scale - expanding adult training provision through online learning to reach a much bigger number of learners with a smaller investment in education infrastructure. However, while they can provide an efficient means of delivering the education they do not provide access to much needed work experience.

In recent years, there has been a proliferation of proprietary courseware offered for example, by Amazon Web Services (AWS), Google, IBM, Microsoft, Salesforce and others. In addition to online learning certifications, many large organisations are extending their expertise in technology fields directly into education via collaborative partnerships. Typically, these initiatives pair the expertise, scale and resources of large multinational tech companies with providers across the education ecosystem. In some cases, this also includes other industry partners. Some examples are detailed below:

- Google has ongoing initiatives underway collaborating across different tiers of the ecosystem. This includes activities to directly support teachers (for example, sponsoring professional development of digital skills for teachers through the Manaiakalani Education Trust,[71] and awarding computer science Professional Development Grants,[72] resulting in high quality training for 300 teachers, impacting over 7,000 students), providing opportunities for students, for creators and education for journalists.
- Microsoft has made significant contributions through partnerships and collaborations with education providers with a particular emphasis on Māori, Pacifc Peoples and including through Digital Future Aotearoa and TupuToa.[73] Through its work with the Global Apprenticeship Network (GAN) and Skills International, Microsoft is connecting underserved groups and non-traditional recruits with access and training on learning pathways for in-demand jobs and plans to support, attract and retain non-traditional tech sector recruits.
- IBM has introduced its PTECH programme[74] to create pathways into technology for 'new collar' jobs. This has been described as an

inclusive education and workplace learning model and is expected to be used by more than 200 schools worldwide by 2020, including two in Auckland in partnership with Manukau Institute of Technology. Course content complements existing New Zealand curricula as students complete a five year pathway during their secondary and tertiary studies. Upon graduation, students receive both their NCEA qualifications and a two year tertiary qualification aligned with industry needs. It is still too early to gain comprehensive data regarding the initiative's impact in New Zealand. However, early results in the USA show P-TECH graduation rates were five times the community college graduation rate for low-income students.

Industry certifications can be an efficient way to prove your skills, especially for those unable or unwilling to undertake longer tertiary qualifications. Industry certifications are often faster, shorter and self-paced pathways into digital roles. These programmes are regularly being adapted as the technology and market evolve, adapting much faster than larger state-sanctioned programmes. The drawback of a solely industry certification-based approach is a general lack of breadth; making the future transfer and evolution of skills more difficult for the learner given the focus on specific narrow skills or technologies. Industry certifications often also lack the professional and non-technical skills that are demanded by employers alongside technical skills. Better integration of industry certifications within career pathways and tertiary education pathways may improve the speed and adaptability of digital technology education while also addressing these issues.

In summary, the number of ICT and digital technology roles continues to grow. This is driven by the growth of the tech sector and the digital transformation currently underway in most other sectors.

However, the nature of the necessary skills requires staff with both experience and advanced skills. Consequently, immigration has been used as the primary source of new talent, fulfilling the majority of all new digital technology jobs created most years. With the impact of COVID-19 and closed borders dramatically reducing this source of talent, there is an increasingly urgent need for domestically produced talent.

Unfortunately, there are low levels of junior roles being created and very limited numbers of internships being provided, for a relatively small number of domestic IT graduates. This, combined with a steady decline in participation rates of domestic students, in both secondary and tertiary education, is exacerbating New Zealand's increasingly large digital skills mismatch.

It does appear that some large organisations such as Google, IBM, Microsoft and others are doing things differently to address their current and future talent needs. Some smaller initiatives are also underway, such as Toro Studios in Tairawhiti where they are commencing a new education to employment programme to address talent shortages in the animation and production industry with a focus on Māori talent. It is clear that more emphasis will need to be put into these types of programmes and more focus on helping technology organisations proactively engage with young New Zealanders to inform and excite them about a pathway into technology.

Part two of this study delves deeper into each of the primary elements of demand and supply to identify the key challenges and opportunities.

Part Two

Demand and Supply Mismatch

Demand and Supply Mismatch

As reported in 2017, the skills shortage issue continues to be an issue of concern in New Zealand. Despite the tech sector's growth, there remains significant opportunity to grow technology exports to contribute even more to New Zealand's export structure.

"New Zealand has not invested in skills and innovation to nearly the same extent as high performing small advanced economies; and has not focused on developing knowledge intensive competitive advantage," says David Skilling in the recently published New Zealand Productivity Commission report, *Frontier Firms*.[75] This is clearly evident in the data collected for this report.

Since 2017, the macro trends of digitalisation and technological convergence have only increased and unfortunately the evidence shows that New Zealand has made little progress in addressing the mismatch in demand and supply for digital skills. The challenge has only increased in 2020 with the arrival of COVID-19 accelerating society's digital transformation and border closures.

> ***"New Zealand has not invested in skills and innovation to nearly the same extent as high performing small advanced economies; and has not focused on developing knowledge intensive competitive advantage."***
>
> **David Skilling**
> Report for the New Zealand Productivity Commission, May 2020

A further impact of COVID-19, as detailed by LinkedIn Talent Insights, describes a new challenge; how to fill roles in an environment where talent is increasingly inclined to stay where they are.[76] Consequently, in the short term at least, as border restrictions tightly control the in-flow of digital talent, we expect this challenge to have an increasingly large impact. In addition, some organisations have also reported a loss of skilled labour, who have returned to their home countries. In the medium term this may have a dramatic impact for New Zealand. Now, more than ever before, New Zealanders can work remotely from the comfort and relative safety of their own homes. Remote working creates a new global employment market for skilled New Zealanders, who may choose to work for offshore companies, further deteriorating our local talent supply.

Understanding and Forecasting the Demand

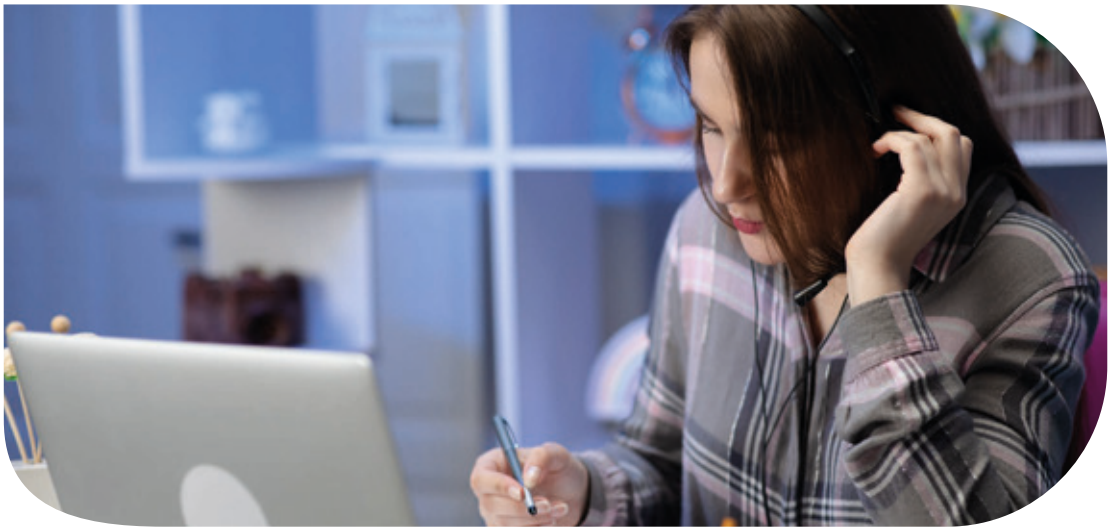
The New Zealand tech sector is made up of more than 20,000 firms, most of them small businesses. Collectively, they contributed around eight percent ($16 billion) to GDP and more than $7 billion in global exports in 2019, up 5.4 percent from 2018, making tech the country's third largest export sector.[77]

In 2019, the revenues of the top 200 tech exporters exceeded $12 billion, growing by 10 percent and delivering the second consecutive year of over $1 billion in revenue growth.[78]

With a global downturn in tourism and its related impacts on the hospitality and retail sectors, the growth of the tech sector remains a strategically critical part of New Zealand's prosperity. In particular, the growth of the tech sector contributes to regional growth and employment, with over 114,000 people now employed by tech firms in New Zealand.[79] Of those, 51.5 percent are in Auckland, 13.8 percent in Wellington, 13.9 percent in Canterbury, with the remaining 20.8 percent or 23,805 tech sector workers spread throughout regional New Zealand.

The greatest impact of our growing tech sector is the positive influence on the economy as a whole. Each four percent growth in tech sector productivity creates $2.7 billion additional GDP.[80] As noted earlier, direct technology intensive exports remain a significant opportunity for New Zealand's export structure. However, they are inhibited, in part, by lack of investment in skills and innovation at the same level as high performing, small advanced economies. For example, Ireland, Singapore and Denmark.[81]

While the tech sector is regionally spread, we can see in Table 1 organisations from other sectors are major employers of digital talent, especially in regional New Zealand. It is also worth noting that the largest employers tend to



be public sector organisations, for example local governments, universities and district health boards (DHB). There should be scope for better collective coordination and workforce planning throughout our public sector. Given many of these large public sector organisations also use external IT suppliers, Government procurement policy might also be a tool for encouraging market behaviours such as graduate development.

Demand for Digital Skills, Across all Sectors, Remains High

To understand the current and future demand for digital skills, NZTech surveyed New Zealand organisations who are hiring tech talent, for comparison with the 2017 survey. This was complemented with relevant recruitment trends and LinkedIn Talent Insights data for New Zealand IT workers.

The 190 organisations who responded to the 2020 Digital Skills Survey employ 58,291 people in total. In each of these organisations, senior leadership completed the survey, with 49 percent of respondents being Chief Executives or Managing Directors and a further 29 percent Chief Digital, Information or Technology Officers. While responding organisations covered

TABLE 1: Demand for digital skills by location

Location	1Y Growth	Hiring Demand	Top Employer
Auckland	-1%	Very high	Auckland Council
Wellington	+1%	Very high	Datacom
Christchurch	0%	Very high	Canterbury DHB
Hamilton	+1%	High	Waikato DHB
Tauranga	0%	Moderate	Tauranga City Council
Dunedin	+2%	High	University of Otago
Palmerston North	+3%	Moderate	Massey University
Whangarei	-1%	Low	Northpower
New Plymouth	0%	High	Powerco
Napier	0%	Low	Napier City Council

Source: LinkedIn Talent Pool Report for NZTech, LinkedIn, October 2020.

Note: This report is the number of professionals on LinkedIn in New Zealand that indicate their job function is information technology (IT) and their location. The one year (1Y) growth rate is the percentage change of the number of IT professionals working at the location at the end of September 2020, compared with September 2019. Hiring demand provides a measure of demand for the location, relative to supply in the location. It is calculated by the average number of recruiter inMails sent to IT professionals in the location over the past 12 months, compared to the average number of inMails sent to IT professionals across the talent pool.

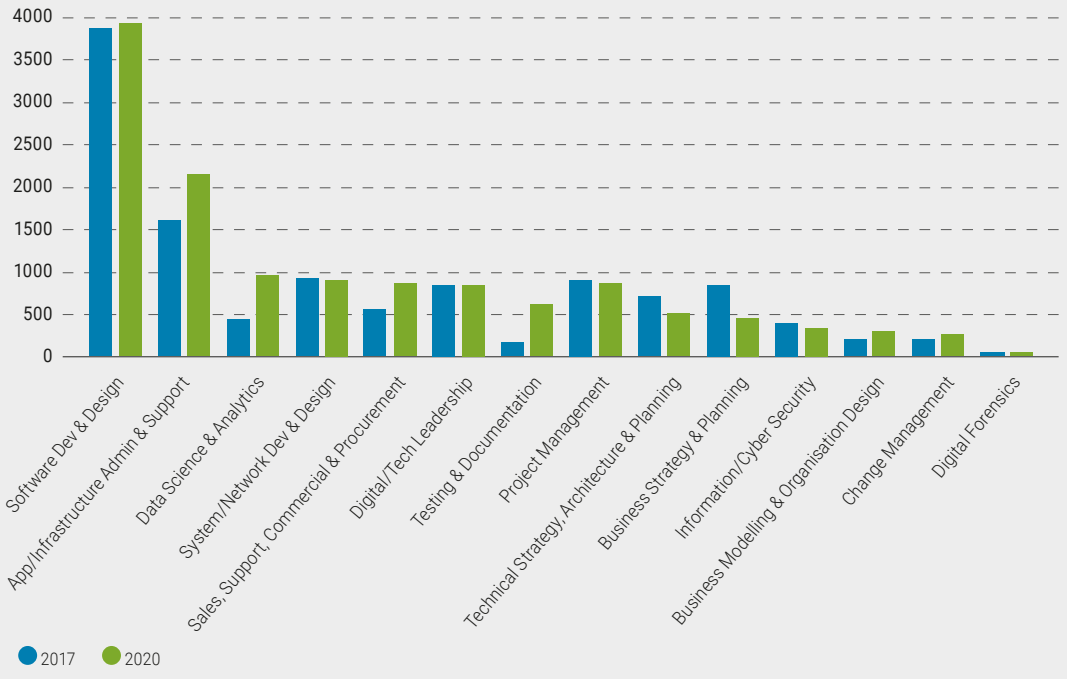
multiple sectors including large public sector agencies, 79 percent of respondents were from the tech sector. Further details and survey demographics can be found in the appendix.

All evidence points to continuing strong demand for digital skills both within the tech sector and more broady in society. The 2020 Digital Skills Survey respondents employ 13,261 digital technology workers or 15 percent of the digital technology workforce. The majority of digital technology teams include 10 or less people, with roughly 75 percent of all IT teams in New Zealand being under 50 people.

High levels of experience still in demand.

At the time of the survey, in November 2020 alone, LinkedIn was advertising 2,020 senior IT positions and 746 roles were being actively recruited for by the respondents to the Digital Skills Survey. However this activity masks the fact that most of these are not new roles, with significant recruitment activity primarily due to churn. According to LinkedIn data, 19 percent of IT professionals in New Zealand had changed jobs within the last year, broadly in line with recruitment data sourced from AbsoluteIT.[82]

FIGURE 5: Number of people employed in each digital skill area, 2017 vs 2020

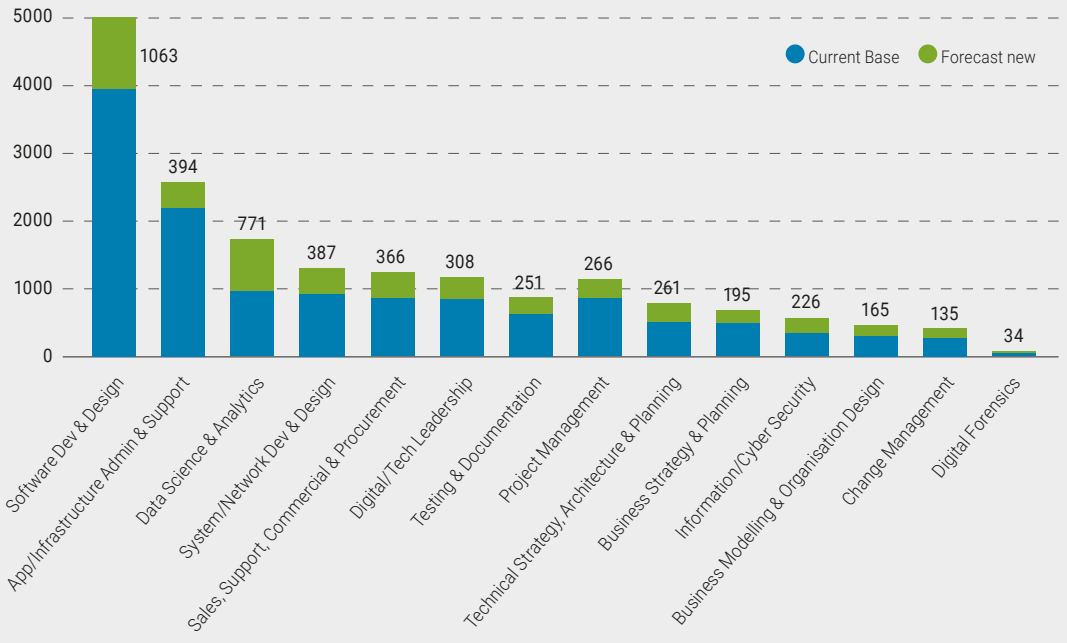


Source: New Zealand Digital Skills Surveys 2017 and 2020, NZTech and Digital Skills Forum, Oct 2017 and 2020 n = 121 and 149.

Across the 190 firms surveyed, 23 percent of their employees work in advanced digital skill roles, with the main skill group being software development and design. This is consistent with both the 2017 findings and global trends for skills demand. Even though the survey samples were not identical, the distribution of skills in 2020 is very closely aligned to the 2017 survey results, as shown in Figure 5.

When asked to forecast future requirements, survey respondents anticipate an additional 4,822 digitally skilled employees, within the next two years. This is an increase of more than 41 percent, compared to 2017 forecasts. Assuming the trend within these 190 companies is borne out by the rest of the industry, this could equate to demand of around 10,000 new digitally skilled employees in the next two years. Looking ahead, the highest demand continues to be for software developers, accounting for 22 percent of the forecast new skills required. According to the respondents, the largest growth will be in the skills of data analytics with 80 percent growth. This amounts to an additional 771 people with data analytics skills. It is closely followed by cybersecurity skills, reporting 65 percent growth and an additional 226 people gaining these skills, as shown in Figure 6.

FIGURE 6: Number and type of additional skilled people needed over next two years



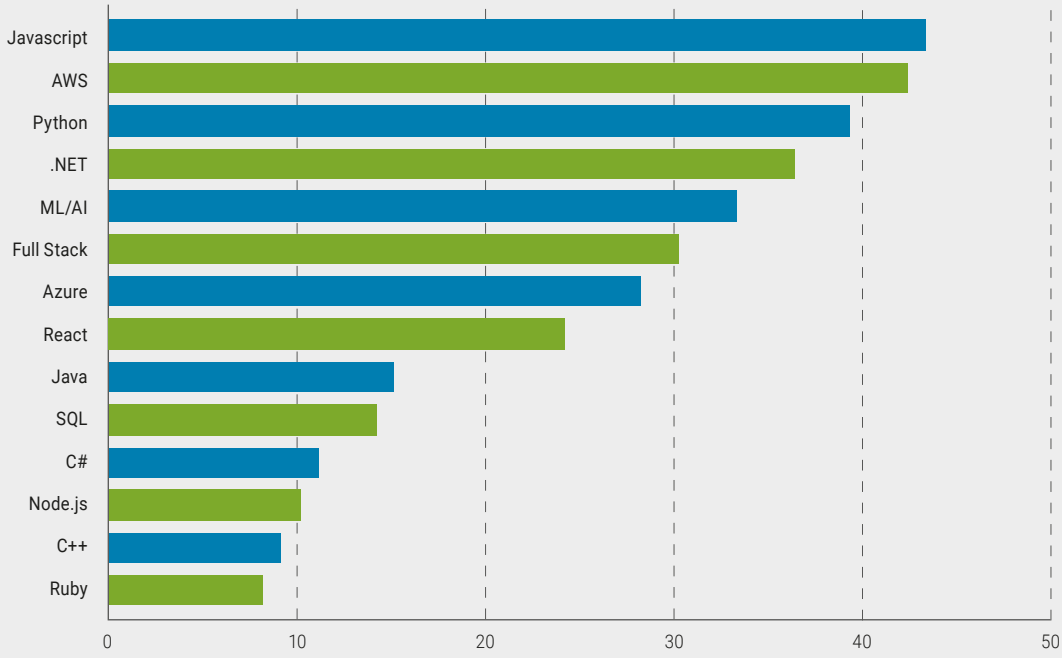
Source: New Zealand Digital Skills Survey, NZTech, Oct 2020 n = 149.

Changing demand for software development skills and languages.

Software developers dominate the skills profile and this reflects current global trends. However, there are a range of software development skills and languages. Globally, Javascript is currently the most in demand software development skill,[83] and this was mirrored in the New Zealand survey, closely followed by Amazon Web Services (AWS) and Python (Figure 7).

As described in Table 2, the top IT skills currently in the market are not well aligned to the high demand skills forecast in the Digital Skills Survey 2020. This suggests a mismatch

FIGURE 7: Demand for software development languages and environments over the next two years



Source: New Zealand Digital Skills Survey, NZTech, Oct 2020 n = 149.

between the market supply and demand. However, according to LinkedIn profiling, the fastest growing skills more closely reflect the market demand with data analytics, data analysis, Azure and Python in the top ten.

Both the survey and the LinkedIn demand data highlight that not all IT skills are created equal. The shift from traditional on-premise computing, where organisations owned their own hardware, to cloud based computing is driving demand for skills related to cloud-native environments such as Azure and AWS, both of which are in strong demand.

Soft skills are still in demand and highly sought

Digital skills are only one piece of the talent puzzle. Employers are also looking for a

TABLE 2: Top 10 Skills Listed on LinkedIn Profiles of New Zealand IT Professionals, 2020

Top 10 skills	Male	Female
Technical Support	81%	19%
Information Technology	80%	20%
SQL	78%	22%
Business Analysis	71%	29%
Troubleshooting	84%	16%
Active Directory	88%	12%
Windows Server	89%	11%
ITIL	83%	17%
Software Development	82%	18%
Cloud Computing	87%	13%

Fastest growing skills	1Y Growth
Microsoft Azure	51.30%
Python	30.70%
Data Analytics	17.40%
Service Desk	16.20%
Data Analysis	12.80%
Customer Satisfaction	12.60%
Information Technology	11.00%
Network Engineering	10.70%
Data Entry	10.10%
Java	10.00%

Source: LinkedIn Talent Pool Report for NZTech, LinkedIn, October 2020.

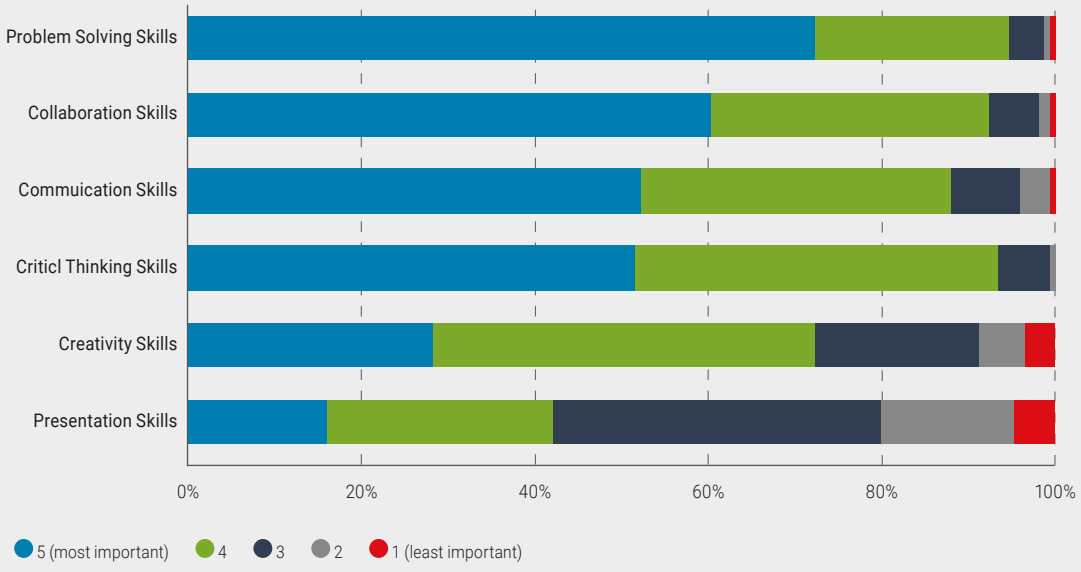
range of competencies, including what are often referred to as soft skills, to support the future growth of their organisations. In 2017, problem solving and creative skills were in high demand. As shown in Figure 8, problem solving skills continue to be in high demand in 2020, however they are now followed by collaboration and communication skills.

Demand in New Zealand is Similar to Global Trends

An analysis of the fastest growing skills in other countries, finds similar skills in demand, for example, Python programming and data analytics. However, while data and cybersecurity dominates the fastest growing skills in most other countries, they are not as dominant in New Zealand. This is

> ***"The pace of change is increasing with new technologies affecting the skills we need to recruit for. We have struggled to find candidates with the required skills needed in terms of problem solving, communication and negotiation that are of critical importance to us and our clients."***
>
> **Respondent to 2020 Digital Skills Survey**
> Chief Executive, New Zealand IT Services Company

FIGURE 8: The importance of soft skills



Source: New Zealand Digital Skills Survey, NZTech, Oct 2020 n = 149.

shown in Table 3, where we can view data entry and network engineering as two of New Zealand IT professionals top ten fastest growing skills. This creates a sense that New Zealand may be lagging behind in skills development for the future.

In an attempt to identify skill development delays in New Zealand, a comparison was made of the fastest growing skills. New Zealand was compared with cities considered to be leading indicators for technology development, including San Francisco, London, Beijing and Singapore, as shown in Table 4.

The worldwide demand for Python programming language was found to be similar across these locations. However, there is massive growth in data analytics in the UK, USA and Singapore and relatively modest growth in New Zealand. As discussed earlier, the demand for data analytics in New Zealand indicates an 80 percent growth. This growth is globally comparative, however we can see supply growth is trailing at 17 percent. Likewise, demand growth for cybersecurity skills in New Zealand is 65 percent, whereas skills growth has been non existent based on this analysis.

As countries and industries digitalise, the use and security of data has become integral to business models in almost all sectors of the global economy. According to recent OECD research, up to 33 percent of large firms were performing big data analytics by 2017.[84] Data-intensive technologies such as AI and the Internet of Things (IoT), offering greater consumer choice and personalisation, are growing

TABLE 3: Fastest growing skills comparison by country

New Zealand	Australia	UK	USA	Singapore	Ireland
Microsoft Azure	Python	Python	Python	Data Analytics	Data Analytics
Python	AWS	Cybersecurity	Cybersecurity	AWS	AWS
Data Analytics	Analytical Skills	Analytical Skills	Information Technology	Machine Learning	Python
Service Desk	Service Desk	Data Analytics	Data Analytics	Tableau	R (Language)
Data Analysis	Data Entry	Information Technology	Analytical Skills	Python	Analytical Skills
Customer Satisfaction	Data Analytics	Service Desk	Data Analysis	Cybersecurity	Data Mining
Information Technology	Data Analysis	Customer Experience	Programming	Analytical Skills	Cybersecurity
Network Engineering	Information Technology	Data Analysis	Data Entry	Information Technology	Data Analysis
Data Entry	Network Engineering	Programming	Information Security	Data Analysis	Information Technology
Java	Programming	Information Security	Salesforce.com	Agile Methodologies	Analytics

Source: LinkedIn Talent Pool Report for NZTech, LinkedIn, October 2020.

rapidly. However they also pose new risks to privacy and security. Over 80 percent of OECD countries reported AI and big data analytics as the biggest challenges to privacy and personal data protection, followed closely by the IoT and biometrics.[85] These trends are driving the global demand for data and cybersecurity skills. If New Zealand relies too heavily on the international market for these skills we will be risking the growth and security of our economy. A more comprehensive and targeted approach should be considered for developing these critical skills.

Lack of Investment in Upskilling Staff

Internal mobility is improving

While COVID-19 has seen organisations quickly adopt more technology and transition to remote working, it has also been a catalyst for more internal mobility. This is the transition of workers into new roles, within the same organisation. Travel restrictions, financial uncertainty and hiring freezes have driven firms to transfer staff internally rather than go to market. Within the Asia Pacific region, New Zealand has the second highest rate of internal mobility, across all sectors combined, with 22 percent of placements via LinkedIn Jobs going to internal candidates.[86] In larger firms, many human resource (HR) teams already have a sense of their existing internal talent pool, but identifying new opportunities for employees can deliver benefits beyond filling roles. LinkedIn's Global Talent Trends report found that employees stay at companies with high internal hiring 41 percent longer.[87]

While New Zealand has good internal mobility, there are more generalist roles supporting this data. Over the past year, there has been greater mobility into and out of certain roles, for example product managers. This is less apparent within technical roles. With a churn rate of 19 percent, the tendency for employers has been to recruit externally, which increases the perception of skills shortages. However, during the past year, within the tech sector increased internal mobility is being reported and 17 percent of LinkedIn job post placements have been internal.

Majority of new roles require experience

Respondents to the 2020 Digital Skills Survey were forecasting roles that would require senior IT professionals with experience and new specialist skills. In 2017, the biggest

TABLE 4: Growth rates of fast growth skills around the world

Fast growth skills	New Zealand	San Francisco	London	Beijing	Singapore
Python	31%	18%	27%	18%	37%
Data Analytics	17%	94%	93%	22%	80%
Cybersecurity	0%	13%	18%	25%	28%
Machine Learning	0%	0%	0%	22%	41%

Source: LinkedIn Talent Pool Report for NZTech, LinkedIn, October 2020.

challenge for the development of employees skills was a lack of available time for training and prioritisation of training against business as usual activities. Less than 10 percent of large organisations and Government agencies training was spent on digital skills.[88]

Rather than upskilling, organisations are going to market for the new skills they need which is exacerbating the issue. LinkedIn analysis found that IT workers receive twice as many InMails from recruiters, than in other verticals. Software engineers receive two and a half times as many. Research found that the main reason IT employees leave their current job is for career advancement and the main thing they look for before joining a new company is a stronger career path.[89]

Until COVID-19, survey respondents found it easier to recruit externally for new skills, rather than develop their own workforce. We can see this reflected in Table 5, showing the top ten employers of IT professionals and their attrition rates. Assuming the digital skills shortage/mismatch is a long term phenomenon, more focus must be made by tech employers, to develop efficient ongoing upskilling processes. Providing experienced senior staff with new skills may be more efficient in the long term, than continual recruitment activity in a high cost competitive market.

For example, cybersecurity skills have been identified as an area of significant shortages and growing demand. There is evidence from survey respondents that they are primarily using internal training or short specialised courses to develop these skills. Only 27 new cybersecurity roles were forecast in the 2020 survey, however respondents indicated they will be adding cybersecurity skills to 226 people, during the next two years.

TABLE 5: Top 10 employers of IT professionals and their attrition rates

Company	1Y Growth	Attrition Rate
Datacom	-2%	12%
Spark	+2%	6%
Auckland Council	-7%	11%
Fonterra	+2%	3%
Ministry of Social Development	+5%	4%
ANZ Bank	+4%	4%
Air New Zealand	-3%	10%
The University of Auckland	+2%	7%
ASB Bank	+10%	6%
Bank of New Zealand	+9%	8%

Source: LinkedIn Talent Pool Report for NZTech, LinkedIn, October 2020.

Given this approach is occurring with cybersecurity skills, there is potential opportunity for developing other skills within current senior staff. This will require education providers to work with employers to design and develop appropriate learning to enable staff to continue working full time while also upskilling.

In summary, the key observation from our analysis shows the annual increase in demand is not as large as often perceived and is not an insurmountable challenge.

Currently, skills demand is not at a level that exceeds even current local supply, when looked at from a pure numbers perspective. However, the demand for advanced skills and high levels of experience is currently excluding most of New Zealand's domestic graduates.

Put another way, there is a mismatch between the skill needs of industry versus the skills available in the market and there is a preference to hire skilled workers from overseas rather than invest in developing the domestic talent pool. This is unsustainable, especially in light of Covid-19.

Additionally, it appears that the New Zealand market has a similar demand profile compared to leading international technology hubs. Regardless of the duration of COVID-19 border restrictions, in the mid to long term, New Zealand needs to improve its domestic supply, as it may become increasingly difficult to fill the gap via immigration.

To improve the creation and development of domestic talent, better ongoing information on required skills is needed. Improved and timely coordination between industry demand and education supply is also essential.

Invest in the upskilling of the existing workforce, to take on the more advanced skill requirements of industry. Each existing IT Professional who is able to step up to a more advanced skilled role also creates an opening for a more junior professional, who in turn creates an opening for a graduate. This is the only sustainable way of addressing the skills mismatch. New Zealand should also continue to introduce new education pathways, more adaptable to changes in demand and provide opportunities for learning while working. This will help graduates gain experience faster and help companies upskill current staff.

Call to Action

In order to improve workforce planning, we must find ways to regularly capture and report on the developing skills needs. To improve the quality of the data, key data points must be agreed and have consistent definitions.

To better meet the market need for higher levels of experience, new pathways will need to be developed with better integration opportunities for learning while in employment.

Challenges and Opportunities in Supply

Demand for digital skills continues to grow and is not limited to New Zealand. Digital skills supply is a global challenge, however, it is not unpredictable or growing exponentially. The data clearly shows that demand for digital skills is fairly predictable and subsequently, something that can be planned for.

The Diversity Opportunity

Many digital technology teams include high levels of diversity due to immigration providing the main source of skills for the past five years. However, on closer examination, there is a fundamental lack of diversity that includes low participation of women, Māori and Pacific peoples. This is not a new challenge, but it does present opportunities to meet the demand requirements for digital skills, with the proper focus and strategies.

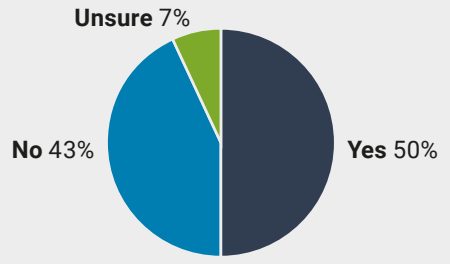
The number of women[90] working in digital roles has not increased since our 2017 survey and remains at 27 percent. Women are still significantly underrepresented in digital roles, compared to national demographics, where they make up 50.8 percent of the population. Globally, the number of women between 15 and 64 years of age, working or looking for work, has increased in the past five years.[91] This presents a significant opportunity for a new wave of people entering the workforce to be reskilled or upskilled into in-demand technology roles. To successfully facilitate this, policy structures need to encourage and support greater participation of women.

The theme of under-representation, not limited to digital technologies, persists across other cohorts and their limited presence in IT roles. Our 2020 survey showed that Māori made up just 4.1 percent of staff in respondents' digital technology teams and Pacific staff only 2.8 percent.

Diversity is more than representing gender and ethnicity, it encompasses our individual differences, whether internal, external, organisational or world views. This includes age, ability, disability, education, family status, gender identity, neurology, political beliefs, religion, sexual orientation, socio-economic status and more.

We did not collect data regarding neurodiversity or disability, as the survey was unable to accurately capture this data based on its respondent structure. While beyond the scope of this research, neurodiversity and disability require further exploration, to examine opportunities for both workers and employers. The key to realising the social and economic benefits of diversity is through our companies and organisations having cultures of inclusion. While all workplaces should be inclusive, as of right, data from numerous studies also clearly demonstrates the social and economic benefits (for individuals and organisations) of sharing different perspectives.

FIGURE 9: How many firms surveyed have a diversity policy



Source: New Zealand Digital Skills Survey, NZTech, Oct 2020 n = 149.

Approximately half of surveyed organisations did not have any form of diversity and inclusion policy in place. This provides an immediate opportunity to help organisations improve their understanding and approaches within their technology teams.

While unconscious bias may be responsible for some lack of diversity within digital technology roles, it appears the main challenge is a lack of supply. As noted earlier, disparities in participation begin early in the talent pipeline, as early as secondary school. Digital skills remains male dominated at tertiary level, with more than 75 percent of graduates specialising in these qualifications being male.[92] This substantial diversity shortfall then continues into the workforce as shown in Table 6.

This diversity shortfall may appear an intractable issue, primarily due to a lack of shared community, education, Government and industry planning to address it. As a result, hundreds of micro initiatives and fragmented resources have led to varying levels of impact.

A grassroots model to increase awareness.

In the world of sports, focusing on the grassroots of a sporting code can generate greater participation, leading to increased growth and development of the sport. It is a highly effective model for inspiring participation at higher levels. Using a similar model, increased public awareness of digital tech careers may help develop a larger talent pipeline. This positive engagement may then lead to greater participation in schools, tertiary education, reskilling and upskilling.

A grassroots campaign could be designed to inspire and activitate community members, across all demographic groups.

> ***"I have not seen more than 2-4 CVs from Māori or Pasifika come across my desk in 30 years. So it has been very difficult to hire what is not apparently available in the marketplace."***
>
> **Respondent to 2020 Digital Skills Survey**
> Chief Executive, New Zealand IT Services Company

TABLE 6: Diversity shortfall throughout the talent pipeline, 2019

	Secondary School	NCEA Technology	IT Degree Graduate	IT Workforce
Females	50%	39%	22%	27%
Māori	23%	14%	10%	4%
Pacific People	9%	9%	5%	2.8%

Source: New Zealand Digital Skills Survey, NZTech, Oct 2020 n = 149.

Call to Action

Significant focused investment should be applied to address each of these diversity challenges separately. For women, Māori and Pacific peoples - support must be provided to help these communities develop and showcase their tech leaders, design relevant education pathways toward tech careers, promote career pathways and career opportunities.

The Domestic Education Pipeline is Decreasing

exacerbating the skills shortage, the reality is different. Filling between 4,000 to 5,000 newly created digital technology roles a year is not an insurmountable hurdle, given there are 363,000 students within the local secondary school system and around 50,000 in year 13 in any given year. Each year, less than ten percent need to be attracted to digital technology pathways to help meet this demand.

Secondary school participation in technology study is declining.

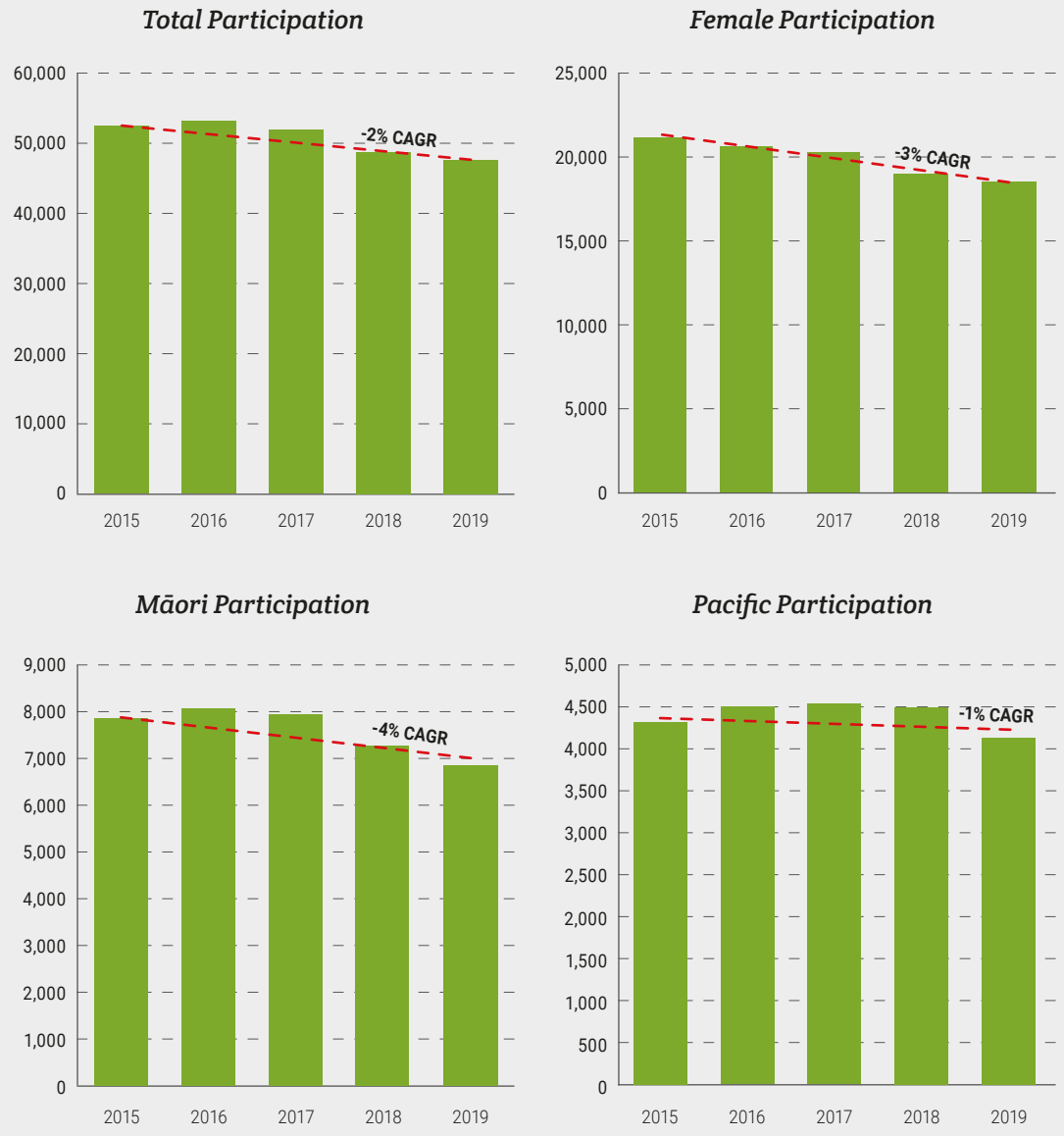
Unfortunately, even with the introduction of the new Digital Technologies and Hangarau Matihiko content into The New Zealand Curriculum in 2018, there has been a slow decline in engagement in technology subjects at secondary school. While expected to change as more schools implement the curriculum changes in 2020-2022, over the past five years, participation in National Certificate of Education Achievement (NCEA) Technology standards have been slowly declining at a compound annual growth rate (CAGR) of -2 percent. It must be noted that this decline is in the context of an overall decline of -0.4 percent CAGR in the numbers of students taking NCEA standards across the same period. As shown in Figure 10, the number of females participating in NCEA Technology standards has been declining at a CAGR of -3 percent, Māori students at -4 percent and Pacific students at -1 percent.

Technology standards include construction and mechanical technologies, design and visual communication technologies, digital technologies, processing technologies and hangarau. A complete analysis of NCEA Technology standard achievement rates is included in the appendix.

Digital technology NCEA participation rates have also been declining. As shown in Figure 11, over the past five years, female participation has been decreasing at -7 percent CAGR, Māori participation at -5 percent and Pacific Peoples at -6 percent.

Stronger pathway subjects for computer science typically include maths and science. As shown in Figure 11, over the past five years, participation in these subjects has also been declining at a rate of minus one percent CAGR. Whereas participation has been increasing in standards for pathways into careers in lower wage industries such as construction and hospitality.

FIGURE 10: NCEA Technology Standards Participation, 2015-2019



Source: Ministry of Education, 2021. CAGR calculated by NZTech.

FIGURE 11: Various NCEA Standards Participation levels, 2015-2019

Source: Ministry of Education, 2020. CAGR calculated by NZTech.

Examination of information technology, computer science and software engineering in the tertiary education system also shows similar trends of declining participation and graduate numbers.

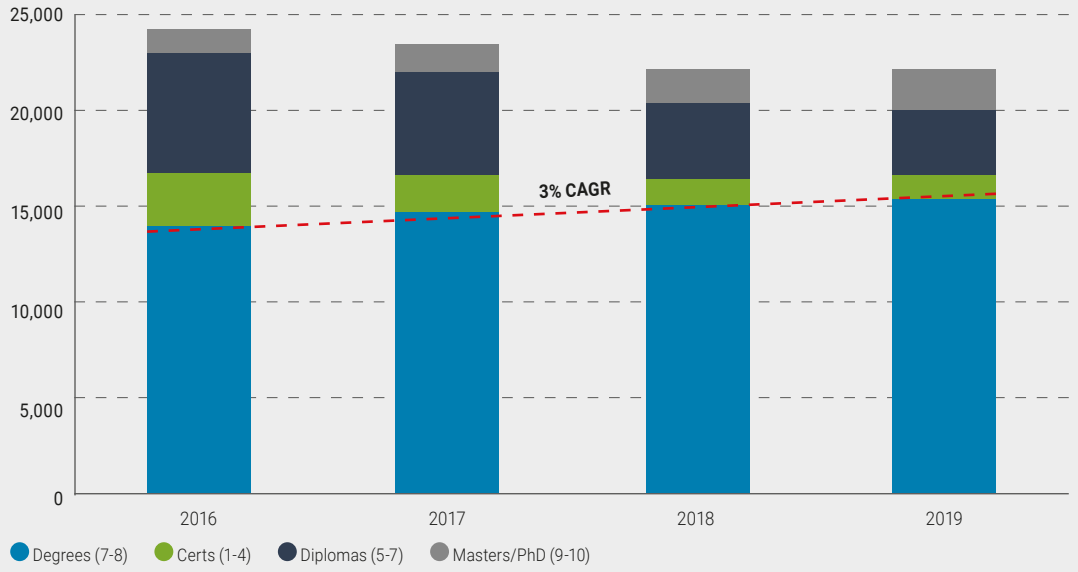
Tertiary participation in IT is declining, but degrees are increasing.

An analysis was undertaken of tertiary enrolments and graduation rates for fields of study including computer science courses, information systems and information technology courses and software engineering courses. For ease of reading, these courses will be referred to collectively as information technology (IT). A detailed analysis is included in the appendix.

Across all qualification levels, from Level 1 certificates to Level 10 doctorates, enrolment in information technology courses has been declining at a CAGR of -2 percent, over the past five years. However, there has also been a steady decline in certificate level courses at -20 percent CAGR and sub-degree diploma courses at -15 percent CAGR, over the past five years. Meanwhile, degree level enrolment has been growing at three percent and postgraduate qualifications at 19 percent. With the decline, sub-degree IT qualification enrolments now only make up 21 percent, while degree level students account for 70 percent of all IT students.

While this is good news, as degree qualifications (and above) are arguably better suited to prepare students for the skills shortage areas of the industry,[93] this three percent growth is masking another interesting trend. Over the last five

FIGURE 12: Enrolments in information technology courses, by qualification level, 2015-2019

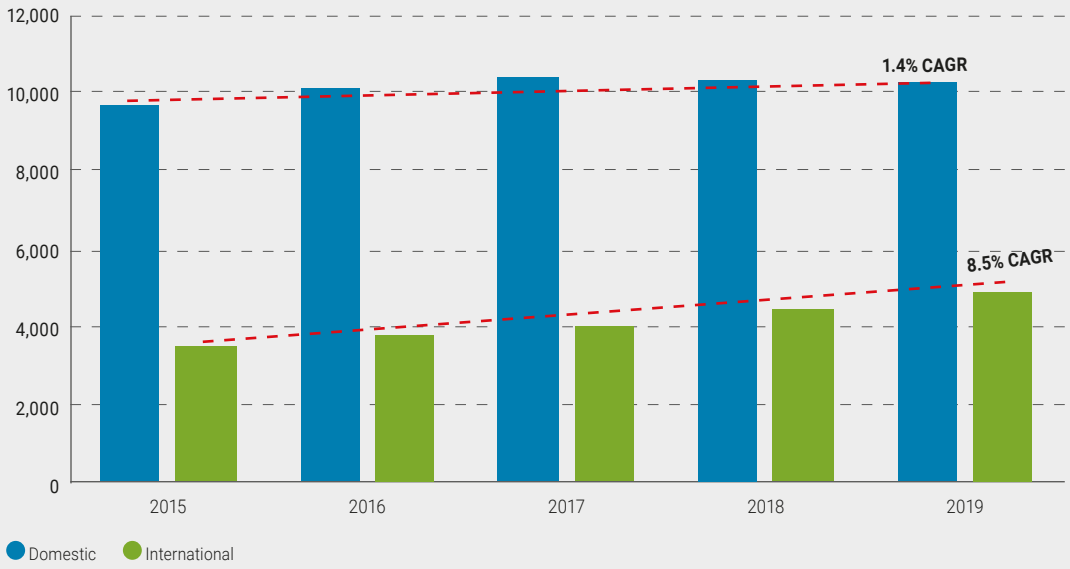


Source: Ministry of Education, 2020. CAGR calculated by NZTech.

years, the growth of domestic enrolments in degree level IT courses has remained almost flat, at one percent CAGR, while international students have been growing at 8.5 percent CAGR. The pressure on tertiary education providers to partially self-fund by selling to international students has aided an increase in degree qualified IT graduates. However, many of these students return overseas following graduation, so a growing domestic pipeline is considered more beneficial for New Zealand in the long term.

In 2019, there were 21,615 students enrolled in tertiary level IT courses. As these are multiple year courses, each year, a smaller number graduate. For example, in 2019, there were 3,265 students graduating with degrees. Of these, 1,730 graduated with computer science

FIGURE 13: Domestic and international students enrolled in degree level IT qualifications, 2015-2019



Source: Ministry of Education, 2020. CAGR calculated by NZTech.

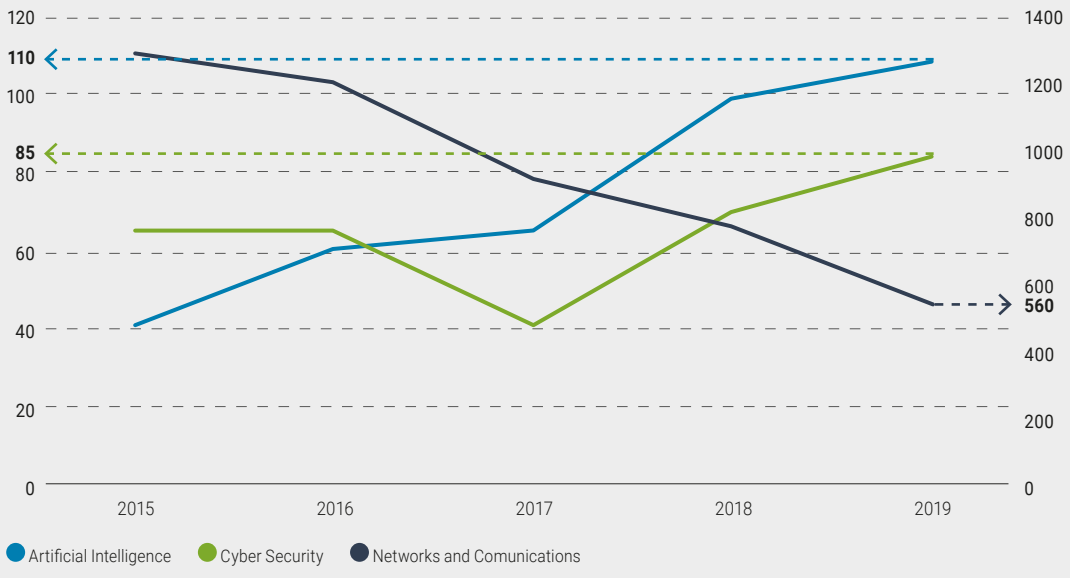
degrees, 1,510 with information systems degrees, 385 with software engineering degrees and 410 with other information technology specialisations such as cybersecurity. Since 2015, the number of students graduating with degrees has been growing at six percent CAGR.

Since 2015, the number of students graduating with postgraduate qualifications has also been growing, with a 26 percent CAGR, delivering 580 graduates in 2019. A large majority of these graduates (255) were from the ICT Graduate Schools and most were either reskilling from other industries or upskilling into postgraduate qualifications.

The tertiary data has begun reflecting the changes in market demand with a 29 percent growth rate in students graduating with AI qualifications and seven percent growth of cybersecurity graduates. Over the past five years, network management graduates have been decreasing at a rate of -19 percent CAGR, reflecting market conditions (see Figure 14). However, there is still an oversupply of network management graduates, with 560 graduating in 2019. According to forecasts from survey respondents, only 387 are expected to be recruited for employment during the next two years. This example clearly demonstrates the time lag and difficulty for the education system to respond to market demands in a timely way.

Currently, the New Zealand education system is producing a relatively small number of domestic IT graduates each year, which is then boosted with international students. International students provide ethnic diversity, however there

FIGURE 14: Students graduating by selected fields of study, 2015-2019



Source: Ministry of Education, 2020.

continues to be low levels of women, Māori and Pacific peoples graduating. In 2019, only 25 percent, or 810 women, graduated with IT degrees. There were 150 Māori graduates (4.6 percent) and 95 Pacific graduates (2.9 percent). By comparison, there were 1,955 Asian degree graduates and 1,070 European degree graduates.

Not all students who study technology at secondary school will embark on a career in technology. However, learning digital technology skills will undoubtedly prepare students to better succeed in an increasingly digital world. If we can encourage greater interest in digital technologies, we will inevitably increase the number of students who may study technology and enter subsequent careers. If New Zealand can encourage more students on this journey, the growth in demand for digital skills will be manageable. What appears to be missing, is an understanding of the diverse career opportunities available and their pathways.

Education to Employment Challenges

Students who progress to tertiary education are often not considered 'work ready' on graduation. An essential element of work readiness is identifying the practical and soft skills required, beyond formal education. In response to industry feedback, almost all qualifications now require some form of work experience placement or internship. These internships are now one of the key channels for students and graduates into technology roles.

Low industry engagement in internship programmes

With almost all courses requiring some form of internship, every tertiary institution is in the market to gain intern positions. Internships are facilitated by a range of mechanisms including education providers (for example, ICT Graduate

Call to Action

Beginning in primary school, we must encourage students to learn about technology in age appropriate ways. Throughout secondary school, we must stimulate domestic students' interest in continuing into tertiary study for roles in New Zealand's fastest growing sector with high paying jobs. We also need to actively inspire women, Māori and Pacific people to consider the myriad of tech careers available.

Summer of Tech Provides Internship Pathways for Most Graduates

The largest technology internship programme in New Zealand is Summer of Tech. It was founded in 2006 in Wellington, in response to start-ups wanting to access inexpensive talent. The Summer of Tech programme begins with a series of bootcamps to prepare students for the realities of the workplace. Summer of Tech then helps place students into paid internships, usually over the summer holidays, from November to February.

The bootcamps have been designed to help students prepare, research and apply for paid work experience and entry level jobs in ICT and digital design roles. Throughout the year, the Summer of Tech team, collaborate with employers to help students prepare for work through exposure to the technical topics and in demand skills.

However, even with high levels of industry responsiveness, quality student preparation and extensive marketing to industry, Summer of Tech's supply of interns consistently outstrips demand.

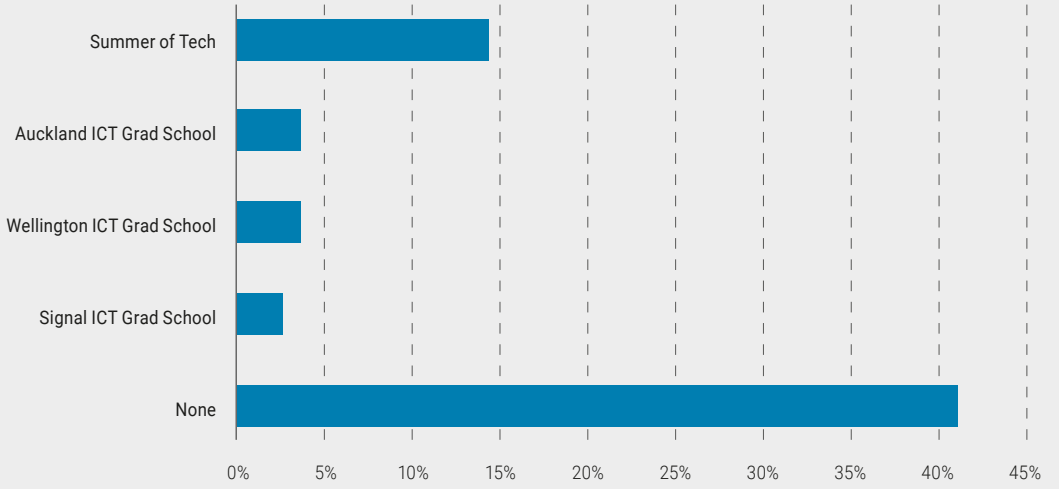
In 2019, there were 4,463 students registered with Summer of Tech of which 2,699 went on to create active profiles to attract an internship. However, only 352 students were placed in summer internships. Less than 20 percent of students manage to get an internship each year, but of those that do, over 70 percent end up being employed by the company.

Schools), organisation run internship programmes and external providers, such as Summer of Tech. However, the number of interns vastly outstrips the available roles despite the reported challenges in finding skilled IT professionals by industry.

Interestingly, even though businesses demand skilled workers and have asked for more work preparedness of graduates, each year very few organisations employ interns. According to survey respondents, at least 42 percent have never taken an intern and only 15 percent have used Summer of Tech, as shown in Figure

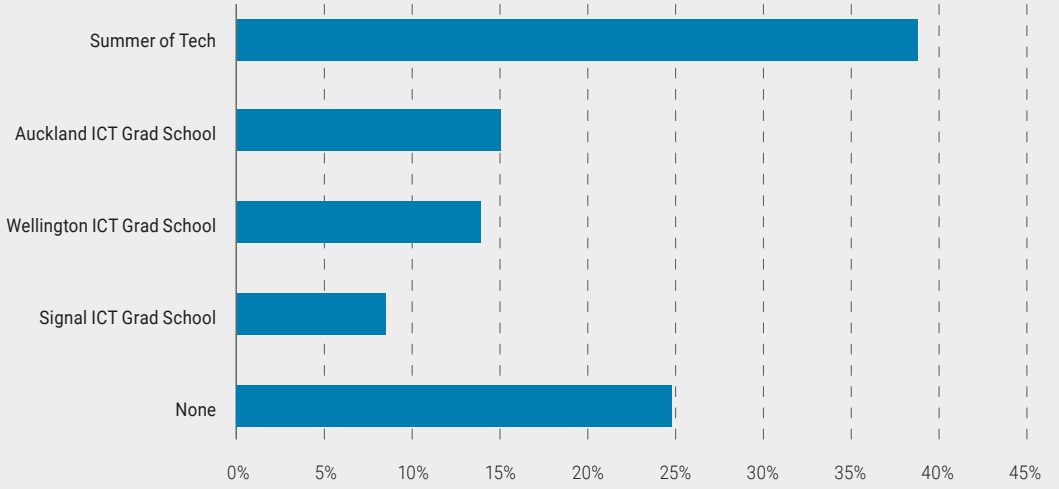
> ***"The market seems to fight over existing resources rather than developing new people."***
>
> **Respondent to 2020 Digital Skills Survey**
> Chief Executive, New Zealand Tech Exporter

FIGURE 15: Have you used any of the following intern programmes?



Source: 2020 Digital Skills Survey, NZTech, October 2020. N = 106.

FIGURE 16: Are you aware of these intern programmes?



Source: 2020 Digital Skills Survey, NZTech, October 2020. n = 104.

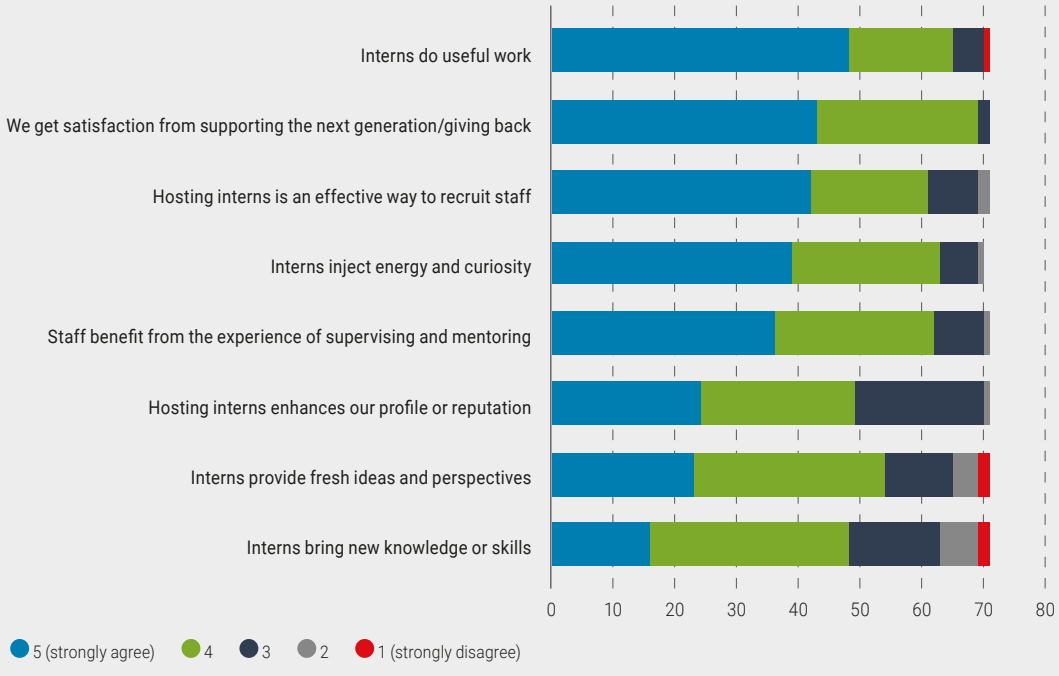
15. Partly, this is due to a lack of awareness of the available options (Figure 16). However, even with strong market awareness in their home city of Wellington, Summer of Tech is still challenged in placing interns.

Commercial benefits and barriers in taking on interns

According to Summer of Tech, most employers report satisfaction and value, with the majority employing their interns. As shown in Figure 17, companies who employ interns acknowledge that interns do useful work and inject energy into the organisation. They have also identified internships as an effective recruitment mechanism.

However, there are many barriers reported by employers, who consistently cite the costs to their business as the primary concern. This includes the direct cost of taking on an additional employee, plus the cost of management time, impact on regular work and other required support. It is worth noting that the direct cost of employing an intern is low. The average pay for the Summer of Tech 2020 cohort was only $23.97/hour.[94] Regardless, many businesses perceive their lack of capacity to support and develop the intern as a key barrier. Finding both suitable interns and suitable projects for them is also a concern.

FIGURE 17: Benefits of engaging interns



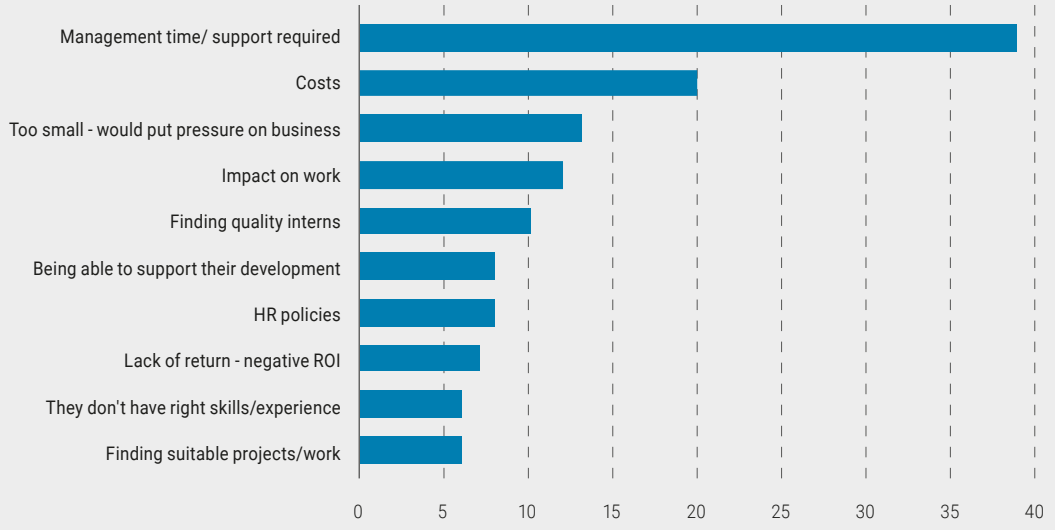
Source: Summer of Tech, 2020.

To increase the likelihood of engaging an intern, most survey respondents reported their business would need to be more successful, as shown in Figure 19. These firms cited needing more senior staff, increased project work or a more secure future pipeline of work, to ensure the financial capacity to employ an intern. However, 24 percent of respondents also indicated some form of direct external funding support would lower the financial barrier and encourage them to take the risk of employing an intern.

An example of the impact of external funding support is the Callaghan Innovation Research and Development (R&D) Experience grant. This grant encourages businesses to engage interns for full time work over the summer holidays, to support R&D projects. The number of student places funded by this scheme has risen from approximately 300 in 2017/18 to over 1300 in 2020/21 due to strong customer demand and significant promotion of the grant. Companies in the digital sector own a growing share of the grants, increasing from 33 percent to almost 40 percent over the past four years. This is higher than their share of the Callaghan Innovation customer base (currently 28 percent).[95]

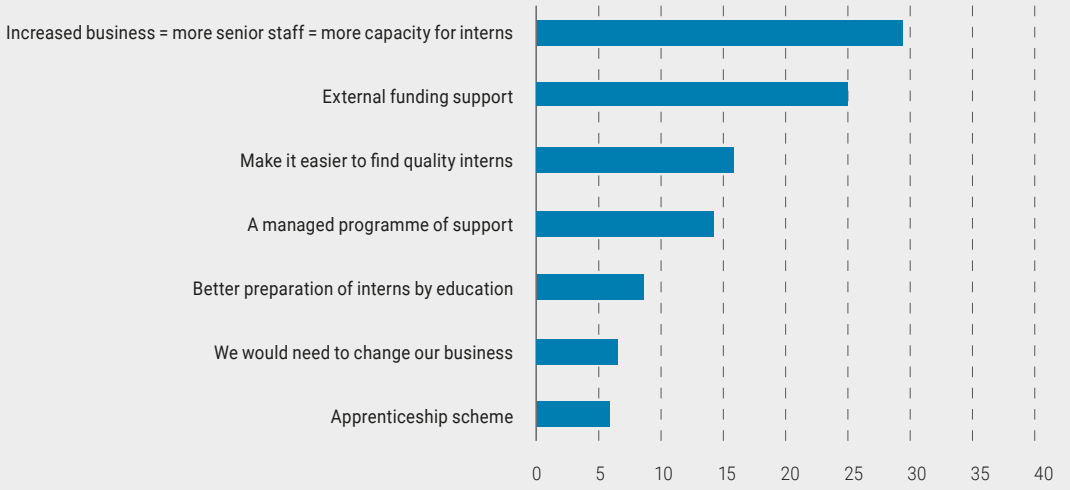
In the 2019/2020 year, 469 grants were allocated to digital sector companies, accounting for 36 percent or $3.96 million of grants. The addition of a simplified internship grant scheme, not restricted to R&D and potentially managed by Summer of Tech, would increase the uptake of internships by businesses. Ultimately, this will result in an increased flow of qualified and experienced graduates into the workforce.

FIGURE 18: Barriers to engaging interns



Source: 2020 Digital Skills Survey, NZTech, October 2020. n = 105.

FIGURE 19: What would increase the likelihood of taking on an intern?



Source: 2020 Digital Skills Survey, NZTech, October 2020. n = 105.

New pathways from education to employment needed

As reported earlier, one of the key challenges is the skills lag. There is a clear mismatch between what is needed by industry, in terms of experience and skills, and what many interns can offer. One of the underlying issues to address is the lack of clear pathways running throughout the education system and into work ready graduates. This is a significant statement and a challenging reality to overcome, one that is not unique to New Zealand. In its draft report on technological change and the future of work, The Productivity Commission similarly noted that if the education and training system is to meet the needs of a more dynamic economy with greater technological change, *"policy makers will need to rethink some of the boundaries and biases evident in education and training policy."*[96]

This would include adapting policies from:

1. Classroom delivery - to those that provide education delivery in workplaces or through technology (or through combinations of these three);
2. Training for employees - to education supporting those in other work arrangements (including business owners, the self-employed and volunteers);
3. Long duration full time programmes – to shorter, targeted and bite sized courses.[97]

An example of a new style course is the proposed Media Design School Master of Digital Transformation (subject to NZQA approval). Made up of bite sized learning (micro-credentials) providing flexible, online, study options allowing professionals to curate a study programme, which over time will add up to a full Masters qualification.

TORO Venture Studio connects the Tairāwhiti digital skills pipeline.

TORO Venture Studio is a national centre of excellence for production, animation and technology. It is an end-to-end solution from education to production, technology IP creation and supporting technology capability for local industry.

TORO offers a new education programme, a fit for purpose animation course for school leavers and career changers. In just 12 weeks, students will graduate as an industry ready animator.

TORO is part of the regional digital and technology strategy within the Tairāwhiti economic development plan. TORO is implementing a venture studio model for digital animation, accelerating technology start-ups, building cross-sector technology innovation, workforce training, talent attraction, and establishing an investment fund.

The TORO model includes a production facility (generating sustainable income), a training academy (developing talent) and a software development shop (creating value).

1. TORO Studio – is the production facility completing domestic and international projects.

2. TORO Academy – trains high-end animators, software developers and cybersecurity technicians.

3. TORO Technology – is building two internal productivity platforms. It is also partnering with major cross sector innovation projects in the region.

// TORO: An East Coast Māori term describing a band of scouts leading ahead of the main war party. We lead into new markets underpinned by values of whanokē (innovation), whanaungatanga (family) and manaaki (hosting).//

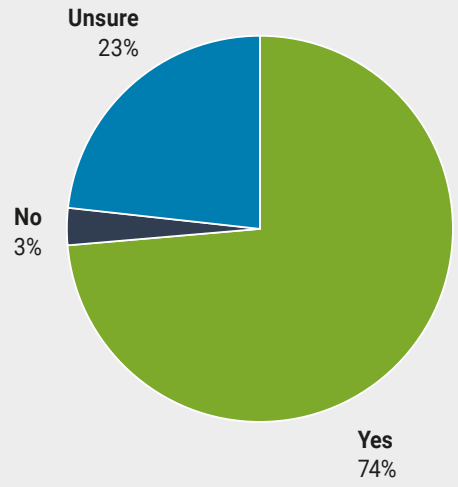
TORO is a strong Māori led, Māori enabled and Māori outcome focused initiative. It has strong regional support as a Post-COVID recovery economic priority. Leadership includes the local council, the economic development agency, community trust, business and corporate leadership, and the four local post-settlement Iwi entities. While TORO has been born in the COVID era, its strategic context for regional support was established in 2019. At that time, the need for a regional Māori CTO leadership role and a tech incubation centre was prioritised. Both these actions have since been incorporated into TORO.

This model is of interest to other regions who have expressed an interest in replicating the end to end, ecosystem inclusive approach. TORO is currently in development and will begin operating in the second half of 2021.

The introduction of digital apprenticeships

One potential solution to meeting the demand for more experienced roles is increasing infrastructure to help develop students into productive employees. This could be delivered through a coordinated, national apprenticeship programme targeted at technology professions. Respondents to the Digital Skills Survey showed strong support for the concept (Figure 20). Based on their feedback, a scheme supporting organisations to increase their capacity to employ interns, external funding and support, a managed programme of support from finding quality interns through to preparing them for the internship, would all help better prepare students for employment.

FIGURE 20: Support for the development of a digital apprenticeship



Source: 2020 Digital Skills Survey, NZTech, October 2020. n = 126.

Call to Action

To enhance the transition from education to employment, a more coordinated approach is required for both employers and students.

The number of student internship positions available needs to significantly increase, to overcome the clear barriers evident in the shift from study to employment. Increasing the number of funded internship positions made available via Callaghan Innovation and relaxing the strict R&D requirement would enable a more sustainable and scaled-up co-funding arrangement. Other work-based and flexible education models must also be developed alongside the existing models, such as apprenticeships or apprenticeship degrees

A single national platform approach may also be needed to assist employers in accessing graduates. This should be complimented with a simplified intern grants process and new pathways to better integrate education with work.

Over Reliance on Immigration

Digital skills are highly mobile and this has allowed New Zealand organisations to access the skills they need from the global talent pool. One might argue that given the high global demand for digital skills and the mobility of these skills, it is not in New Zealand's best interests to develop these skills domestically as they are likely to leave New Zealand for international experience and salaries. The counter argument is that high demand is making the global market very competitive, potentially leaving New Zealand vulnerable, and that we should develop critical skills domestically, rather than rely on immigration.

The reality is that we need a balance of both. Migration isn't a bad thing as skilled migrants bring new knowledge and connections to global networks. So overall New Zealand will benefit from some migration. However, as we have found with COVID-19 border closures, a heavy reliance on immigration comes with risk.

In lieu of suitable work ready graduates, New Zealand has become heavily reliant on international imports for digital skills. During the past five years, 27,057 visas were granted for people entering New Zealand to work in ICT occupations. In addition, 34,935 international students entered New Zealand to study IT at a tertiary level.

The long term skills shortage list, as shown in Table 7, lists almost all IT professions. This, combined with Immigration New Zealand's accreditation process, has reduced barriers for employers to source IT talent internationally.

TABLE 7: Long term skills shortage list – IT occupations

Long Term Skills Shortage List – IT Occupations	
ICT Project Manager	ICT Business Analyst
Organisation and Methods Analyst	Multimedia Specialist
Systems Analyst	Analyst Programmer
Web Developer	Software Engineer
Developer Programmer	Software and Applications Programmers
Software Tester	ICT Security Specialist
Database Administrator	Computer Network and Systems Engineer
Systems Administrator	ICT Quality Assurance Engineer
Network Administrator	ICT Systems Test Engineer
ICT Support Engineer	Telecommunications Engineer
Test Engineers	ICT Customer Support Officer
Telecommunications Network Engineer	

Source: Immigration New Zealand.

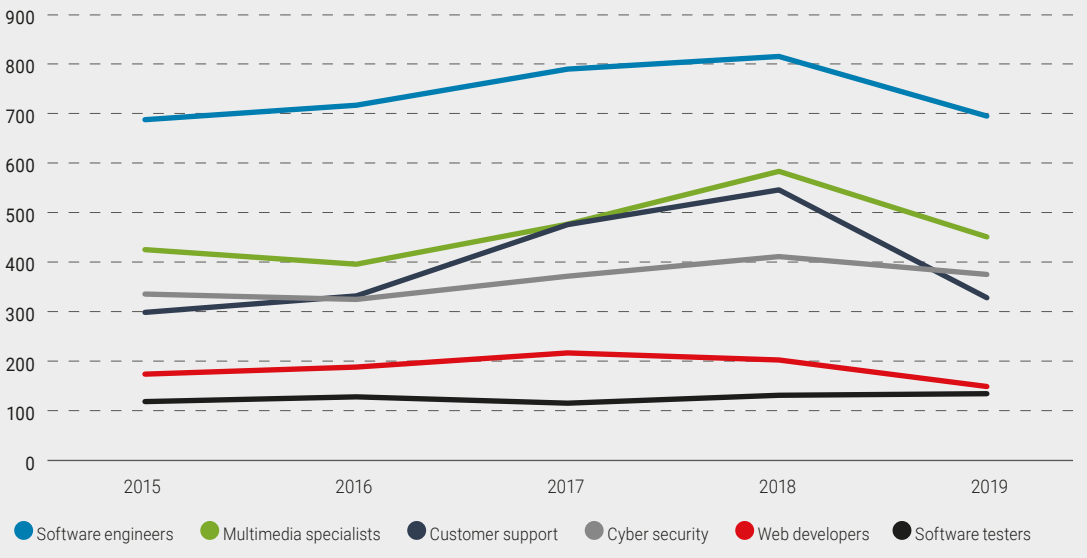
"We've spent the last few years hiring experienced specialists from around the world and 90% of our employees are on temporary visas (working towards residency). We did this because we couldn't find the skilled people we needed in New Zealand, and would like to continue offering exceptional people the chance to move to New Zealand."

Respondent to 2020 Digital Skills Survey
Head of HR, New Zealand Software Company

Survey respondents indicated the skills mismatches they are experiencing includes senior, experienced professionals with specialty skills. Imigration has been the only immediate pathway to meet this demand.

In 2019, there were 3,863 visas approved for people to work in IT occupations in New Zealand. This is equivalent to 75 percent of all new IT jobs created that year. The majority of these visas were for software engineers (694), multimedia specialists (452) and business analysts (375). Unfortunately, Immigration New Zealand uses the Australia and New Zealand Standard Classification of Occupations (ANZSCO) coding to classify occupations, resulting in

FIGURE 21: Number of people entering New Zealand to work in selected IT occupations, by visa approvals



Source: Immigration New Zealand.

modern occupations (for example, data analysts and data scientists) not being identified.

The immigration data does provide some insight into the opportunity for developing local students. The underlying theory for the high proportion of immigration is employers need specialised skills with experience.

However, some of the roles being recruited internationally may lend themselves to some form of internship or apprenticeship. For example, as shown in Figure 21, 138 software testers and 149 web developers were imported in 2019, but often these skills are relatively easy to learn on the job or through alternative education pathways. Visa approvals for software testers have been growing at four percent CAGR since 2015. A complete analysis of visa approvals for IT occupations is included in the appendix.

Alternative Pathways for Skills Development

Education is not 'one size fits all'

Not all employees journey along the IT degree pathway. The focus on this pathway often distracts us from considering the huge diversity of digital technology roles and the diversity of people and skills needed. Even software developers, the most in demand skill, can enter work with different experience levels. For example, an alternative pathway is Enspiral Dev Academy (Dev Academy), training software developers with an intensive 15 week bootcamp. In response to industry feedback, the Dev Academy iterates each cohort with the goal of producing highly employable and sought after junior software developers with core and technical skills. The Dev Academy has graduated over 700 software developers with an 86 percent employment rate, including more than 100 Māori and 300 women.

Even at the secondary school level, there is potential to provide new pathways into digital technology careers. Some schools, like Avondale College in West Auckland for example, have developed specific programmes to encourage students into digital technology career pathways. Avondale College has an Innovation Academy where students use industry standard technology to create their own market ready solutions. They also gain educational qualifications and industry benchmarked certifications along the way. There is plenty of scope for many more schools to take a focused approach to providing digital career pathways.

Opportunities for upskilling

The future of work requires two types of changes in the workforce:

1. **Upskilling** - gaining new skills to help in current roles.
2. **Reskilling** - developing capabilities needed to take on entirely new roles.

Reskilling will be particularly important for sectors with 'high automation potential,' for example, manufacturing, transportation and retail.[98]

Call to Action

A deeper review of the skills being imported is needed to clearly identify the potential for improving the domestic production of less advanced skills. Incentives should be considered for tertiary education providers to develop and upskill domestic students into local roles.

Reskilling, by nature, will require longer, intensive programmes and approaches, so people can successfully transition to entirely new roles.

Upskilling, on the other hand, presents more immediate opportunities to move people into high demand roles or adjacent roles. It also helps reduce job churn and supports the development of a more skilled workforce. To scale, a number of elements are required including training investment (time/funding) for professionals, appropriate upskilling programmes that fit with work requirements, planning and systems to identify suitable people and roles and a willingness to enable role mobility.

For example, the Dev Academy has focused on upskilling people with work experience, but no ICT experience. Within a short period of time, they provide them with a focused set of skills to enable them to enter the IT workforce as productive employees. The ICT Graduate Schools were also designed for the same reason, to focus on more advanced skills over a longer period of time. Both pathways are working well and delivering small, but increasing numbers of local talent. The removal of funding for the ICT Graduates Schools at the end of 2020 will decrease the focus and capacity for upskilling at scale.

As noted earlier, less than 10 percent of large organisations and Government agency training is being spent on upskilling IT or digital staff. Given the majority of the IT workforce have more than a decade of experience, plus there is predictable demand growth, a national coordinated approach to upskilling will make a significant contribution. Digital technology employment needs to mature, ensuring better management of skills while maintaining the current levels of growth.

Wentworth Computer Science College – a secondary school for the future.

Wentworth College, a successful private school in Whangaparaoa, has opened a digital technology and STEM focused satellite campus in Newmarket, Auckland. The new campus provides digital technology and STEM focused education for secondary school students with a passion for these subject areas. Wentworth College has partnered with New Zealand based digital technology education company, Code Avengers, to offer students the digital curriculum. Senior students follow the internationally recognised Cambridge Assessment International Education (CAIE) curriculum, preparing them for entrance into university degrees or computer science related careers. The subjects of Computer Science, Information and Communications Technology and Digital Media and Design will provide students with a more robust level of knowledge than equivalent NCEA standards, and a respective career pathway into advanced digital technology roles. The Year 13 curriculum includes options of internships at interested IT companies and classes in interpersonal skills, business studies and entrepreneurship. This provides students with some real world skills before entering university or the workplace.

IT Professionals New Zealand (ITP) Te Pou Hangarau Ngaio is the representative body for IT workers and provides a professional certification structure to encourage upskilling.[99] A combination of career path planning, professional certification processes and easy to find upskilling programmes may help reduce IT staff churn and provide new targeted skills into the workforce.

In summary, the pace and scale of digitalisation and technological convergence is not one that any government or nation has fully prepared for. It is not a surprise to learn that the supply of the right digital skills is not keeping pace with requirements in New Zealand. What is surprising is the declining participation at the beginning of the talent pipeline. Clearly, this requires further investigation. However, it is assumed the low participation is primarily due to little understanding of future opportunities in the workforce, plus a lack of clarity of potential pathways through education.

For students who do embark on a pathway to a digital technology career, it is likely they will struggle to gain an entry level role. Employers have indicated they are seeking experienced staff with specialist skills. However immigration data shows even non-specialist IT roles are being sourced internationally, rather than developed in New Zealand.

The result is a system wide challenge that demands collaboration between industry, education and Government. A collaborative approach will help ensure the best skilled people are being developed for current roles and those forecast for 2030-2035. Government funding alone is not the answer, and there are several examples of collaboration highlighted in this report that should be explored further and used as guides for wider application.

Call to Action

To improve diversity at the beginning of the talent pipeline, national investment is essential. Appropriate support must be provided to assist targeted communities in developing and showcasing their tech leaders, and to co-design relevant education pathways. Digital careers must also be widely promoted to inspire New Zealand students to consider digital technology careers.

The transition process from education to employment must be simplified. A national platform is required to coordinate and promote internships, plus education to employment pathways. Access to internship grants must be expanded and simplified. New pathways into digital roles that have better integration with employers and market opportunities, such as apprenticeships or apprenticeship degrees, should be introduced.

Ongoing commitment to reskilling and upskilling is essential. It is important to note, as the working age increases, efforts must be tailored to adult professionals, not just those beginning their working lives.

Conclusion

A System Wide Approach is Essential

CONCLUSION: A System Wide Approach is Essential

New Zealand continues to experience a digital skills problem. However, it is not strictly a skills shortage, but a skills mismatch.

The growth of New Zealand's tech sector and digitalisation across sectors is driving demand for people with digital skills. However, the growth of in demand skills is not an insurmountable challenge. A carefully considered system wide approach can transform this challenge into an opportunity.

The research shows that demand in the market is for senior experienced specialists, while unfortunately, there are very few entry level roles. Until recently, immigration has been the preferred pathway to access these specialist digital skills, but this is no longer a sustainable long term solution. The heavy reliance on immigration places New Zealand's economic growth at risk with ongoing global digital skills shortages, compounded by COVID-19 border restrictions. Instead, attention must be strongly focused on improving domestic digital skills pathways.

Fortunately, the growth in roles requiring digital skills is predictable and manageable. While we may continue to complement it with experienced specialists from overseas, we must ensure New Zealand's workforce is upskilled, while also creating smoother pathways from education to employment.

In addition, a multi-year, integrated effort will be required to reskill New Zealand's existing workforce. Education policy must evolve to enable lifelong learning, empowering people to be self-sustaining and ensuring access to new, rewarding jobs. In tandem, organisations in public and private sectors must invest in their own learning programmes to upskill their employees. Global initiatives currently addressing the digital skills gap use an integrated approach leveraging different resources and skills of various stakeholders: funding and infrastructure of government, innovation capability and agility of business, and connection to social causes and purpose of non-profit/social enterprises.

If we continue to import some skills and upskill those already in the workforce, only a small percent of the secondary school students leaving school each year would be required to meet the expected growth rates. With low levels of diversity throughout the digital skills pipeline, it is essential we attract more women, Māori and Pacific people and support their transition through education pathways into the workforce.

Respondents to the 2020 Digital Skills Survey broadly supported the creation of a nationwide apprenticeship programme. An apprenticeship degree scheme similar to that implemented in the United Kingdom, with pastoral support could greatly benefit both employers and workers, especially given New Zealand's high proportion of small-medium enterprises. It will also provide a clear pathway for those returning to work, or looking to change careers and enter digital roles.

Recommendations

This study was undertaken as part of the New Zealand Government's Digital Technology Industry Transformation Plan (ITP) to provide evidence and data to help identify the best ways to address reported skills shortages so that the digital technology sector can continue to grow and prosper. The research will enable the skills workstream within the ITP to focus resources in the most meaningful way.

In developing these recommendations input was gathered from a range of stakeholders including employers of digital skills, educators, the Ministry of Education, MBIE's employment and skills policy team, industry bodies and non-governmental organisations (NGO's) working to address diversity and transition from education to employment.

The report makes the following recommendations:

1. Build the Digital Skills Pipeline

Attention must be focused on developing a digital skills pipeline that provides much needed immediate skills whilst also developing to ensure it meets future needs. New Zealand's digital skills pipeline needs to evolve to a more planned and purposeful system that provides clear pathways through education to employment augmented by high quality immigration.

There are a number of important reasons for building a stronger domestic pipeline for digital skills.

- Preparing students for the future of work: As the tech sector continues to grow and more organisations in other sectors undergo digital transformation, there will be a growing number of jobs created for people with a range of digital skills. So it makes sense to prepare as many New Zealanders for these future work opportunities.
- Balancing our immigration risk: As the demand for digital skills grows globally it will be prudent to have a balanced skills pipeline that is not overly reliant on immigration.
- Capturing our culture in code: As we become more reliant on algorithms and automated decision making tools that augment our interactions at work, with the Government and socially, it will be increasingly important that our unique New Zealand culture and values are embedded within the code. To do this we will need Kiwi's with digital skills.

It is also important that New Zealand continues to have access to the best digital skills the world has to offer. Immigration brings specialised skills and experience that we are unable to develop locally.

1.1 Promote digital technology to students, parents and whanau

WHY An understanding of, and confidence with, digital skills will be important for all students in the future workforce. While most will not go on to become software programmers or data scientists, the early digital skills they learn will be as important for them as their knowledge of maths and English. Understanding how digital technologies work will also improve individual and national awareness of cybersecurity, privacy, how to manage data and how to work with digital tools. As tasks are automated in the future, those with digital skills will be most resilient to these changes.

Parents are key influencers behind student career choices and most parents probably do not understand the tech sector or understand how 'playing with a computer' will get you a job. So it will be important to help both students and their parents better understand the importance of digital technologies.

Ultimately, the development of the grass roots of the digital skills pipeline will result in a larger number of New Zealanders taking on the advanced digital skills needed to help the economy grow as its digital technology sector expands and other sectors undergo digital transformation.

Recommended actions and participants

HOW

- Develop a multi-year promotional campaign targeted at parents of students in school years 5-6 to raise their awareness of the importance of developing digital skills.
- Develop a multi-year promotional campaign targeted at parents of students in school years 7-10 to raise their awareness of the world of opportunities in digital technology careers.
- Provide significantly more resources to successful initiatives that are already addressing these issues, such as Code Club Aotearoa, 123Tech, ShadowTech and TechHub.

WHO Ministry of Education in collaboration with target cohorts, industry and industry bodies such as NZTech and IT Professionals NZ and other relevant agencie such as the Ministry of Business, Innovation and Employment, Te Puni Kokiri, Ministry for Pacific Peoples.

1.2 Increase investment in educators confidence and upskilling

WHY Like parents, educators are significant influencers in students' decisions with respect to future learning and careers. If educators are not aware of the large variety of opportunities within the digital technology workforce, or if they have preconceived ideas, they will not be encouraging students to consider these options.

Likewise, if educators are not confident with digital technologies this may indirectly influence students, particularly girls. The majority of primary school teachers are women. If they are uncomfortable with technology then girls see this and it may reinforce stereotypes.

Recommended actions and participants

HOW

- Further investments should be made to ensure continuous professional development is not only available but promoted to educators at all levels.
- Additional opportunities should be provided for educators to take on specialist certification programmes providing digital technology credentials through a variety of pathways and providers.
- A systematic approach should be developed to inform all school career advisors of the variety of career options available in digital technology careers, from creative roles, people focused roles and design roles to data experts, developers and entrepreneurs.

WHO Ministry of Education and Tertiary Education Commission in collaboration with education focused philanthropists, industry and educators.

1.3 Develop clearer pathways into digital roles

WHY While there are a multitude of different types of roles available for people interested in digital technologies and the tech sector it is difficult to see how to get to many of them via education and experience. This lack of clarity limits the understanding and interest of students and the ability for educators to encourage them into digital career pathways.

For those that do express an interest in digital roles there is limited information available to help their decision. What little information is available is a dated set of guidance about IT jobs on Careers.govt.nz website hidden within the Manufacturing and Technology pathways. To quote the website, this pathway is for those interested in wood, metals, textiles, chemicals or other materials, making or processing food or beverages, using technology to develop and monitor production, working with your hands or managing and planning production. Not that relevant or compelling.

Additionally, to better meet the market need for higher levels of experience, new pathways will need to be developed with better integration opportunities for learning while in employment. Pathways that are relevant for different cohorts and provide access to a broader variety of digital careers.

Recommended actions and participants

HOW

- Map out and promote current education pathways into the broad range of digital roles.
- Develop and pilot new pathway models with tighter integration between education and employment such as digital apprenticeships.
- Work with diverse communities to increase their awareness and desire for pathways into digital technology roles and co-design new more relevant pathways.
- Update Careers New Zealand information to include a broader range of modern digital careers such as creative tech and user design within the IT sector.
- Develop clearer storytelling and case studies which demonstrate the diversity of roles available in advanced digital areas.

WHO Ministry of Education, Tertiary Education Commission, IT Professionals NZ, the Creative, Cultural, Recreation and Technology (CCRT) Workforce Development Council and Industry with target communities.

1.4 Work with women, Māori and Pasifika communities to improve participation rates

WHY There will continue to be a growing number of digital technology roles across all sectors of the New Zealand economy. This should present an opportunity for all New Zealanders, however there have always been low levels of women, Māori and Pasifika in digital technology education and jobs. Without addressing this imbalance there is increasing risk of digital inequality in New Zealand.

Diversity needs to be improved at the beginning of the talent pipeline, national coordination and investment is essential. Beginning in primary school, we must encourage a diverse range of students to learn about technology in age appropriate ways. Throughout secondary school, we must stimulate students' interest in continuing into pathways for roles in New Zealand's fastest growing sector with high paying jobs. We need to actively inspire women, Māori and Pacific people to consider the myriad of tech careers available.

Recommended actions and participants

HOW

- Significant focused investment should be applied to address each of these diversity challenges separately. For women, Māori and Pacific peoples - support must be provided to enable these communities to develop and showcase their own tech leaders, design relevant education pathways toward tech careers, and to promote career pathways and career opportunities.

WHO Ministry of Education, the Ministry of Business, Innovation and Employment and Community leaders with the support of philanthropists and industry.

1.5 Develop consistent data for workforce planning

WHY A consistent flow of quality digital skills is important for the entire economy, not just the fast growing tech sector. However, as we have found with this study, there is a lack of timely information available to assist with policy setting and workforce planning.

In order to improve the development and flow of digital skills for the New Zealand economy we should consider some form of workforce planning. In order to do this we must find ways to regularly capture and report on the developing skills needs. To improve the quality of the data, key data points must be agreed and have consistent definitions.

Recommended actions and participants

HOW

- Introduce a dashboard of key digital technology skills data points from across the pipeline including NCEA participation, tertiary participation, internships, open roles, new roles, forecast roles, visa approvals and diversity targets.
- Reconcile and standardise a list of digital technology roles to measure, track and report on across the economy including job numbers and visa approvals.

- Introduce annual data collection by Statistics NZ, in collaboration with Industry, on current and forecast demand for the list of digital technology roles.

WHO Ministry of Business, Innovation and Employment, Statistics NZ, CCRT Workforce Development Council, and Ministry of Education in collaboration with NZTech, IT Professionals NZ and Industry.

1.6 Create and deploy targeted international talent attraction

WHY New Zealand will never be able to produce all of the digital technology talent it requires domestically, and nor should it. There is immense value from accessing the global talent pool, especially with rapidly developing technologies. Migrants with advanced digital technology skills bring new ideas, experience with new technologies and connections to international markets.

However, we should focus on attracting the best of the best and avoid moving toward importing low cost tech labour like the USA. To attract the best digital technology talent New Zealand needs to be more targeted. Identifying the skills needed and deploying the appropriate messaging consistently over time to ensure there is a quality international supply for New Zealand organisations.

Recommended actions and participants

HOW

- Continue to promote New Zealand to the world, especially showcasing a hi-tech economy and world class tech firms, to attract a pool of international tech talent.
- Develop targeted marketing campaigns for specific in demand talents such as data science or machine learning.
- Remove barriers for applicants with skills needed in New Zealand by expanding the current Immigration Skills and Qualifications Assessment process between Immigration NZ and IT Professionals NZ to all applicants (including those without a Bachelors Degree).

WHO NZTech via the Tech Story, in collaboration with Industry, Immigration, New Zealand Trade and Enterprise, Ministry of Business, Innovation and Employment and NZ Story.

2. Support the Transition to Work

The transition from employment to work can be difficult in all industries. Experience takes time to build and in fast paced digital organisations employers often don't have the time or resources available to invest in helping graduates develop experience. However, the research indicates that if it was easier most employers would like to engage graduates.

To make it easier for both employers, educators and students, more clarity is needed of the skills in demand. Then education pathways can be improved to help connect employers with students as they develop. Simplification and expansion of internship grants should be considered to help remove barriers for employers to start engaging interns, and a more systematic approach should be designed for one of the largest employers of digital skills, the public sector.

2.1 Launch a national education to employment and workforce planning platform

WHY Exacerbating the issues around digital technology education to employment transition is a lack of clarity. There is no transparency in terms of the types and numbers of skills needed by employers now and in the future. Likewise, there is no simple view of the nature of the skills being developed throughout the education system. Currently each tertiary institute is working independently to encourage employers to take on interns with limited success. Improving the transition from education to employment will reduce the skills mismatch providing better outcomes for both employers and students.

To enhance the transition from education to employment, a more coordinated approach is required for both employers and students. A single national platform approach is recommended to assist with workforce planning and to help employers access the right graduates at the right time.

Recommended actions and participants

HOW

- Develop a neutral, trusted national platform to support workforce planning, with organisations integrating their recruitment activity and workforce predictions into the platform so industry wide predictions can be developed in order to guide education pathway developments.
- Design the platform to help coordinate, promote and manage all digital technology internships through a one stop window. Taking a platform approach so that the market can continue to operate with multiple providers.
- Pilot the platform with a sub-sector of the digital technology ecosystem, the Interactive Media / Game Developers companies and relevant education pathways.

WHO Ministry of Business, Innovation and Employment, supporting the development of a pilot in collaboration with NZTech, IT Professionals NZ, Industry, Ministry of Education, the CCRT Workforce Development Council, Summer of Tech and tertiary education providers.

2.2 Develop Digital Apprenticeship Pathways

WHY In order to better attract women, Māori and Pacific peoples new pathways into digital technology careers should be considered. Education pathways that include the ability to earn while learning will provide increased options for many people that may have the capabilities but not the resources to undertake a digital technology education. This includes people considering reskilling.

Additionally, an apprenticeship model will have the added advantage of providing better integration of education with employers and market opportunities.

Recommended actions and participants

HOW

- Develop pilot models of digital apprenticeships with targeted cohorts. Work with industry and target cohorts to co-design education pathways that meet the needs of both employers and individuals.
- Trial a couple of sub-degree pathways and assess the viability of extending to include a degree level digital apprenticeship.

WHO Target cohort communities and industry in collaboration with New Zealand Institute of Skills and Technology, IT Professionals NZ, local tertiary institutes, Ministry of Education, Tertiary Education Commission and local economic development agencies.

2.3 Simplify and expand internship grants

WHY Internships are a proven method for helping students develop work experience and the skills that employers say are lacking in many graduates. These skills increase the productivity of graduates and make them more economically useful for employers when they enter the workforce. However, employers have indicated that taking on interns is costly and a significant drain on resources. Consequently only a small proportion of digital technology students are successful in obtaining an internship prior to trying to enter the workforce.

A small reduction in the cost of taking on an intern has been shown to improve engagement by employers. Where grants have been provided for internships, via the Callaghan Innovation R&D Experience Grant, there has been a large increase in uptake of internships. It is recommended that this approach be simplified, so that internships can be obtained beyond R&D work, and expanded so that more smaller organisations are provided this incentive to take on interns.

Recommended actions and participants

HOW

- Increase the amount of funding Callaghan Innovation has for Experience Grants.
- Simplify the criteria by removing the focus on R&D and broaden the applicability to something more general like innovation or software development.
- Further simplify the process by allowing Callaghan Innovation to provide bulk funding to accredited or preferred providers, such as Summer of Tech, so they can provide the intern and the funding in a single process.
- To support smaller companies that don't have HR staff, consider creating specific roles within an agency to help firms develop work plans for interns.

WHO Ministry of Business, Innovation and Employment, Callaghan Innovation, Summer of Tech and Industry bodies.

2.4 Expand the Government's GovtTechTalent graduate programme

WHY Combined, the Public Sector is the largest employer of digital technology skills. Yet most public sector organisations recruit individually and few take on interns. The Government has a small but successful GovTechTalent graduate programme in place where IT graduates spend 24-months rotating through three of the participating central government agencies, spending eight months in each. The participating agencies are: Department of Internal Affairs, StatsNZ, ACC, Ministry of Education, Ministry of Business, Innovation and Employment, Inland Revenue, NZ Transport Agency and Ministry for Primary Industries.

The largest employers of digital skills in almost every region of New Zealand are public sector organisations, including city councils, district health boards, universities and central government agencies. Using the GovTechTalent programme, or something similar, a more structured approach should be put in place by the Government to better coordinate and enable all public sector organisations to engage with digital technology graduates.

The same mechanism should also be expanded to provide internships for digital technology students to help them gain work experience while studying. This will improve the quality of graduates and support the difficult education to employment transition.

Recommended actions and participants

HOW

- Redevelop the current GovTechTalent programme to involve additional agencies and public sector organisations.
- Extend the programme to also provide a structured internship for students prior to graduation.

WHO Department of Internal Affairs and Ministry of Business, Innovation and Employment.

3. Upskill and Reskill

The research has identified an opportunity. Very little is currently being invested in upskilling or reskilling people with new digital skills. High employee turnover rates appear to be a result of employers not investing in providing current employees with the opportunity to take on new skills and new roles. It is currently easier to recruit new skills than develop them, and as a consequence employees are driven to change jobs to gain new opportunities. Employers need to be encouraged to upskill their employees and they need more convenient options available to enable this upskilling while working.

With immigration expected to be limited in 2021 due to COVID-19 related border restrictions there may be opportunities for reskilling some of the people that have lost their jobs. Any reskilling efforts must be finely tuned to market needs so it is recommended that the ICT Graduate schools and non-degree reskilling programmes such as the Dev Academy are provided more support to improve alignment and integration with industry.

3.1 Fund and coordinate specialisations across the ICT Graduate Schools

WHY The research found that experienced senior professionals were in demand more than graduates. The objective of the ICT Graduate Schools was to deliver industry focused education and to create connections between tertiary education providers and hi-tech firms. The ICT Graduate Schools have increased the pool of postgraduate students graduating locally with advanced information technology and computer science skills. However, the special funding for the ICT Graduate Schools ended in December 2020 and they have been absorbed back into the tertiary provider structures. The ICT Graduate School brand is an attractive proposition for international students and the tertiary institutions need international students to help with funding. This has resulted in a high number of international students attending and graduating from the ICT Graduate Schools.

The ICT Graduate Schools should be provided additional funding to enable them to focus on increasing the number of domestic students attending and graduating. They should also be tasked with better collaboration (rather than competition), especially with marketing as a single New Zealand ICT Graduate Schools brand. Better collaboration may also improve specialisation with each school encouraged to focus on one of the areas of growing need – data, AI and security.

Recommended actions and participants

HOW

- Create a new fund to support the ICT Graduate Schools under the proviso that there is structured collaboration.

- Put in place incentive funding and targets for domestic student graduates.
- Establish a single New Zealand ICT Graduate Schools brand and provide funding to support the marketing of the Schools and their reskilling opportunities to New Zealanders.
- Establish a working group from industry and each of the schools to explore potential specialisation aligned with industries current and future needs.

WHO Tertiary Education Commission, Ministry of Business, Innovation and Employment, and Industry.

3.2 Encourage industry accreditation

WHY Industry accreditation is a sign of a mature industry that is focused on ongoing professional development. Additional benefits may include reduced staff turnover, reduced professional liability and greater confidence for customers.

IT Professionals Association New Zealand currently provides a professional accreditation programme under licence from BCS, the UK-based Chartered Institute for IT, a global charity with a royal charter focused on supporting the IT industry, the people who work in the industry, and to make IT good for society.

The two accreditations currently available via IT Professionals Association New Zealand are practicing qualifications. Rather than a degree or diploma that showed an individual possessed knowledge at a particular point in time, these accreditations show that as professionals, candidates have committed to ongoing professional development and staying current. Accreditation also helps professionals take responsibility for their professional development, and provides incentives to advance their careers – all things that help a company develop and build a culture of ongoing professional maturity.

Employers of IT professionals should be encouraged to support their staff undertake and maintain professional accreditation as this will introduce a culture of supporting the upskilling of employees and of employees taking responsibility for their own upskilling.

It is recommended that as the largest purchaser of IT services that the Government should consider making professional accreditation of staff a prerequisite for suppliers.

Recommended actions and participants

HOW

- Review current industry accreditations and identify any new or additional certifications that would support industry upskilling.
- Introduce industry accreditation as a prerequisite for suppliers of Government IT services and solutions.

WHO

Department of Internal Affairs Government Chief Digital Office in collaboration with industry, led by IT Professionals NZ.

3.3 Recognise and incentivise industry certifications

WHY Many large multinational software organisations provide their own certification programmes. They range from simple online courses to complex training. In some instances the multinational organisation has developed a relationship with a university or polytech and their free certificate course work is embedded in an existing qualification. However, in most instances the training and certification is provided directly by the multinational software company which, unless you work in the software industry, is not very visible.

The research identified that there is very high demand for basic skills in several of the platform technologies. There may be an opportunity to collaborate with multinational software companies to instigate targeted programmes for faster re-skilling of people undergoing job transitions from sectors impacted by COVID-19.

It is recommended that the software companies collaborate and work with the Government to provide a less fragmented window into the opportunities available through industry certification programmes. It is also recommended that the Government supports industry certifications allowing access for fees-free study.

Recommended actions and participants

HOW

- A coalition of the willing from across Industry to collaborate with MBIE and TEC to develop a re-skilling portal, funded by Government, to showcase industry certification and other educational pathways into tech careers and provide easy access to courses.
- Appropriate status provided to selected, in demand, industry certifications to enable uptake of fees-free study for those attempting to transition from COVID-19 impacted industries into IT roles.

WHO Tertiary Education Commission, Ministry of Business, Innovation and Employment, and Industry.

APPENDIX: Research Methodology

During September and October of 2020 NZTech surveyed the tech sector, large corporate IT departments and large government agencies on their current and perceived future digital skills needs, current open roles, approaches to diversity and internships.

The 2020 Digital Skills Survey was developed based on the 2017 survey questions. The 2017 survey was developed with input from the Department of Internal Affairs which had conducted a similar survey across Government agencies at the end of 2016. For the purposes of the survey, information technology and digital are used interchangeably and to describe the application of computing.

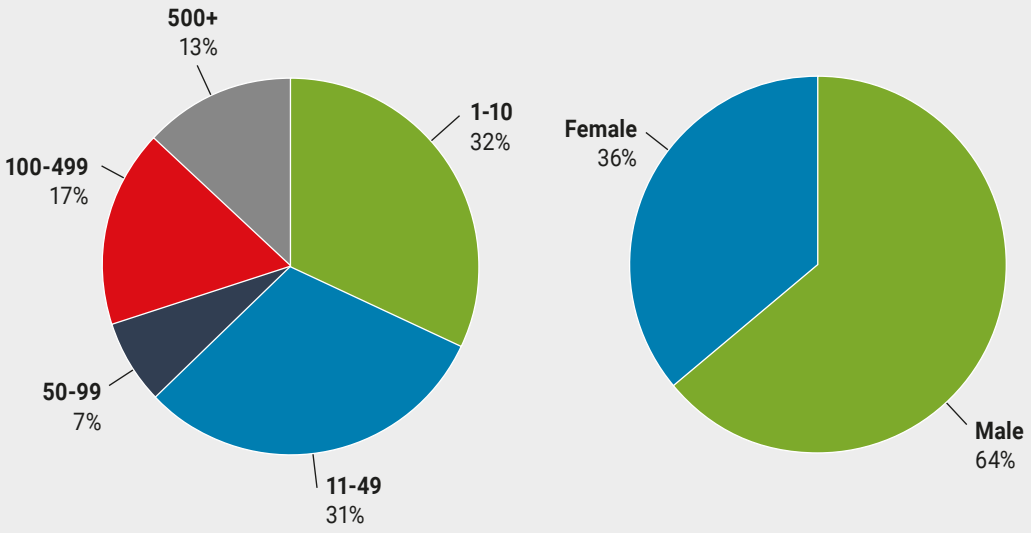
The survey was conducted as an online survey. It was promoted to the senior management of organisations that employ an IT or digital team. The survey was promoted to the membership and subscriber bases of NZTech, IT Professionals, NZRise and other New Zealand tech associations. It was also promoted to the Government CIO Forum and through NZTech's Techweek partner channels.

Survey Demographics

A total of 278 people responses were received providing clean complete responses from 190 organisations which employ 58,291 people in New Zealand of which 36 percent are women. Within these 190 organisations they employ 13,261 people in their digital/IT teams of which 27 percent are women, 4.1 percent are Māori and 2.8 percent are Pasifika.

The respondents of the completed surveys were senior executives with 47 percent being

FIGURE 22: Survey respondents by company size and proportion female



Source: 2020 Digital Skills Survey, NZTech n = 190.

Chief Executives or Managing Directors and a further 29 percent being Chief Technology, Digital or Information Offices.

The majority of the respondents were from tech firms, accounting for almost 80 percent of respondents. The remaining 20 percent were made up of large non-tech corporates (8 percent), public sector organisations (5 percent), financial institutions (3 percent) and others (5 percent).

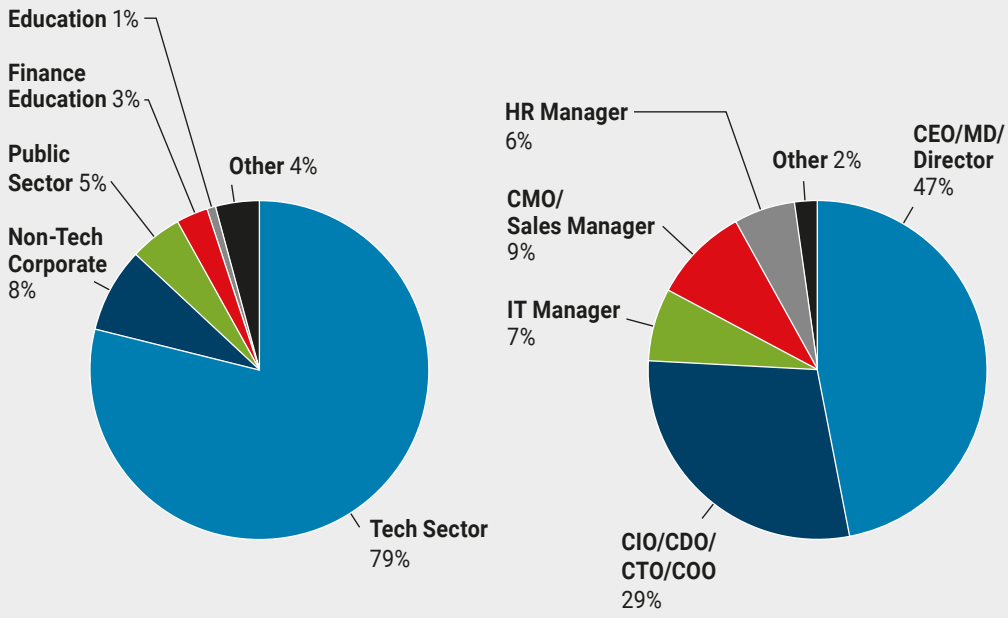
Categorising Roles and Skills

The survey asked respondents about their open roles to gauge what roles the organisations were currently marketing for a comparative against the specific skills they perceived that they had and would need in the future.

The skills list used the same list as the 2017 survey which was developed using a high level of the Skills for the Information Age (SFIA) standards.

Roles were collected as free-type to capture the actual role names firms were using to attract candidates. These roles were then grouped into simplified categories as shown in Table 8 for ease of analysis.

FIGURE 23: Survey respondents by job title and sector



Source: 2020 Digital Skills Survey, NZTech n = 190.

TABLE 8: List of open roles from survey respondents

Role Category	Roles Included
Architects	Architect Senior Architects Cloud Architect Enterprise Architect Programme Architect Software Architect Solution Architect System Architect
Business Analysts	Business Analyst QA Senior Business Analysts Technical Analysts
Consultants	Pre Sales Consultnt Senior Consultant Digital Accessibility Consultant Functional Consultant Lead Consultant Senior Consultant Senior Design Consultant
Cybersecurity	Security Consultant Security Consultant Security Engineer Security Ops Lead Security Skills
Data Experts	Data Analyst Data Architect Data Engineer Data Managers Data Scientist Data Lead Data Visualisation Designer GIS Analyst Information/Data Scientists Quantitative Data Analyst
Management & Sales	Chief Digital Officer Chief Customer Transformation Advisor Chief Technology Officer Digital Strategists General Manager Head of Product Management ICT Client Lead Operations Manager Product Manager Specialised IT Sales
Project Managers	IT Project Manager Project Manager Senior Project Manager
Software Developers	3D Animator 3D Web Visualization Developer Developer Evangelist Digital Designer Embedded Software Developers Full stack developer Intermediate Developer Java Engineer Mobile App Developer Backend Developer Programmer Senior Developer Senior UI Designer Software Developer UI/UX Developer UX Designer UX designers Web Application Engineer Web Developer
Software Engineers	Engineering Technical Administrator Application Support Backend Engineer Cloud Engineers Cloud Infrastructure Consultant DevOps Engineering Manager FirmWare Engineer Game Automation Engineer Infrastructure Engineers IT Engineering Storage Junior Software Engineer Lead Engineer Mechanical Engineer Mechatronics Engineer Platform Engineer Senior Design Engineer Senior Software Engineer Service Engineers Software Engineer Solution Engineer UE Programmers
Support, Testing & Training	Software Tester Service Desk Analysts Software Test Analyst Software Testers Technical Support Technical Trainers

Source: 2020 Digital Skills Survey, NZTech.

Additional Data

Secondary School Participation Data

The following tables provide data on the number of students participating in NCEA standards most relevant to digital skills as defined by the report authors.

The data looks across a five year period from 2015 to 2019 and includes breakdowns on female, Māori and Pasifika participation. The tables include an analysis of all Year 11-13 students in the New Zealand domestic student population, consistent with the enrolment-based NCEA statistics measure. Participation is defined as being assessed in standards totaling 14 credits, cumulatively (i.e. includes results gained in prior years), for each given year. The standards assessed include achievement standards, standard levels 1-3, from subjects in the Science, Technology and Mathematics (STM) subjects only.

The Standards were sourced from the New Zealand Directory of Standards (DAS) and include:

- Technology/Construction and mechanical technologies
- Technology/Design and visual communication
- Technology/Digital technologies
- Technology/Processing technologies
- Technology/Hangarau
- Mathematics/Calculus
- Mathematics/Statistics
- Mathematics/Pangarau
- Science/Agriculture and Horticulture
- Science/Biology
- Science/Chemistry
- Science/Earth space science
- Science/Physics
- Science/Putaiao
- Science/Education sustainability

A student may identify with up to three ethnicities. A student will be counted once for each ethnic group that they identify with, but only once in total. Therefore the sum of individual ethnicities will likely exceed the total number of students.

This data was provided by the Ministry of Education on 6 January 2021. The compound annual growth rates (CAGR) has been calculated by NZTech.

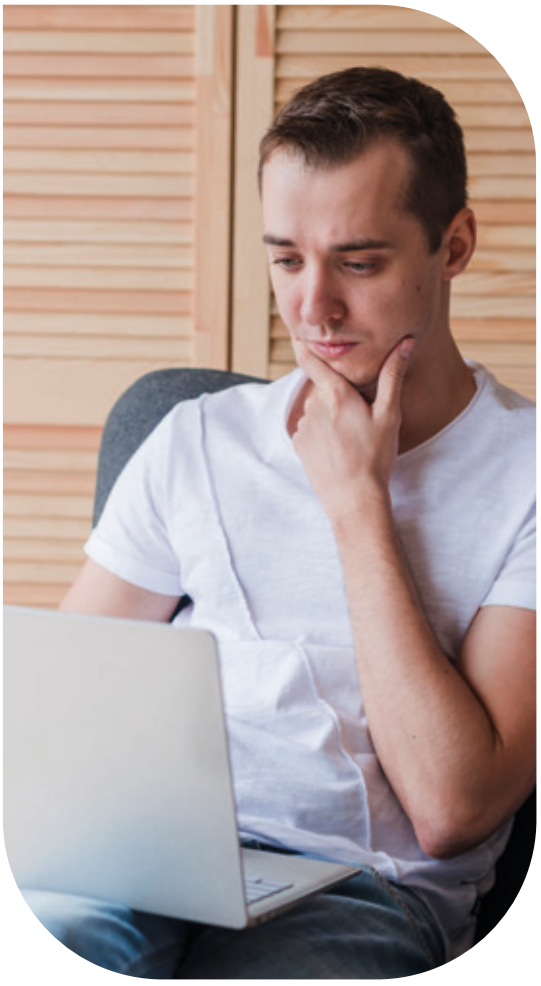


TABLE 9: Number of students taking NCEA Technology Standards by year and gender, 2015-2019

		2015	2016	2017	2018	2019	CAGR
Year 11	Female	6839	6259	6093	5895	5750	-4%
	Male	10116	10164	9809	9586	8951	-3%
	Total Year 11	**16955**	**16423**	**15902**	**15481**	**14701**	**-4%**
Year 12	Female	7366	7637	7060	6788	6662	-2%
	Male	10962	11289	11388	10906	10662	-1%
	Total Year 12	**18328**	**18926**	**18448**	**17694**	**17324**	**-1%**
Year 13	Female	7504	7262	7406	6693	6557	-3%
	Male	9717	9960	10083	9869	9442	-1%
	Total Year 13	**17221**	**17222**	**17489**	**16562**	**15999**	**-2%**
Total	Female	21709	21158	20559	19376	18969	-3%
	Male	30795	31413	31280	30361	29055	-1%
Total Participation		**52504**	**52571**	**51839**	**49737**	**48024**	**-2%**

Source: Ministry of Education, 2021. CAGR calculated by NZTech.

TABLE 10: Number of Māori students taking NCEA Technology Standards by year and gender, 2015-2019

		2015	2016	2017	2018	2019	CAGR
Year 11	Female	1094	920	908	815	726	-10%
	Male	1518	1630	1479	1337	1253	-5%
	Total Year 11	**2612**	**2550**	**2387**	**2152**	**1979**	**-7%**
Year 12	Female	1162	1290	1080	1025	957	-5%
	Male	1622	1735	1856	1684	1521	-2%
	Total Year 12	**2784**	**3025**	**2936**	**2709**	**2478**	**-3%**
Year 13	Female	1166	1100	1199	974	962	-5%
	Male	1388	1389	1460	1481	1406	0%
	Total Year 13	**2554**	**2489**	**2659**	**2455**	**2368**	**-2%**
Total	Female	3422	3310	3187	2814	2645	-6%
	Male	4528	4754	4795	4502	4180	-2%
Combined Participation		**7950**	**8064**	**7982**	**7316**	**6825**	**-4%**

Source: Ministry of Education, 2021. CAGR calculated by NZTech.

TABLE 11: Number of Pacific students taking NCEA Technology Standards by year and gender, 2015-2019

		2015	2016	2017	2018	2019	CAGR
Year 11	Female	488	487	467	429	403	-5%
	Male	767	841	848	843	751	-1%
	Total Year 11	**1255**	**1328**	**1315**	**1272**	**1154**	**-2%**
Year 12	Female	583	636	642	579	537	-2%
	Male	950	960	997	1020	962	0%
	Total Year 12	**1533**	**1596**	**1639**	**1599**	**1499**	**-1%**
Year 13	Female	663	614	673	664	585	-3%
	Male	890	940	927	966	968	2%
	Total Year 13	**1553**	**1554**	**1600**	**1630**	**1553**	**0%**
Total	Female	1734	1737	1782	1672	1525	-3%
	Male	2607	2741	2772	2829	2681	1%
Combined Participation		**4341**	**4478**	**4554**	**4501**	**4206**	**-1%**

Source: Ministry of Education, 2021. CAGR calculated by NZTech

TABLE 12: Number of students participating in NCEA Science, Technology and Maths, 2015-2019

		2015	2016	2017	2018	2019	CAGR
Science	Female	63696	65093	65320	63226	62052	-1%
	Māori	21791	23225	23741	22951	22054	0%
	Pacific	21791	23225	23741	22951	22054	0%
	Total	**123101**	**126193**	**126593**	**123092**	**120384**	**-1%**
Technology	Female	21709	21158	20559	19376	18969	-3%
	Māori	7950	8064	7982	7316	6825	-4%
	Pacific	4341	4478	4554	4501	4206	-1%
	Total	**52504**	**52571**	**51839**	**49737**	**48024**	**-2%**
Maths	Female	67577	68612	68674	67079	66688	0%
	Māori	24785	25851	25885	25137	24682	0%
	Pacific	24785	25851	25885	25137	24682	0%
	Total	**132798**	**134826**	**134387**	**131441**	**129968**	**-1%**
STM	Female	72440	73443	73664	72022	71370	0%
	Māori	28071	29349	29625	28787	28038	0%
	Pacific	28071	29349	29625	28787	28038	0%
Total		**142291**	**144339**	**144383**	**141486**	**139636**	**0%**

Source: Ministry of Education, 2021. CAGR calculated by NZTech.

Tertiary Study Participation and Achievement Data

The following data has been provided by the Ministry of Education based on data supplied by tertiary education providers via the Single Data Return Process.

These tables present data relating to the predominant field(s) of study of students enrolled and completing qualifications at tertiary education providers. This data looks at all the courses studied within a qualification to determine a student's predominant field(s) of study. It indicates the number of students taking or completing IT qualifications.

To calculate IT as a collective we have included computer science, information systems and information technology from the Information Technology and Computer Science schools plus software engineering subjects from the Engineering schools. The data is for formal study in government-funded tertiary provider-based study and only includes enrolments or completions for the following New Zealand Standard Classification of Education (NZSCED) categories: Narrow fields 0201, 0203, 0299 and detailed fields 031303, 031305 and 031307. These four groups define the IT groups in this data. Enrolments in other fields of study are excluded, so the enrolment numbers here may not match other published data.

Enrolment data relates to students enrolled at any time during the year with a tertiary education provider in formal qualifications of greater than 0.03 EFTS (more than one week's full-time duration) and excludes all non-formal learning and on-job industry training.

Graduation data for 2019 should be treated as indicative as providers can continue to report completions throughout the following year.

Given the predominant pathway into digital technology careers is via degree qualifications, the qualifications data has been clustered to better expose degree level participation and completion. Qualifications have been clustered as Certificates (covering qualification levels 1 to 4), Diplomas (covering sub-degree qualification levels 5 to 7), Degrees (covering level 7 degree

qualifications and level 8 honours degrees and postgraduate certificates), Masters/ PhD's (covering qualification levels 9 to 10).

Additional notes on the data:

- The data includes those private training establishments that received Student Achievement Component funding, and/or had students with student loans or allowances, and/or Youth Guarantee programmes.
- Students are counted in each field of study they enrol in or complete, so the sum of the various fields may not add to the total.
- Students are counted in each qualification type/NZQF level they enrol in or complete, so the sum of the various levels may not add to the total.
- Students are counted in each ethnic group they identify with, so the sum of the various ethnic groups may not add to the total.
- Students age is based on age as at 31 December each year.
- International students are those studying here without New Zealand/Australian citizenship or permanent residence status. Students studying off-shore at tertiary education providers that are registered in New Zealand are considered international students unless they hold New Zealand citizenship.
- Data in these tables, including totals, have been rounded to the nearest 5 to protect the privacy of individuals, so the sum of individual counts may not add to the total.
- ''nfd' or 'Not further defined' covers general responses such as "engineering", where it is not possible to assign to a more specific field.
- 'Mixed' relates to study that covers several of the fields in the group, where it is not possible or appropriate to separate them.
- ''nec' or not elsewhere classified covers specific fields of study other than those listed for that group.

Information Technology Enrolments

TABLE 13: Number of students enrolled in IT qualifications, by qualification, 2019

	Certs (1-4)	Diplomas (5-7)	Degrees (7-8)	Masters/PhD (9-10)	Total
Computer science	440	2,065	9,145	1,070	12,550
Information systems	180	1,005	5,505	635	7,285
Software engineering	10	70	2,525	140	2,740
Other information technology	720	950	910	330	2,855
Total	**1,225**	**3,430**	**15,325**	**2,065**	**21,615**

Source: Ministry of Education, 2021.

TABLE 14: Number of students enrolled in degree level IT qualifications by ethnicity, 2019

	European	Māori	Pacific Peoples	Asian	Other	Unknown	Total
Computer science	3,835	540	420	4,630	550	100	9,145
Information systems	2,110	365	230	2,840	290	130	5,505
Software engineering	1,250	130	115	1,130	140	30	2,525
Other information technology	315	60	30	515	60	5	910
Total	**6,370**	**910**	**685**	**7,730**	**885**	**215**	**15,325**
	41.6%	5.9%	4.5%	50.4%	5.8%		

Source: Ministry of Education, 2020.

TABLE 15: Number of students enrolled in degree level IT qualifications by gender 2019

	Gender Diverse	Female	Males	Total
Computer science	15	2,065	7,060	9145
Information systems	0	1,620	3,885	5505
Software engineering	5	450	2,070	2525
Other information technology	0	285	625	910
Total	**20**	**3,835**	**11,470**	**15,325**
	0.1%	25.0%	74.8%	

Source: Ministry of Education, 2020.

TABLE 16: Number of students enrolled in degree level IT qualifications by age, 2019

	Under 18 years	18-19 years	20-24 years	25-39 years	40 years and over	Total
Computer science	25	1565	5025	2205	325	9145
Information systems	5	345	2780	1995	380	5505
Software engineering	0	430	1725	340	30	2525
Other information technology	5	35	295	470	105	910
Total	**35**	**2,200**	**8,235**	**4,140**	**710**	**15,325**
	0.2%	14.4%	53.7%	27.0%	4.6%	

Source: Ministry of Education, 2020.

TABLE 17: Number of students enrolled in IT qualifications, by field of study, 2019

Algorithms	450
Artificial Intelligence	290
Compiler Construction	75
Computational Theory	370
Computer Applications and Programming	5,800
Computer Science nec, mixed or nfd	5,105
Data Structures	120
Formal Language Theory	225
Multimedia Computing Science	500
Networks and Communications	1,635
Operating Systems	575
Total Computer Science	**12,550**
Conceptual Modelling	280
Database Management	740
Decision Support Systems	330
Information Systems nec, mixed or nfd	3,365
Systems Analysis and Design	3,505
Total Information Systems	**7,285**
Communications Technologies	105
Computer Engineering	2,165
Electronic Engineering	705
Total Software Engineering	**2,740**
Information Technology nec, mixed or nfd	2,635
Security Science	245
Other Information Technology: Total	2,855
Total	**21,615**

Source: Ministry of Education, 2020.

TABLE 18: Number of students enrolled in IT qualifications by qualification level, 2015 - 2019

	2015	2016	2017	2018	2019	CAGR
Certs (1-4)	1,460	1,280	785	400	440	-26%
Diplomas (5-7)	4,090	4,040	3,530	2,485	2,065	-16%
Degrees (7-8)	7,910	8,185	8,365	8,820	9,145	4%
Masters/PhD (9-10)	480	575	725	915	1,070	22%
Total Computer Science	**13,665**	**13,835**	**13,215**	**12,470**	**12,550**	**-2%**
Certs (1-4)	430	340	215	290	180	-20%
Diplomas (5-7)	1,625	1,570	1,310	1,185	1,005	-11%
Degrees (7-8)	4,545	4,925	5,410	5,535	5,505	5%
Masters/PhD (9-10)	330	405	475	535	635	18%
Total Information Systems	**6,865**	**7,175**	**7,335**	**7,490**	**7,285**	**1%**
Certs (1-4)	190	165	70	30	10	-52%
Diplomas (5-7)	590	510	215	75	70	-41%
Degrees (7-8)	2,130	2,390	2,580	2,460	2,525	4%
Masters/PhD (9-10)	155	135	125	115	140	-3%
Total Software Engineering	**3,055**	**3,200**	**2,980**	**2,675**	**2,740**	**-3%**
Certs (1-4)	1,670	1,690	1,300	745	720	-19%
Diplomas (5-7)	1,230	985	885	955	950	-6%
Degrees (7-8)	1,515	1,405	1,100	1,125	910	-12%
Masters/PhD (9-10)	100	135	230	280	330	35%
Total Other Information Technology	**4,500**	**4,190**	**3,470**	**3,055**	**2,855**	**-11%**
Total	**23,600**	**23,805**	**22,665**	**21,485**	**21,615**	**-2%**
Total Certs (1-4)	3,035	2,790	1,905	1,340	1,225	-20%
Total Diplomas (5-7)	6,715	6,285	5,235	3,940	3,430	-15%
Total Degrees (7-8)	13,390	14,080	14,610	14,940	15,325	3%
Total Masters/PhD (9-10)	1,015	1,205	1,460	1,735	2,065	19%

Source: Ministry of Education, 2020.

TABLE 19: Number of domestic and international students enrolled in degree level IT qualifications, 2015 - 2019

	2015	2016	2017	2018	2019	CAGR
Domestic	6,030	6,185	6,300	6,440	6,450	2%
International	1,880	2,000	2,070	2,380	2,695	9%
Total Computer Science	**7,910**	**8,185**	**8,365**	**8,820**	**9,145**	**4%**
Domestic	3,080	3,175	3,330	3,290	3,090	0%
International	1,465	1,750	2,080	2,245	2,415	13%
Total Information Systems	**4,545**	**4,925**	**5,410**	**5,535**	**5,505**	**5%**
Domestic	1,825	2,070	2,210	2,115	2,160	4%
International	305	320	365	345	365	5%
Total Computer Engineering	**2,130**	**2,390**	**2,580**	**2,460**	**2,525**	**4%**
Domestic	695	665	575	575	440	-11%
International	820	740	525	550	470	-13%
Total Other Information Technology	**1,515**	**1,405**	**1,100**	**1,125**	**910**	**-12%**
Total	**13,390**	**14,080**	**14,610**	**14,940**	**15,325**	**3%**
Total Domestic	9,825	10,265	10,540	10,460	10,400	1%
Total International	3,560	3,815	4,070	4,480	4,925	8%

Source: Ministry of Education, 2020.

Information Technology Graduations

TABLE 20: Number of graduates by predominant field of study and qualification level, 2019

	Certs (1-4)	Diplomas (5-7)	Degrees (7-8)	Masters/PhD (9-10)	Total
Computer science	155	885	1,730	300	3,060
Information systems	80	345	1,510	155	2,085
Software engineering	0	20	385	45	450
Other information technology	245	395	410	105	1,155
Total	**445**	**1,480**	**3,265**	**580**	**5,745**

TABLE 21: Number of students graduating with degree level IT qualifications by ethnicity, 2019

	European	Māori	Pacific Peoples	Asian	Other	Unknown	Total
Computer science	570	90	55	1,030	95	20	1,730
Information systems	450	75	40	920	85	30	1,510
Software engineering	190	10	15	180	15	5	385
Other information technology	75	20	10	290	30	5	410
Total	**1,070**	**150**	**95**	**1,955**	**175**	**40**	**3,265**
	32.8%	4.6%	2.9%	59.9%	5.4%		

Source: Ministry of Education, 2020.

TABLE 22: Number of students graduating with degree level IT qualifications by gender, 2019

	Female	Males	Total
Computer science	400	1,325	1,730
Information systems	400	1,110	1,510
Software engineering	60	325	385
Other information technology	135	275	410
Total	**810**	**2,455**	**3,265**
	24.8%	75.2%	

Source: Ministry of Education, 2020.

TABLE 23: Number of students graduating with degree level IT qualifications by age, 2019

	Under 18 years	18-19 years	20-24 years	25-39 years	40 years and over	Total
Computer science	0	5	925	715	80	1,730
Information systems	0	5	680	730	95	1,510
Software engineering	0		310	75	0	385
Other information technology	0	0	105	265	40	410
Total	**0**	**10**	**1,695**	**1,390**	**175**	**3,265**
	0.0%	0.3%	51.9%	42.6%	5.4%	

Source: Ministry of Education, 2020.

TABLE 24: Number of students graduating with IT qualifications, by detailed field of study, 2019

Algorithms	25
Artificial Intelligence	110
Compiler Construction	25
Computational Theory	60
Computer Applications and Programming	1,045
Computer Science nec, mixed or nfd	1,455
Data Structures	15
Formal Language Theory	45
Multimedia Computing Science	115
Networks and Communications	560
Operating Systems	120
Total Computer Science	**3,060**
Conceptual Modelling	20
Database Management	195
Decision Support Systems	105
Information Systems nec, mixed or nfd	1,160
Systems Analysis and Design	975
Total Information Systems	**2,085**
Communications Technologies	25
Computer Engineering	380
Electronic Engineering	100
Total Software Engineering	**450**
Information Technology nec, mixed or nfd	1,080
Security Science	85
Other Information Technology: Total	**1,155**
Total	**5,745**

Source: Ministry of Education, 2020.

TABLE 25: Number of students graduating with IT qualifications by qualification level, 2015-2019

	2015	2016	2017	2018	2019	CAGR
Certs (1-4)	805	655	365	130	155	-34%
Diplomas (5-7)	1,755	1,930	1,685	1,250	885	-16%
Degrees (7-8)	1,350	1,425	1,625	1,725	1,730	6%
Masters/PhD (9-10)	85	110	180	255	300	37%
Total Computer Science	**3,980**	**4,120**	**3,850**	**3,350**	**3,060**	**-6%**
Certs (1-4)	310	200	80	150	80	-29%
Diplomas (5-7)	645	610	480	420	345	-14%
Degrees (7-8)	1,230	1,470	1,470	1,690	1,510	5%
Masters/PhD (9-10)	60	85	95	140	155	27%
Total Information Systems	**2,240**	**2,360**	**2,125**	**2,395**	**2,085**	**-2%**
Certs (1-4)	25	15	15	15	0	-100%
Diplomas (5-7)	180	165	105	35	20	-42%
Degrees (7-8)	295	375	425	450	385	7%
Masters/PhD (9-10)	65	40	35	40	45	-9%
Total Software Engineering	**565**	**595**	**580**	**535**	**450**	**-6%**
Certs (1-4)	850	860	510	330	245	-27%
Diplomas (5-7)	590	500	445	470	395	-10%
Degrees (7-8)	570	545	425	410	410	-8%
Masters/PhD (9-10)	20	40	65	110	105	51%
Total Other Information Technology	**2,030**	**1,940**	**1,435**	**1,315**	**1,155**	**-13%**
Total	**7,225**	**7,445**	**6,680**	**6,430**	**5,745**	**-6%**
Total Certs (1-4)	1,460	1,275	750	580	445	-26%
Total Diplomas (5-7)	2,950	2,970	2,450	1,900	1,480	-16%
Total Degrees (7-8)	2,630	2,950	3,145	3,460	3,265	6%
Total Masters/PhD (9-10)	230	265	360	515	580	26%

Source: Ministry of Education, 2020.

TABLE 26: Number of domestic and international students graduating with degree level IT qualifications, 2015-2019

	2015	2016	2017	2018	2019	CAGR
Domestic	825	815	1,005	1,005	975	4%
International	525	610	620	715	755	10%
Total Computer Science	**1,350**	**1,425**	**1,625**	**1,725**	**1,730**	**6%**
Domestic	635	675	625	725	665	1%
International	595	795	845	965	845	9%
Total Information Systems	**1,230**	**1,470**	**1,470**	**1,690**	**1,510**	**5%**
Domestic	245	300	345	365	320	7%
International	55	75	85	85	60	2%
Total Computer Engineering	**295**	**375**	**425**	**450**	**385**	**7%**
Domestic	185	190	185	155	120	-10%
International	385	355	240	250	290	-7%
Total Other Information Technology	**570**	**545**	**425**	**410**	**410**	**-8%**
Total	2,630	2,950	3,145	3,460	3,265	6%
Total Domestic	1,500	1,590	1,785	1,910	1,750	4%
Total International	1,130	1,360	1,355	1,545	1,515	8%

Source: Ministry of Education, 2020.

ICT Occupations Data

IT Occupations Data is collected through the New Zealand Government's Household Economic Survey (HES). HES is an annual survey that collects a comprehensive range of statistics relating to household income and expenditure, and demographic information on households and individuals in New Zealand.

The survey provides indicators on how personal and household income, housing costs, and living standards have changed over time.

The survey runs every year, from 1 July to 30 June of the following year. It covers people aged 15 years and over (15+) who usually live in New Zealand permanent private dwellings.

The sample size for the survey was 28,500 private households. Households selected for the survey are sampled from rural and urban areas throughout New Zealand on a statistically representative basis. Information is obtained for every household member who is 15+.

The table below provides detailed employment estimates, calculated by the Ministry of Business, Innovation and Employment in December 2020 from the Household Labour Force Survey and the Linked Employer-Employee Data (LEED) translated into occupational employment using census based occupational shares.

TABLE 27: Number of people in New Zealand in ICT occupations by type, 2015 - 2019

ICT Occupations	2015	2016	2017	2018	2019
Computer Network Professionals	2,382	2,192	2,135	2,586	2,632
Database and Systems Administrators, and ICT Security Specialists	6,332	6,370	6,574	7,106	7,313
Electronic Engineering Draftspersons and Technicians	1,288	1,097	950	1,220	1,175
Electronics Engineers	905	835	816	910	908
Electronics Trades Workers	3,167	3,379	3,635	3,963	4,252
ICT Business and Systems Analysts	13,755	14,294	15,132	15,565	16,315
ICT Managers	7,667	7,857	8,215	8,397	8,705
ICT Sales Assistants	199	191	196	241	250
ICT Sales Professionals	929	691	501	589	469
ICT Support and Test Engineers	1,806	1,746	1,841	2,274	2,437
ICT Support Technicians	8,466	8,135	8,069	8,633	8,605
ICT Trainers	542	436	373	450	424
Multimedia Designer	355	394	438	462	507
Multimedia Specialists and Web Developers	3,058	3,336	3,646	3,874	4,170
Software and Applications Programmers	25,023	27,146	29,718	31,080	33,399
Telecommunications Engineering Professionals	1,574	1,491	1,524	1,713	1,729
Telecommunications Technical Specialists	76	52	48	84	83
Telecommunications Trades Workers	3,254	3,237	3,318	3,610	3,773
Web Designers	1,144	1,168	1,233	1,364	1,437
	81,922	**84,048**	**88,361**	**94,121**	**98,583**

Source: ICT Occupations Calculations, Ministry of Business, Innovation and Employment, December 2020.

ICT Visa Approvals Data

Immigrations New Zealand publishes an annual report on occupations of principal applicants for approved work visas. This report summarises the occupations of principal applicants approved residence under the Skilled Migrant Category (SMC) or the 1995 General Skills policy. Occupations are presented as per the NZSCO (New Zealand Standard Classification of Occupations) or ANZSCO (Australia & New Zealand Standard Classification of Occupations) groupings. The dates are Government financial years, so the 2019 data in the table below are all approved applications between 1 July 2018 and 30 June 2019.

TABLE 28: Number of approved ICT work visas, 2011 - 2020

ICT Visa Category	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
ICT Account Manager	22	35	24	39	29	41	55	61	61	37
ICT Business Analyst	183	193	182	279	335	324	373	415	375	331
ICT Business Development Manager	41	29	32	45	53	76	77	79	55	50
ICT Customer Support Officer	220	190	246	230	298	332	478	547	326	281
ICT Managers nec	96	74	55	73	79	79	61	72	51	57
ICT Project Manager	150	164	172	197	229	193	230	234	182	146
ICT Quality Assurance Engineer	11	16	21	25	18	20	33	38	36	27
ICT Sales Assistant	20	18	13	20	12	21	28	43	51	32
ICT Sales Representative	50	51	73	88	92	118	140	133	59	44
ICT Security Specialist	22	16	22	29	27	33	61	75	58	53
ICT Support Engineer	90	103	124	114	105	131	134	115	105	92
ICT Support Technicians nec	377	351	374	399	385	494	523	513	295	214
ICT Support and Test Engineers nec	47	68	50	53	50	31	48	46	41	43
ICT Systems Test Engineer	97	107	168	202	190	208	203	213	134	123
ICT Trainer	30	25	29	25	27	33	26	57	21	5
Software Engineer	599	567	509	563	684	717	791	817	694	465
Software Tester	52	89	113	78	119	129	115	135	138	73
Software and Applications Programmers nec	94	111	103	87	82	87	110	119	84	68
Computer Network and Systems Engineer	116	147	145	126	99	123	161	121	130	81
Web Administrator	45	42	41	41	51	57	64	85	38	29
Web Designer	40	23	27	24	22	40	42	52	49	33
Web Developer	86	93	113	144	174	190	218	203	149	120
Database Administrator	55	59	62	55	44	66	83	79	62	42
Mulitmedia Designer	69	67	73	49	66	71	65	58	37	20
Multimedia Specialist	240	334	386	412	424	396	477	586	452	277
	2852	**2972**	**3157**	**3397**	**3694**	**4010**	**4596**	**4896**	**3683**	**2743**

Source: Approved Work Visas, Immigration NZ, November 2020.

References

1 Jobs Will Be Very Different in 10 Years, Here's How to Prepare, World Economic Forum, January 2020.

2 Digital Skills for a Digital Nation, Digital Skills Forum,December, 2017.

3 Refreshed Industry Strategy In Response to Covid-19, Ministry of Business, Innovation and Employment, July 2020.

4 Jobs Will Be Very Different in 10 Years, Here's How to Prepare, World Economic Forum, January 2020.

5 Future of Work: The Global Talent Crunch, Korn Ferry, October 2020.

6 Digitization of the World Economy, Microsoft Analytics utilising LinkedIn data, August 2020.

7 Jobs Will Be Very Different in 10 Years, Here's How to Prepare, World Economic Forum, January 2020.

8 ACS Australia's Digital Pulse 2020, Australian Computer Society and Deloitte, August 2020.

9 ACS Australia's Digital Pulse 2019, Australian Computer Society and Deloitte, August 2019.

10 Ibid.

11 Australia's Global Tech Talent Visa Attracts 4109 Migrants in First Year, IT News, 16 September 2020.

12 Digital Skills Organisation Pilot, Department of Education and Employment, Australian Government, July 2020.

13 Future of Work: The Global Talent Crunch, Korn Ferry, October 2020.

14 Go Digital ASEAN, The Asia Foundation, June 2020.

15 Microsoft, LinkedIn and GitHub make significant headway on digital skills initiative, RemoteWorker Tech, October 2020.

16 SkillsFuture Singapore, The Future Economy Council, Singapore.

17 Human Resources Development Fund, Ministry of Human Resources, Malaysia.

18 Harvey Nash/KPMG CIO Survey 2020, KPMG, September 2020.

19 China's digital economy is a world leader, but it still faces challenges, World Economic Forum, January 2018.

20 Gartner Survey Finds Digital Business Top Priority of Chinese CIOs, Gartner, May 2019.

21 Talent shortage hampering digital transformation moves of firms, say experts, China Daily Mail, December 2019.

22 Europe's Digital Strategy - Shaping Europe's Digital Future, European Commission, February 2020.

23 Europe investing in digital: the Digital Europe Programme, European Commission, October 2019.

24 Shaping Europe's digital future: Digital Skills & Jobs, European Commission, October 2019.

25 EU Action Plan for digital skills for All broadly welcomed, University World News, October 2020.

26 Digital Education Action Plan (2021-2027), European Commission, September 2020.

27 The Digital Economy and Society Index, European Commission, 2020.

28 Ibid.

29 UK Tech for a Changing World, Tech Nation, March 2020.

30 Bridging the Digital Divide, The Open University, 2019.

31 Future of Work: The Global Talent Crunch, Korn Ferry, October 2020.

32 Transforming the US government's approach to hiring digital talent, McKinsey, September 2020.

33 Computer and Information Technology Occupations,Occupational Outlook Handbook, US Bureau of Labor Statistics, May 2019.

34 Earned bachelor's degrees, by sex and field: 2000–15, Science & Engineering Indicators 2018, National Science Board, 2018.

35 H-1B visas and prevailing wage levels, Economic Policy Institute, May 2020.

36 Computational thinking and thinking about computing, The Royal Society, July 2008.

37 What do we know about the expansion of K-12 computer science education?, Brookings Institution, August 2020.

38 OECD Skills Outlook 2019: Thriving in a Digital World, OECD, May 2019.

39 After the Reboot: Computing Education in UK Schools, The Royal Society, November 2017.

40 Anatomy of an Enduring Gender Gap: The Evolution of Women's Participation in Computer Science, Sax et al, The Journal of Higher Education, 2017.

41 Diversity Gaps in Computer Science, Google/Gallup, 2016.

42 Hour of Code: A Study of Gender Differences in Computing, Du & Wimmer, Information Systems Education Journal, August 2019.

43 Ibid.

44 The New Zealand Tech Sector - Key Metrics 2019, NZTech, July 2020.

45 Detailed Employment Estimates, calculated from the Household Labour Force Survey and the Linked Employer-Employee Data and historical censuses, Ministry of Business, Innovation and Employment, 2020.

46 Digital Skills for a DIgital Nation, New Zealand Digital Skills Forum, December 2017.

47 Work visas approved for ICT Occupations, Immigration New Zealand, November 2020.

48 Labour market statistics (income): June 2019 quarter, Statistics New Zealand, August 2019.

49 Tech Digital Remuneration Report, Absolute IT, July 2020. Note: Median salaries are split in the report by tech and digital, this figure is reached by averaging the two.

50 Ibid.

51 Ibid.

52 We asked respondents to state the number of female staff in their organisations and digital teams. We recognise that this number may be slightly higher or lower than reported in the survey, because we did not ask questions about gender diversity or identity to staff directly. A similar reporting error is possible with respect to data collected about both Māori and Pacific people.

53 Technology in the New Zealand Curriculum, Ministry of Education.

54 On Your Marks...Get Set...Go! A Tale of Six Schools and the Digital Technologies Curriculum Content, Education Review Office, January 2020.

55 It's Early Days for the New Digital Technologies Curriculum Content, Education Review Office, June 2019.

56 Update on Digital technology Curriculum uptake for Digital Technology Industry Transformation Plan, prepared by Ministry of Education for Ministry of Business, Innovation & Employment, October 2020.

57 Digital curriculum changes connect young people to the future, Beehive Media Release, June 2017.

58 Achievement Rates for Subset of NCEA Subjects 2008 - 2019, Ministry of Education, September 2020.

59 Helping Kiwi Teachers Learn Digital Skills through the Manaiakalani Education Trust, Google, 2017.

60 Education at a Glance, OECD, 2017.

61 Ibid.

62 Provider based Enrolments Predominant Field of Study 2019, Education Counts, Ministry of Education.

63 Review of New Zealand ICT Qualifications, NZQA National Qualification Services, November 2017.

64 Budget 2014: $28.6m investment in ICT Grad Schools, New Zealand Government Budget, June 2014.

65 The New Zealand Tech Sector Key Metrics - 2019 Update, NZTech, July 2020.

66 Provider based Graduates Predominant Field of Study 2019, Education Counts, Ministry of Education.

67 SoT2019 Report, Summer of Tech, January 2020.

68 2019 data supplied from the three ICT Graduate Schools to NZTech, July 2020.

69 2020 Digital Skills Survey 2020, NZTech, September 2020.

70 Massive online open courses see exponential growth during COVID-19 pandemic, The Conversation, July 2020.

71 Helping Kiwi Teachers Learn Digital Skills through the Manaiakalani Education Trust, Google, November 2019.

72 Computer Science Grants Awarded to New Zealand Educators, Google, April 2020.

73 Microsoft to help New Zealand job seekers acquire new digital skills needed for the COVID-19 economy, Microsoft, July 2020.

74 Reimagining P-TECH and online learning, IBM, May 2020.

75 Frontier firms: an international small advanced economy perspective, Productivity Commission, May 2020.

76 Covid-19 fuels internal hires in Asia Pacific, LinkedIn Talent Insights, August 2020.

77 The New Zealand Tech Sector Key Metrics - 2019 Update, NZTech, July 2020.

78 TIN Report 15th Edition, Technology Investment Network, October 2019.

79 The New Zealand Tech Sector Key Metrics - 2019 Update, NZTech, July 2020.

80 From Tech Sector to Digital Nation, NZTech, June 2016.

81 Frontier firms: an international small advanced economy perspective, Productivity Commission, May 2020.

82 IT Job Market Report, Absolute IT, May 2020.

83 JavaScript is the most in-demand IT skill, InfoWorld, January 2020.

84 OECD Digital Economy Outlook 2020, OECD, November 2020

85 Ibid.

86 Asia-Pacific outpaces global trends in internal mobility rates, LinkedIn, August 2020.

87 Global Talent Trends 2020, LinkedIn, March 2020.

88 Digital Skills for a DIgital Nation, New Zealand Digital Skills Forum, December 2017.

89 The Biggest Reason Tech Workers Switch Jobs (Hint: It Isn't Money or Their Boss), LinkedIn, November 2016.

90 We asked respondents to state the number of female staff in their organisations and digital teams. We recognise that this number may be slightly higher, or lower, than reported in the survey, because we did not ask questions about gender diversity or identity to staff directly. A similar reporting error is possible with respect to data collected about both Māori and Pacific people.

91 Labour force participation rate by sex, OECD, November 2020.

92 Provider Based Graduates Predominant Field of Study 2010-2019, Ministry of Education, 2020.

93 Based on the majority of open roles for digital skills on LinkedIn at the time of the research requiring degree qualifications and the majority of survey respondents indicating that their current and forecast skills shortages were for skills that require advanced qualifications such as data science and cybersecurity.

94 Summer of Tech, 2020.

95 Digital Sector Student Grants Report, Callaghan Innovation, October 2020.

96 Training New Zealand's Workforce, The Productivity Commission, December 2019.

97 Ibid.

98 Building the vital skills for the future of work in operations, McKinsey & Company, August 2020.

99 Certification of IT Professionals, IT Professionals New Zealand, November 2020.

NEW ZEALAND
DIGITAL SKILLS FORUM

NEW ZEALAND
DIGITAL SKILLS FORUM

e info@digitalskillsforum.nz
w digitalskillsforum.nz