DIGITAL SKILLS

For a Digital Nation

digitalnation.nz

An Analysis of the Digital Skills
landscape of New Zealand

NEW ZEALAND
DIGITAL SKILLS FORUM

About the
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 ICT, high-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.

IT Professionals
NEW ZEALAND

NZTech

NZRise

MINISTRY OF BUSINESS, INNOVATION & EMPLOYMENT
HĪKINA WHAKATUTUKI

MINISTRY OF EDUCATION
Te Tāhuhu o te Mātauranga

Tertiary Education Commission
Te Amorangi Mātauranga Matua

INTERNAL AFFAIRS
Te Tari Taiwhenua

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INTRODUCTION
New Zealand Digital Skills Forum

The Digital Skills Forums is a collaboration between New Zealand Government agencies and the private sector through industry groups NZRise, NZTech and IT Professionals NZ.

This report, commissioned by the Forum, provides actionable findings, to ensure we, as a nation, can realise our potential through developing a skilled capable workforce prepared for the future of work.

As citizens, we are starting to experience the impact of digitisation, robotics and automation in our everyday lives. Some businesses are realising productivity gains through replacing repetitive manual activities and automating human centric calculations, other business models are facing rapid disruption and obsolescence - from taxis to retailers and clinical diagnosis.

These enhancements are increasing demand for a workforce skilled in emerging capabilities like artificial intelligence and augmented reality. They are also driving an urgent need for every citizen to be armed with a basic level of digital literacy, so they can continue to engage in everyday life; to pay their bills, apply for a passport or order goods.

As an industry, the Digital Technology sector creates two massive opportunities for New Zealand, improved social prosperity with a median salary of $82,000 (compared with the median $49,868) and increased export revenue from an industry currently generating 8% of GDP. Our ability to capitalise on these opportunities is currently challenged by diversity. We are constrained by under representation of women, Māori and Pasifika and face global competition for the same capabilities. There is also an underinvestment in training, including limited pathways for graduates into our workforce.

This analysis of New Zealand's digital skills landscape is the first piece of substantive

Victoria MacLennan
Chairperson
New Zealand Digital Skills Forum

research undertaken collaboratively across the public and private sectors. To realise the potential highlighted in the report, we need to ensure every child in New Zealand;

- is exposed to and understands the possibilities of a career in digital technologies,
- is provided with an enhanced digital technologies education,
- and has access to a variety of pathways and support into future roles.

Last year, 14,000 new jobs were created in our sector, yet only 5,090 students graduated from computer science or information technology studies the year prior. We made up much of the shortfall through granting 5,500 technology visas, yet immigration cannot meet this alone. New Zealand also needs programmes designed to support re-entry to work and upskilling for those whose jobs are most likely to be replaced by automation.

Without investment and a coordinated national effort, public and private sector partnerships, we run the risk of falling behind other nations investing in a Digital Future. We cannot wait, we need to act on the findings of this report, today.

FOREWORD
New Zealand Government
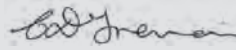
The Ministry of Business, Innovation and Employment is pleased to support the production of the digital skills survey. Our purpose is to grow New Zealand for all.

Digital skills are critical for enabling growth for New Zealand, not just in the ICT, high-tech and digital sectors, but for all sectors of the economy.

When you consider that the tech sector is New Zealand's fastest growing industry and a significant contributor to the economy, it is important that we have good information about what the sector needs so it can continue to support our transition to a digital nation. A key challenge is to understand digital skills gaps to improve the flow of talent into the tech sector and other sectors of the economy – this challenge is not unique to New Zealand.

The report takes a look at long term digital skills needs and highlights the gap between limited supply and increased demand for digital skills. It also looks at current pathways to fill the new roles we expect to see in coming years. It's important to have information on these sorts of issues, so decision-makers are in a better position to find solutions; New Zealanders are better informed of what skills are needed and educators know what sorts of future skills to teach to – this report is a critical component for building that knowledge base.

The report is a product of the Ministry's partnership with the Digital Skills Forum – a coalition of industry associations and government organisations that work together to identify key skills and opportunities across the tech sector. The Ministry is delighted to be involved with the Forum and to support industry to understand and deal with these important issues.

Carolyn Tremain
Chief Executive
Ministry of Business, Innovation and Employment

As a nation we have made extensive investment in digital infrastructure and this makes New Zealand one of the best places in the world to do business and to develop new technologies. The opportunity is there for us to be a leading digital nation and this report will help us achieve this goal.

We look forward to working with the digital technology sector to shape the digital economy and to ensure a successful and prosperous digital nation for all New Zealanders.

FOREWORD
The Tech Sector

As a united sector, we're proud to have contributed to the development of this Digital Skills Report.

This report and its contents are compelling reading and should sound a warning bell to industry, Government, and the education sector. The evidence shows that the skills shortage felt by New Zealand's tech sector and broader economy is very real and if our industry, government and education sector don't work closely together to accelerate plans and activities to address it, the future prosperity of New Zealand will suffer greatly.

However, this report also represents a great opportunity. The digital skills challenges our sector faces are not new and are certainly not limited to New Zealand. If we as a nation work together to develop, properly resource and execute a clear multi-pronged plan to fully and finally address blockages in the supply of talent, we have the opportunity to establish ourselves as a technology powerhouse on the world stage.

The evidence in this report shows that the supply of those with advanced digital skills doesn't meet demand, and this gap is growing. Through the Digital Skills Forum and other activities, we're working together to deal with it. But more must be done.

There has never been a better time than now for action. Our school education sector has this year been reformed to give every kiwi child a digital education. Through targeted reviews and industry recognition, our tertiary sector is better positioned than ever before to deliver the quality graduates needed. There are also more alternative pathways into digital roles than ever before. The Government's Immigration agency is working closely with industry to help fill the skills gap, and our Industry and Professional Bodies are working together, in genuine partnership with the New Zealand Government.

Graeme Muller
Chief Executive
NZTech

Paul Matthews
Chief Executive
IT Professionals NZ

Yet this momentum needs to continue, and it needs to build. As a country, we must help more young New Zealanders discover a future in technology. Together, we need to remove barriers for our graduates finding their first job, make it easier for those seeking a career change, and improve the gender and cultural diversity in digital roles. None of us can do this on our own.

As a result of this report, we now have tangible and concrete data on the size, scale and nature of the digital skills shortage in our sector and New Zealand industry as a whole. This report identifies a grave challenge and a massive opportunity, but it will take all of us to realise it.

Now we know the scale of the problem, let's all work together to solve it.

Digital Skills
– what are they and why are they important?

Digital skills are the skills needed to find, evaluate, utilize, 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.

As many services move online, basic digital literacy skills are now required by the entire population. These skills are needed to carry out essential functions such as digital communication or basic internet searches in a secure way. Because of this, the House of Lords in the United Kingdom recently stated that digital skills should be treated with the same importance as numeracy and literacy[1].

For the purposes of this study, we have focused on advanced digital skills. Traditionally, these were the skills required by ICT professionals, however as digital technologies become more pervasive throughout businesses, it is no longer just IT professionals that need these advanced digital skills.

Advance digital skills – the ability to control and create

Advanced digital skills are those needed 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 cyber security.

Vital skills for the future

Digital technology is expanding rapidly into all aspects of our lives. Digital skills that allow an individual to create using these technologies are already highly valued. In the future, for many roles these skills will be vital.

The speed at which industries and companies are adopting digital technologies means demand for people with advanced digital skills is growing too. From an economic perspective, a shortage of skills has the potential to slow economic growth as businesses delay investment in new efficiency boosting technologies. Whereas, maintaining a supply of high quality digital skills within an economy could effectively act as a catalyst to continued growth and improved social prosperity.

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Executive Summary

For decades, digital or ICT skills shortages have been a concern and recently this concern has further increased in response to the tech sector's rapid growth and the economy's digitalisation. The demand for digital workers is not limited to New Zealand.

Australia is predicting an additional 81,000 ICT jobs by 2022, the United Kingdom forecasts an additional 745,000 digital workers by 2018, Europe expects to be short of 500,000 IT specialists by 2020 and the United States of America estimates there will be over 20 million new technology jobs within two decades.

While this forecasting suggests a skills shortage, there is also contradictory anecdotal evidence. For example, the difficulty in placing graduates, which in turn has led to some questioning whether there is in fact a skills issue.

Until now, the key challenge in resolving the issue has been insufficient data. To address the issue, the Digital Skills Forum set out to aggregate empirical evidence for the supply and demand of digital skills in New Zealand. Through analysis of education and immigration pathways, we can also better understand supply trends. In order to understand demand trends, the Skills Forum conducted a survey of the tech sector's needs. This was complemented with data from a similar survey of Government digital skills and the analysis of LinkedIn profiles and recruitment trends.

Not enough local digitally skilled people being developed

A major pathway into advanced digital roles is via tertiary education. Almost every public

and private tertiary institute in New Zealand provides courses in either computer sciences or information technology. While, there is ongoing market discussion about the demand for ICT skills, the number of students studying these courses is small and growing slowly. The number of students engaged in full computer science or information technology courses is growing at 3% per annum and has just reached 14,000. During the same period, the number of IT services roles has increased at a rate of 4%, with software programmer roles growing at an annual rate of 11%. The number of graduates reached 5,090 in 2015, whereas the tech sector alone added about 14,000 new jobs in 2016.

Not only is there not enough local supply, diversity is also lacking. Women, Māori and Pasifika are, in particular, underrepresented in computer sciences or information technology courses. Urgent action needs to be taken, to both increase the number of students studying these subjects and attracting underrepresented cohorts. Meanwhile, the economy is over reliant on immigration for advanced digital skills. During the past 12 months, Immigration New Zealand has issued 5,500 technology visas and 4,248 international computer science and information technology students were studying in New Zealand in 2016. The current geo-political environment is in New Zealand's favour as there are currently 107,882 digitally skilled people on Immigration

New Zealand's database interested in living and working in New Zealand. Following the recent LookSee campaign, there are an additional 19,000 experienced developers on the Workhere database who are looking for work in New Zealand.

Various organisations provide alternative pathways, such as boot camps and online courses, however these are currently small in scale. It is anticipated, that with the introduction of the new digital technologies curriculum, from year one to year 13, that the pipeline for digital talent will grow over time. Meanwhile, it is critical that as a nation we raise the awareness and interest in the broad range of digital career opportunities.

Demand for digital skills continues to grow

To understand the current and future demand for digital skills the Digital Skills Forum undertook a survey of technology firms. This was complemented with data from the Government IT and Digital Skills survey and the analysis of LinkedIn data of 90,000 New Zealand IT workers and surrounding recruitment trends.

The 142 organisations that responded to the Digital Skills Survey employed 17,324 people in total, of which 27% are female. Across these firms, 68% of their employees work in advance digital skill roles, with the main skill group being software developers. When asked to forecast their future requirements, this sample anticipates an additional 3,248 digitally skilled employees within the next two years. The demand for software developers was very high, alongside data analysts, architects and digital leadership.

The Government survey received feedback from 37 agencies who employ over 80,000 people, of which 23,946 are involved in IT or digital roles. Like the tech sector, 30% of the digital staff were female. The Government

> *The 142 organisations that responded to the Digital Skills Survey employed 17,324 people in total, of which 27% are female. Across these firms, 68% of their employees work in advance digital skill roles, with the main skill group being software developers.*

respondents also forecast increasing demand for certain digital skills. In the Government, the demand is for digital leadership, data analysts, cybersecurity specialists and architects.

The LinkedIn analysis found over 90,000 IT professionals in New Zealand, of which 30% are female. The top 20 employers for these skills are from all sectors of the economy including technology firms, Government agencies, banks and other large corporates. Analysis of the overall demand for different skills versus the growth in demand, found that software developers, web programming and software engineering are the largest demand groups and continue to have strong demand growth. However, some skills such as network administration and storage networks are decreasing in demand. The highest demand growth is for machine learning skills.

Across all three surveys, there is evidence of strong demand for digital skills and significant growth in demand for some of these skills. This is important, as not all skills are growing in demand. There appears to be large numbers of workers currently employed in 'keep the lights

on' IT work, such as infrastructure support and network management. While these jobs are important, their demand is reducing. Logically, organisations should be able to reskill some of their staff over time, in skills they anticipate to increase in demand. LinkedIn data also found that IT professionals change jobs more frequently than the New Zealand average. Eighteen percent of IT professionals have changed employers in the past twelve months, versus the national average of 13%.

Critical investment is needed from industry and Government

The surveys also found, that both private and public sector organisations under invest in the development of their staff. The survey results show that both the tech sector and Government agencies main reasons for not investing in staff development is the perceived lack of available time and difficulty of prioritising training above business as usual activities. This was consistent across organisations regardless of size.

As well as invest in reskilling and upskilling current staff, more investment focus needs to be placed on developing a strong domestic pipeline of talent. This could be achieved primarily through our education system and other education initiatives.

The tech sector and the Government need to co-invest in education, to better align courses with the future demands of the sector. Using insights from this study, tertiary education providers can be better placed to make informed decisions about current and future skill demands. An effective method of reviewing this information annually is required to ensure both education and immigration are informed, and that industry and Government can collaborate efficiently to meet New Zealand's future digital skill needs.

Many of the recommendations from the Future of Work Commission are relevant for addressing the digital skills shortage. The future of work is a digital workforce, so the digital skills shortage is in effect, a national skills issue too. As policy developed for the Future of Work is turned into actions, this will no doubt help address skills shortages in the long term.

Key Highlights

NEW ZEALAND'S DIGITAL SKILLS SHORTAGE

Demand for digital skills is already high

120,350
people employed in the tech sector in 2016.

90,000+
LinkedIn members in New Zealand with IT skills.

23,946
IT and digital workers in just 39 Government agencies.

14,000
new jobs created by the tech sector in 2016.

72,000
IT Services related jobs in all sectors has grown to exceed this.

$82,000
More jobs posted for ICT roles than any other role, median salary now.

Supply of digitally skilled workers is low

Only **14,220**
computer science and information technology students studying in 2016.

Only **5,090**
computer science and information technology graduates in 2015.

Only **5,500**
technology visas granted over the past 12 months.

3% annual increase in student numbers.

11% annual increase in software programmer jobs.

Only **36%**
of computer science and information technology students were FEMALE in 2016.

Only **8%**
of computer science and information technology students were MĀORI in 2016.

Demand is forecast to grow

120 tech firms expect to create more than

3,200
new digitally skilled roles over next 2 years.

More than

1,200
extra software developers will be needed over next 2 years by those 120 tech firms alone.

Highest demand is forecast for

MACHINE LEARNING
SOFTWARE DEVELOPMENT
DATA ANALYSTS
SOFTWARE ARCHITECTS

= SKILLS GAP

Part One:

Is There a Skills Shortage?

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Part One: Is There a Skills Shortage?

Over recent decades, there has been a constant stream of media stories regarding the ICT skills shortage in New Zealand. During the 1990's, demand for IT staff exceeded supply as firms prepared for Y2K.

A decade ago the Government provided several significant grants to organisations to help address the critical ICT skill shortage. By 2011, ICT roles were well embedded on the Government's Long Term Skills Shortage List and CEO's from some of the country's fastest growing tech exporters were often reporting their inability to find the requisite skills onshore.

The skills shortage issue continues to be a topic of concern and with several macro trends, such as a growing tech sector and the digitisation of the economy, the government and the industry are working together to identify and address shortages. However, there are also indicators that are contradictory, such as the difficulty to place graduates, which makes some people question whether there actually is a skills shortage.

As we will see in this report, underlying evidence does show that there is a digital skills shortage in New Zealand, primarily due to the speed and scale of the increase in demand for these skills.

Growth Creating Demand Across New Zealand

A rapidly growing tech sector

The tech sector is a rapidly growing segment of the New Zealand economy and accounts for approximately 8% of the country's GDP and 9% of the exports[2]. The top 200 tech exporters sold NZ$7.3 billion internationally in 2016, an increase of 8.5%. In the past year, the revenues of these fast growing, top 200 tech exporters, exceeded NZ$10 billion, a growth of 7.9% from the previous year[3].

14,000 NEW
tech sector jobs created in 2016.

Consisting of ICT and high tech manufacturing firms, the tech sector's 21,411 organisations employed 120,350 people in 2016[4]. This is less than the 28,749 firms counted in 2015. However, according to the 2017 Information and Communications Technology Report, an analysis of ICT firms by the Ministry of Business, Innovation and Employment (MBIE), 76% of firms in the sector have no employees and are likely to be contractors[5]. Therefore, it is assumed the reduction in the numbers of firms, are contractors now in permanent employment within the sector, accounting for about 7,300 of the growth in employment numbers in 2016.

Based on this calculation, we estimate that approximately 14,000 new tech sector jobs were created in 2016. While some of these new jobs will have been managerial or sales roles, many would have required advanced digital skills such as programmers and engineers.

Increasing digitalisation across all sectors

It is not just the tech sector that requires staff with digital skills. With increasing digitisation occurring in all sectors, even traditional businesses need

staff with advanced digital skills. While all sectors are showing an increase in the number of IT roles, most of the growth outside the tech sector is from professional services, media, finance, construction and public administration sectors.

Jobs in IT services related occupations in all sectors grew to 72,208 of which the majority (35%) are software and applications programmers[6].

Strong demand resulting in high pay

Digital and ICT roles are 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 $49,868 in 2017[7], the national median base salary for ICT employees[8] was $82,000. In addition to higher pay rates, tech employees also receive excellent benefits with 41% having flexible working hours, 27% a phone allowance, 25% paid training, 23% healthcare and 22 % are eligible for bonuses[9].

In 2016, the New Zealand Institute of Economic Research (NZIER) examined data on qualifications and earnings of employees throughout the economy. They also found that employees in the tech sector have higher qualifications, on average, than other industries and that the ICT sector in particular has a very high proportion of tertiary qualified employees. This research found that ICT employees are paid well above the national average regardless of their qualification levels[10].

$82,000
median base salary for ICT workers in 2017.

Seek, a recruitment website, reported in July 2017 that more job advertisements were posted for ICT roles than any other role with the average advertised salary being offered at $93,439[11]. However, they did note that the volume of advertisements for ICT roles had not increased over the previous 12 months.

Mixed messages coming from the market

While there is plenty of evidence for growing demand of digital skills, surprisingly there are also incidents that send a contradictory message.

The AbsoluteIT Salary Survey in March 2017, found that while 79% of tech employers are planning to hire in 2017, almost three quarters of employers say that it isn't getting any harder to find tech talent, with 23% saying it was actually easier[12].

The Wellington Regional Economic Development Agency (WREDA) and Workhere, a specialist recruitment firm, ran an international campaign in June 2017, called LookSee, to bring 100 of the brightest tech talent to Wellington for job interviews and an opportunity to live in New Zealand. Initially, 45 Wellington tech firms expressed an interest in taking part. Participating employers were required to review candidates and select those they would like to interview in person. The 100 candidates with the most interview requests would receive a trip to Wellington and an opportunity to live and work in New Zealand. The campaign generated international interest with 1.6 million people visiting the site and 48,000 applying for the 100 places. However, even though there was no cost to the employers, only 93 of the 100 available places were filled. Five months later, of the 93 candidates who visited Wellington, just over 30 have been offered jobs, with an additional 34 in discussion.

In October 2016, NZTech conducted a survey of 54 Auckland tech firms[13] to gauge the sector's interest in working with secondary school students and specifically whether there was support for a pilot programme. The discussed programme would provide pathways for secondary students studying ICT subjects into tech jobs through some form of internship. The response was positive with 66% of respondents saying they would support an initiative to pilot an intern programme for students. However, when the pilot was launched, only one firm offered to take one student, whereas two schools offered 66 students. The pilot programme was subsequently cancelled.

Summer of Tech, the not-for-profit intern placement programme, consistently struggles to find intern opportunities for ICT students who are preparing to enter the tech workforce.

In 2017, they put over 2000 tertiary computer science or information technology students through multiple boot camps to prepare them for work and have only been able to place 200 into summer internship positions.

A study of the skills shortages in New Zealand by the Government[14] identified two important distinctions. Firstly, the need to distinguish between employers experiencing recruitment difficulties related to skills or other reasons, such as not offering good pay. Given the tech sector is generally offering high pay and excellent benefits, this supports the claim that there could be real shortages. Secondly, it is important to distinguish between an employer's general recruitment activity and having specific skill shortage vacancies. Just because the sector has plenty of roles available, doesn't necessarily mean there is a shortage.

A Global Challenge

Claims of a digital skills shortage are not unique to New Zealand. This provides additional evidence that there may be a skills shortage in New Zealand. Almost every developed nation has identified that the growing demand for people with digital skills is outpacing the ability for the traditional education systems to develop them.

United Kingdom

Similar to the New Zealand experience, media in the United Kingdom (UK) have been reporting on the digital and IT skills shortages for several years. In this year's CIO survey[15] of

3 out of 4

UK businesses are reporting digital skills shortages.

the largest firms in the UK, the CIO's reported skills shortages as the number one challenge with 42% saying they are looking to Europe to recruit skilled IT and technology workers.

Digital skills shortages are even more of a concern for smaller businesses. According to a recent British Chamber of Commerce[16] study, three out of four UK businesses are reporting a digital skills shortage among their employees, despite 84% of firms admitting that digital and IT skills are more important to their enterprise now than two years ago. The research found that 21% thought the shortage was 'significant' and a further 3% said it was 'critical'.

In another study,[17] it was revealed that despite being declared the top priority for nine out of 10

UK companies, only 13% indicated they were ready to meaningfully respond, in terms of education and training, to the digital revolution.

In 2016, the UK Government estimated that the digital skills gap was costing their economy an estimated £63 billion a year in lost GDP. An additional 745,000 workers with digital skills would be required by the end of 2017[18]. Three years ago, in September 2014, the UK Government introduced computing to the national curriculum for students aged 5 to 16 as a long term initiative to address digital skills shortages. However, a year later most teachers (74%) stated they didn't feel equipped to teach ICT and the uptake has been inconsistent. New research from the Royal Society[19] reported that 54% of England's secondary schools still do not offer GCSE computer science. The report also highlighted a continuing lack of gender balance, with females only accounting for 20% of GSCE computing students, dropping to 9% by A Levels. The Royal Society recommend that the UK Government increase investment in teacher training by tenfold and work with industry to co-fund interventions to prioritise gender balance. The continuing challenge to increase the number of students studying computer sciences was described as a 'ticking time bomb'.

Europe

Even though the European Union (EU) has made tackling a shortage of ICT workers a political priority in the past, the latest 2017 forecast indicates that they expect to be short of 500,000 IT specialists by 2020 and will need a further 50,000 new high tech leaders each year until 2025[20].

The European Commission launched the Grand Coalition for Digital Jobs in 2013 to address

Europe expect to be short of

500,000

IT specialists by 2020.

a lack of digital skills in Europe. Its task was to raise political awareness and support of the issue. To add further focus, the European Commission established the Digital Skills and Jobs Coalition in 2016 and called upon all member states to develop comprehensive national digital strategies by mid-2017.

America

By some estimates, there are currently over 500,000 computer software developer job openings in the United States (US) today[21], and there will be over 20 million jobs in software and technology related jobs in the next 20 years. This is not just a short-term need as the demand for software developers is expected to grow about 17 percent per year through to 2024[22]. The need for web developers alone is projected to grow by 27 percent over that same period. The need for talent in this space is going to last for some time. According to Computer Science Zone, there will be 1 million more computing jobs than employees to fill them in the US in the next 10 years[23].

Not only are there many available tech jobs in the US, they are very high paying jobs. One of the highest paying college majors today with a four-year degree is software engineer – with graduates making about US$70,000 on average right out of college. In fact, five of the top 20 highest paying majors out of college with a four-year degree are computer software related[24]. In 2016, according

to Glassdoor, a job search site, eleven of the highest paying jobs in the US were tech jobs[25]. The Bureau of Labor Statistics puts the median salary for software developers at over $100,000[26].

The Obama White House predicted that by 2020, there would be 1.4 million computer-science-related jobs available, and only about 400,000 computer science graduates who have the skills necessary to apply for those jobs[27].

In a recent article for the Brookings Institute former US education secretary Arne Duncan summarised the issue, "we wouldn't expect new graduates to fill all job vacancies in a healthy labour market – as many open positions will require more experience – but filling less than 10 percent is indicative of demand for talent far outstripping supply." Duncan has called for the US government to help fill the gap by making technology education a priority. A growing number of US non-for-profits have seen the shortage of qualified tech workers as an opportunity to encourage companies to hire employees with less traditional (and more equal opportunity) credentials.

The US is predicting

20 million

new software and tech related jobs in next 20 years.

Canada

Canada, like every other developed nation is also facing tech skills shortages and considering its education system, wondering why not enough qualified ICT workers are being produced. Canada's digital economy currently employs

877,470 professionals spread throughout all sectors the economy. The growth in digital jobs has outpaced the overall economy in the last two years by over 4 to 1, leading to a strong demand for skilled digital workers. Unfortunately, the domestic supply of ICT graduates and workers will be insufficient to meet this demand. Between now and 2020 the Canadian economy is expected to create 218,000 new tech jobs[28]. However with only 6% of the country's graduates specialising in ICT there is growing concern regarding the potential economic impact of this widening skills gap.

In March this year, Canada's Government launched its Innovation and Skills Plan[29] aimed at making Canada a world leading centre for innovation. This comprehensive plan has been allocated CAN$8.2 billion through to 2022, including $50 million focused for teaching children to code and $454 million to help adults upgrade their skills.

Australia

The digital economy has added 40,000 jobs to the Australian economy in the last two years and will be worth $139 billion a year by 2020, but its growth is being impeded by a worsening skills shortage according to a recent study[30].

The Australian ICT sector is increasing its importance to the country's GDP, shifting from 5.1 per cent in 2014, to a forecast 7 per cent by 2020. Commentators in Australia are saying that technology companies have the potential to become the engine of the local economy, with demand for skills driving growth in the sector by 2 percent per annum for the past two years, almost double the rate of the overall workforce. An analysis of Australian LinkedIn data found that the roles with the greatest demand, during the past year, were ICT project managers, business analysts and business development managers.

The Australian ICT sector will have created an additional 81,000 jobs by 2022, so the question being asked by policy makers is where will all the people come from when there are only 3000 to 4000 ICT graduates a year? Policy focus is now moving beyond simply encouraging more students to study IT skills at university, towards encouraging more women into the sector and older workers to keep up their skills and stay in the sector.

Summary

Even without implementing a skills survey, general industry consensus is that there is a skills shortage, or at least a skills imbalance. The major consumer of digital skills, the tech sector, is growing rapidly and generating thousands of new roles a year. Additionally, every other sector of the economy is becoming more digital, driving demand for the digitally skilled. Salaries are high, job advertisements are plentiful and other mature economies have indicated a digital skills shortage.

While multiple initiatives to help address the shortage have failed to gain the necessary traction to make an impact, it is crucial that we continue to address this challenge. To determine whether there is a shortage or merely an imbalance, we have studied both the supply and demand side of the equation. The Digital Skills survey and this analysis should help us better understand exactly what skills are needed, so that we can implement a more focused approach.

Part Two:

Limited Local Supply Drives Reliance on Immigration.

25

Part Two: Limited Local Supply Drives Reliance on Immigration.

Like other nations, we must question how we are going to fill the expected new tech and digital roles in New Zealand over the coming years. Where will all the new employees come from?

While there are a variety of sources, including tertiary education, immigration and other pathways, will this provide sufficient supply to meet our demand?

Tertiary Education Pathways

Are enough students graduating?

Almost every public and private tertiary institute in New Zealand provides courses in either computer sciences or information technology. There are numerous ways for students to study subjects relevant for a digital career from entry level certificates, bridging courses, diplomas, bachelor degrees and post graduate studies.

In 2016, there were 39,420 students taking at least one paper in information technology or computer science[31]. This number has been sitting consistently around 40,000 students taking at least one paper, with a slight 1% decline over the last decade. Yet the number of full time equivalent students enrolled in information technology or computer science as their primary field of study has been slowly increasing at a compound annual growth rate of 3% and is sitting just over 14,000 in 2016[32].

14,220

Computer Science and Information Technology students in 2016.

Over the same period, the number of IT services roles has increased at a compound annual growth rate of 4%, with software programmer roles growing at an annual rate of 11%[33]. This means that the growth of the domestic pipeline of students is slightly off pace, but not by much. The critical question is – are we producing the right students? With the demand for software developers so high, if most domestic students are not gaining these skills then this will create a noticeable skills shortage.

While the overall number of students studying information technology and computer science has been slowly growing, the numbers graduating with diplomas, degrees and post graduate qualifications in computer science or information technology has been growing steadily at 7% year on year over the same period. In 2015, just over 5,000 students graduated with an information technology or computer science tertiary level qualification[34].

5,090

Computer Science and Information Technology graduates in 2015.

Figure 1 Computer Science and Information Technology Students (EFTS), 2008-2016
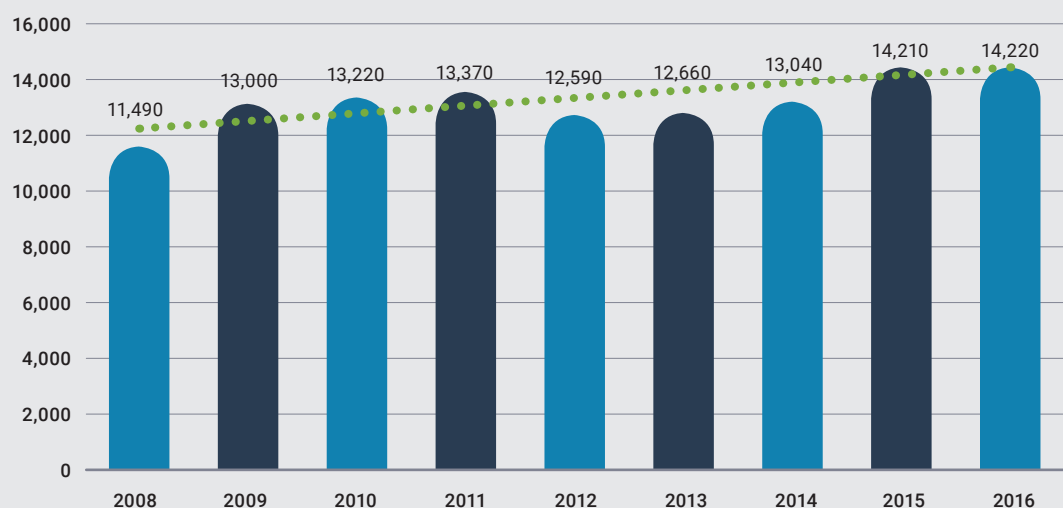
SOURCE: Education Counts, Tertiary Education Participation, 2017.

Figure 2 Computer Science and Information Technology Students (Graduates), 2008-2015

SOURCE: Education Counts, Tertiary Education Participation, 2016.

If the tech sector added approximately 14,000 new jobs in 2016, yet only around 5,000 students graduated, then this alone would indicate the potential for a significant skills gap.

In 2015, the Government invested $28.6 million over four years to develop three ICT Graduate Schools in Auckland, Wellington and Christchurch[35]. The objective of the ICT Graduate School programme is to deliver industry focused education and research that builds 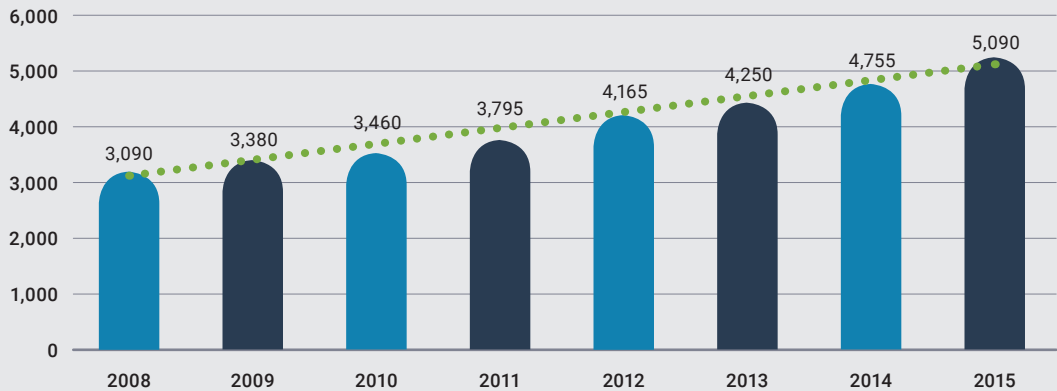connections between tertiary education providers and high tech firms. This initiative will produce an additional 100-200 highly valuable graduates. Unless there is scope to scale this initiative, it will only ever provide a small number of graduates.

Computing and IT qualifications becoming more industry-relevant

In recent years, considerable effort has been made to improve the quality of computer science and information technology qualifications following concerns that some qualifications did not produce graduates suitable for work in the industry.

As part of a Targeted Review of Qualifications process the IT industry (through the professional body IT Professionals NZ and supported by NZTech and other tech bodies), in partnership with the NZ Qualifications Authority, reviewed all 224 sub-degree computing and IT qualifications in New Zealand and replaced them all with 14 new qualifications. These new qualifications, released in 2015 and now taught across New Zealand, were developed to more closely match the industry's changing digital skill needs and ensure graduates had suitable skills and knowledge to enter the industry or general workforce.

The IT industry also recently introduced an independent industry accreditation of Bachelor-level Computer Science and Information Technology related degree programmes offered by Universities, Institutes of Technology and Polytechnics, recognising and endorsing quality programmes producing graduates with the skills and attributes needed to succeed in the tech industry. Degree programmes recognised under

this accreditation focus not just on theory and technical skills, but also the practical application of skills, teamwork, complex problem solving, professional practice, communication skills and more, all essential skills for the tech sector. This accreditation programme is related to the international *Seoul Accord* partnership, meaning graduates of these programmes are also more highly recognised in countries around the world.

Other models of education such as Enspiral DevAcademy's full immersion bootcamps now also provide more diverse alternative educational pathways for those looking to enter the industry. Additionally, there has been greater industry involvement in tertiary qualifications via industry advisory groups and other similar industry engagement mechanisms.

More effort needed to increase the numbers and diversity

Now that courses are better aligned, the focus is shifting to increasing the overall numbers and diversity of those studying. Lack of diversity remains a significant issue and a lost opportunity.

Only 36%

(of Computer Science and Information Technology students) were FEMALE in 2016.

In 2016, only 36% of the students at tertiary level were female. Additionally, there is an under representation of Māori and Pasifika students in degree and post graduate degree level courses.

At first glance, the ethnic diversity profile for students studying computer sciences or information technology courses looks close to ideal, with ratios not too dissimilar to the national population demographics. However, as shown in figure 3, analysis finds that Māori and Pasifika are underrepresented in degree and post graduate degree level courses. They are also over represented in certificate level courses, most of which are not designed as pathways into high paying tech roles.

Figure 3 Information Technology and Computer Science Students (Ethnicity), 2016

InfoTech/CompSci Certificate & Diploma Students

Other 5%
Asian 13%
European 48%
Pasifika 13%
Māori 21%
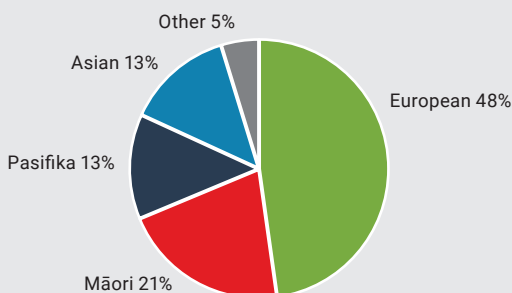
InfoTech/CompSci Degree & Above Students

Other 5%
Asian 26%
European 55%
Pasifika 6%
Māori 8%
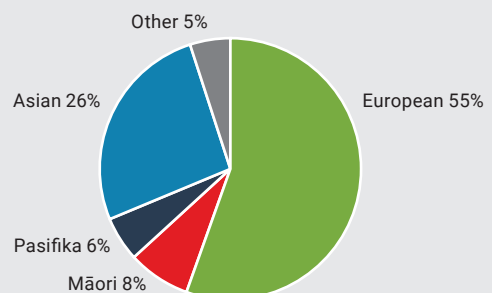
SOURCE: Education Counts, Tertiary Education Participation, 2017.

Immigration

Immigration is also critical for the development of the New Zealand digital skills profile. Not only does it help to fill the gap between the digital jobs created and the locally educated digital workers, it also provides valuable access to unique skills, experiences and diversity.

Following the identification of increasing demand, Immigration New Zealand have been working proactively with the tech sector and IT Professionals NZ, the representative group for digital workers, to help reduce barriers to identifying and accessing essential digital skills offshore.

Over the past 12 months, Immigration New Zealand has issued 5,500 technology visas including 1,655 software and application programmers, 664 multimedia specialists and 598 business and system analysts[36].

Immigration New Zealand also manages a database of people looking to come to New Zealand. There are currently 107,882 people in the New Zealand Now database that are in the technology sector. Other initiatives supported by Immigration include:

- **Skills Finder:** a free Immigration New Zealand service that enables New Zealand technology companies to engage with potential migrant talent through a job alert email. The email is sent to prospective migrants in the New Zealand Now database that are interested in living and working in New Zealand. The companies are able to search for talent by occupation, level of academic qualification, country of residence and years of experience.

- **Accredited employer:** A campaign to increase the number of Accredited Employers across the tech sector. Becoming an Accredited

5,500

technology visas issued over past 12 months.

Employer allows firms to employ skilled migrant workers without first having to check if any New Zealanders can do the work. The firm must take direct responsibility for the workers they employ and must pay a minimum base salary of $55,000.

- **Offshore campaigns:** Immigration New Zealand supported New Zealand technology employers at the AWS and Developer Week events in the US. These events were attended by New Zealand technology employers who were looking to hire talent. Immigration New Zealand provided pre-event promotion through social media adverts, email campaigns, and PR. INZ also attending the events to provide visa information and support employers with the living and working in New Zealand story.

- **Offshore marketing:** Always-on marketing activity to continue building the database of tech talent, including search marketing, social media and public relations in key markets.

- **Long Term Skills Shortage List:** for a number of years a vast range of IT and digital skills have been included on the long term skills shortage list.

Table 1 Long term skills shortage list – IT professions

Long Term Skills Shortage List	
Project Manager	ICT Security Specialist
Organisation and Methods Analyst	Systems Administrator
ICT Business Analyst	Computer Network and Systems Engineer
System Analyst	Network Administrator
Multimedia Specialist	ICT Quality Assurance Engineer
Web Developer	ICT Support Engineer
Analyst Programmer	ICT Systems Test Engineer
Developer Programmer	ICT Support and Test Engineer
Software Engineer	Telecommunications Engineer
Software Tester	Telecommunications Network Engineer
Software and Applications Programmer	

SOURCE: Immigration New Zealand, August 2017.

Alongside the direct to employment pathway, the education pathway also provides an access opportunity. In 2016, there were 4,248 international computer science and information technology full time students studying in New Zealand. This accounts for just under 30% of all tertiary computer science and information technology student.

The Wellington tech sector collaborated on an international marketing campaign for experienced software developers in 2017. The campaign called LookSee was developed by WorkHere, a specialist international attraction firm, and supported by the Wellington Regional Economic Development Agency (WREDA) and Immigration New Zealand. The opportunity for 100 people to be selected for a free flight to New Zealand to attend job interviews was marketed around the world and attracted 1.6 million visitors to the site and over 48,000 applications for the 100 roles. Following the campaign, WorkHere have an active database of around 20,000 experienced IT professionals that are able to make their own travel arrangements to New Zealand for job interviews. This database is being used throughout New Zealand by multiple recruitment firms to efficiently fill open tech roles.

While there is strong demand for experienced digital workers that cannot be met by the education system, the current geo-political environment is making New Zealand an attractive destination for talent. As global demand keeps building for digital talent, New Zealand will still need to compete internationally and import people. However, in the long term, we need to better balance our reliance on immigration and develop additional pathways to increase the flow of local skills into the market.

Other Pathways

Not all tech employees have tertiary qualifications, or even need them. The range of possible digital technology roles across the economy is vast, as are the variety of pathways into tech roles.

To better prepare students for a digital world, in 2018, the Ministry of Education is introducing a new digital technologies curriculum for students from year one to year thirteen. The Ministry is aiming to have all schools teaching digital technologies across all year groups by 2020. Currently, there are a small number of students learning computer sciences or information

technology at secondary school. It is hoped that as more students are exposed to digital technology learning through their primary and secondary school years this will help build a stronger domestic pipeline of digital talent in the long term. Meanwhile, a study by NZTech in 2016[37] found that while many tech firms are open to supporting students to transition directly from secondary school into tech roles, they currently do not feel they have enough experience. According to the study, the main demand by tech firms is for people with at least three years experience. It is possible however, that as the number of students interested in information technology grows, better models will be created to help them develop experience while studying, such as summer internships.

There are also a growing number of private initiatives providing either online courses, boot camps or short intense courses to help people without technology degrees to enter tech roles. In the past year, several international providers such as Udacity, WozU and Codify Academy have entered the market providing mainly online courses in software development. Locally, operations such as Dev Academy have been providing nine week crash courses in programming, supported by boot camps and work preparation. Industry Connect, another local initiative, helps international students transition from computer science courses into the tech sector, by upskilling graduates in commercial software development tools and soft skills.

There is scope for the development of more programmes like Dev Academy courses targeted at Māori and Pasifika students who have completed Level 1 or 2 courses but have not completed tertiary training. Other courses can be targeted at those interested in returning to the workforce, who don't have computer science qualifications.

Summary

At a high level, it appears that the current supply of digital skills is sufficient for the current market demand through a combination of domestic education pathways and international immigration. However, if we delve deeper, it appears our provision of domestically trained talent is insufficient, and it looks like the economy is over reliant on importing advanced digital skills.

While the geo-political situation is currently working to New Zealand's advantage, making it attractive for digital talent to consider a role in New Zealand, it will be risky to continue to rely on immigration for the bulk of the talent pool. Every mature market is facing similar demand for digital skills and this global competition means that if it isn't already, it will become a financial drain on the economy to import so much talent.

Consequently, we should lift efforts to increase the number and type of students throughout New Zealand that are learning advanced digital skills. Overall numbers need to increase, as do the number of females, Māori and Pasifika. In parallel, better pathways are needed to prepare and transition students into roles in ways that accelerate their ability to be productive members of digital teams.

We must also ensure that as we work to increase numbers, they are learning digital skills that are in demand. Analysis of which skills are in demand and short to medium term forecasted needs should be completed on a regular basis to inform the education system.

Part Three:

Demand is High and Forecast to Grow.

Part Three: Demand is High and Forecast to Grow.

A key challenge in resolving the digital skills shortage has been a lack of facts regarding the skills that New Zealand tech firms are employing or seeking to employ. Anecdotal evidence abounds as large high profile tech firms announce they have hundreds of open roles and are struggling to find local talent to fill them.

Anecdotal evidence abounds as large high profile tech firms announce they have hundreds of open roles and are struggling to find local talent to fill them.

Critical to being able to take informed steps to addressing the challenge of digital skills availability is an understanding of what skills are needed by industry. To better inform education delivery and immigration policy, a forecast of future skill needs is also ideal.

The Digital Skills Forum surveyed the tech sector, to establish a profile of the actual and forecasted digital skills needs. This survey was complemented with a recent survey of the digital skills needs of Government agencies and an analysis of LinkedIn data for IT professionals skills and recruitment patterns. The combined data provides a comprehensive profile of New Zealand digital skills needs. Further details of the survey demographics are included in the appendix.

Tech Sector's Digital Skills Profile

The current digital skills profile

The 142 organisations that responded to the survey employed 17,324 people in total of which 27% are female. The respondents were asked to indicate how many people were employed across a number of different areas, grouped by primary skill. This can be used to provide an indicative view of the current digital skills profile of the tech sector.

Respondents indicated that 68% of their employees are engaged in digital skill areas. The vast majority, just over a third, of the respondent's digital employees are in software development roles making this a critical skillset for the sector.
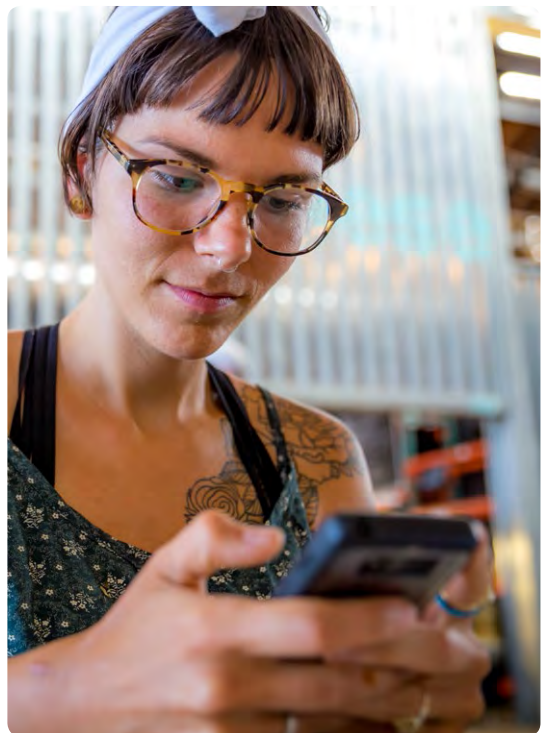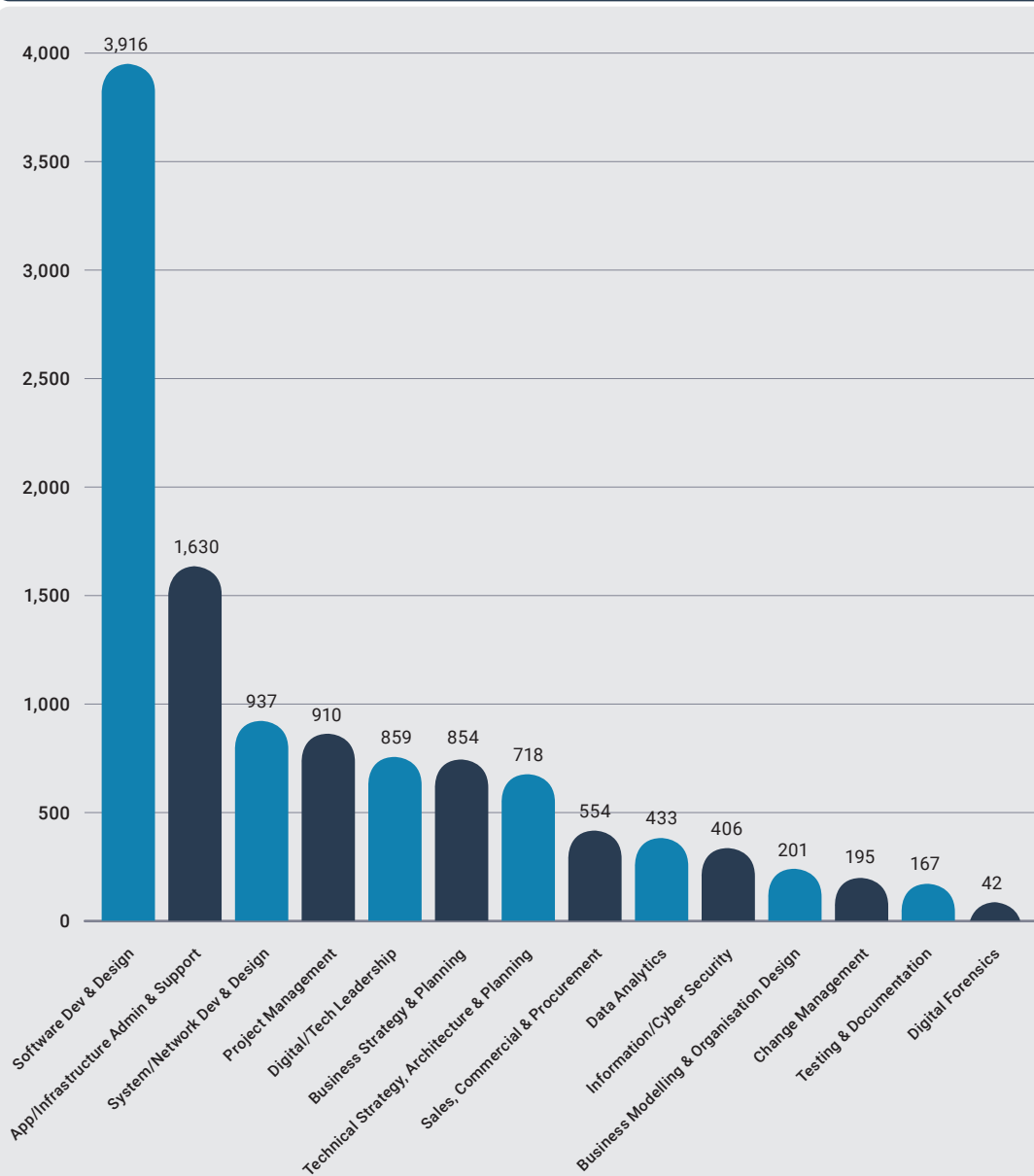
Figure 4 Number of people currently employed by each digital skill area

SOURCE: New Zealand Digital Skills Survey, New Zealand Digital Skills Forum, October 2017. n = 121.

Survey respondents were also asked to list the specific job roles that they are currently recruiting and the number of people for each role. This provides an indication of the type and number of roles that the tech sector is currently trying to recruit.

Of the 75 firms that responded, collectively they are recruiting for 834 people, including 245 software developers. Other areas of high demand are enterprise and application architects, software engineers and data analysts. Surprisingly, given the amount of hype about a critical shortage of cyber security professionals, this category is least in demand from the respondents.

834

jobs available including 245 Software Developers.

Forecast Digital Skills Profile

The survey provides an indicative view of what the current digital skills profile is within the tech sector. However, to better plan resources, such as new education courses, we need a view of what the potential digital skills profile may look like.

Figure 5 Number and type of roles currently needed.

ENGINEERS 127
including production, cloud, DevOps, FAE, system, network & software engineers.

ARCHITECTS 161
including enterprise, solution, IoT, application, cloud & infrastructure architects.

SOFTWARE DEVELOPERS 245
including software developers, AI developers, UX designers, full stack developers.

DATA ANALYSTS 108
including data scientists, data engineers, data architects.

BUSINESS ANALYSTS 64

CYBER SECURITY 14

TESTING 19

MANAGEMENT 81

SOURCE: New Zealand Digital Skills Survey, New Zealand Digital Skills Forum, October 2017. n = 75.

Respondents were asked to estimate the number of people they expect to be employing in each of the different digital skills areas within the next two years. Across 121 firms, they collectively forecast employing an additional 3,248 digitally skilled employees within two years, 38% of which will be software programmers. Other skills in demand will be data analysts, architects, application and infrastructure administration and support, and digital leadership.

Proportionally, the largest growth will be in the skills of cybersecurity with 46% growth, adding 185 people. This contradicts what we saw in

the previous section, that a small number of cybersecurity roles are currently available. However, the forecast may be indicative of the growing awareness of the importance of these skills within an organisation.

Developing Digital Skills

The survey examined the tech sector's opinion on current challenges to developing their organisation's skill base and meeting their resource requirements over the past twelve months. The remainder of the survey explored views on the importance of various non-technical

Figure 6 Number and type of additional skilled people needed over next two years.

SOURCE: New Zealand Digital Skills Survey, New Zealand Digital Skills Forum, October 2017. n = 121.
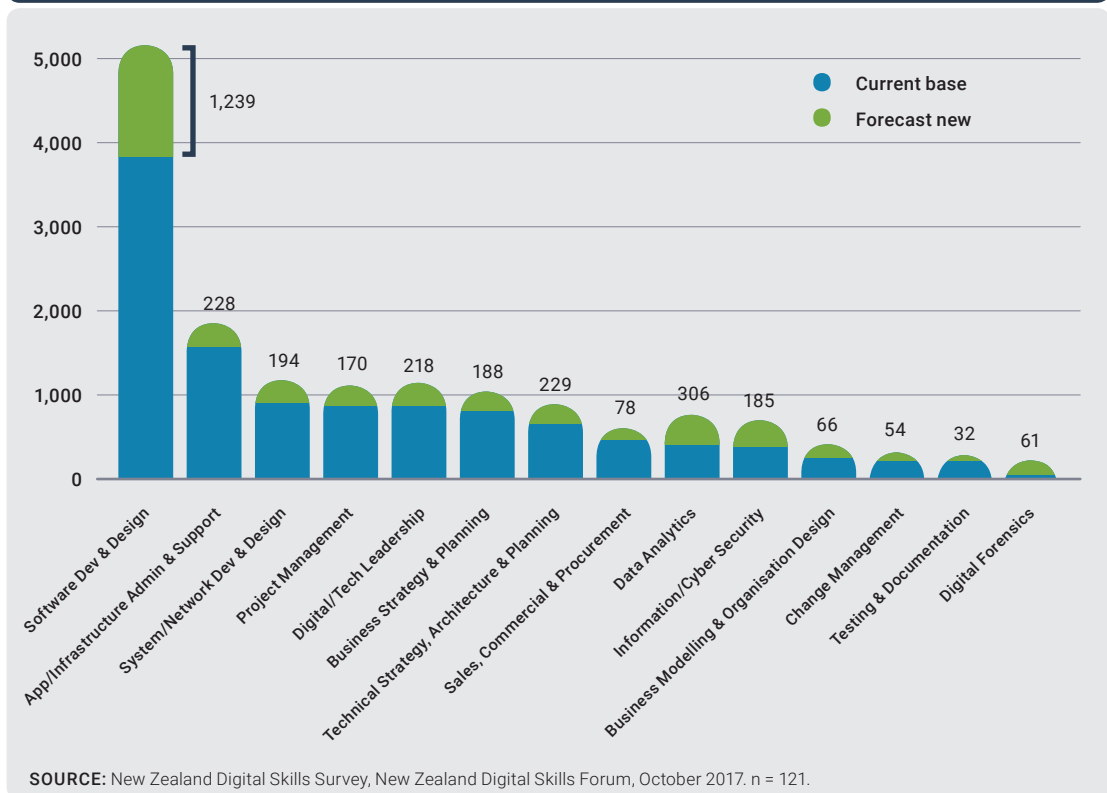
skills, the best methods for developing their organisation's workforce and whether they use a skills framework within their organisation.

Challenges to developing the tech workforce

Respondents were asked to identify the three biggest challenges they faced in the development of skills within their organisation over the past 12 months. Interestingly, even though there is theoretically a skills shortage, most tech firms still appear to be struggling to prioritise the development of their current workforce. The majority of challenges identified were related to not having enough time to train staff, issues with balancing business as usual with training and the cost of training.

Analysing response by company size showed that the availability of time and the issue of prioritising training against business as usual are issues for most companies regardless of their scale. Assuming the digital skills shortage is a long term phenomenon, more focus should be applied by tech companies to developing efficient internal, ongoing training processes. Providing staff with ongoing training and development, especially digital workers, will be critical to staying relevant.

Best ways to develop digital workers

Given the importance of developing the digital workforce, respondents were asked for their opinion on how effective different approaches have been to develop capability in their organisation. On the job learning was by far the most favoured method within tech firms, with 88% of responses saying this was effective or the most effective method of developing staff. Mentoring also featured highly with 66% of responses positive.

Tertiary courses or graduate programmes were considered an ineffective method of developing digital and technology capability with 52% of responses negative or neutral.

Figure 7 Biggest challenges to the development of skills.
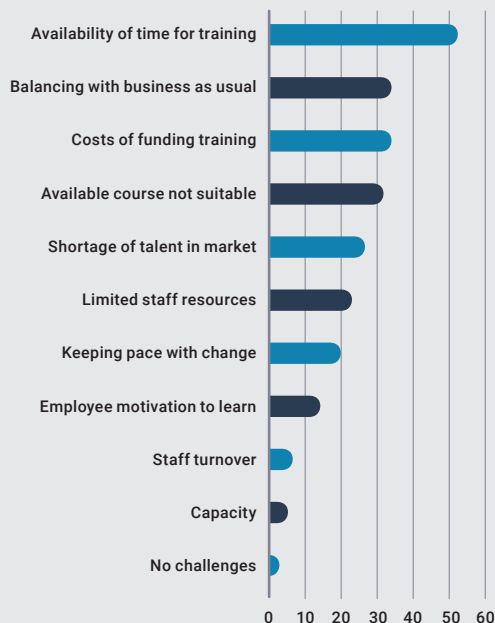
SOURCE: New Zealand Digital Skills Survey, New Zealand Digital Skills Forum, October 2017. n = 113.

> ## 88%
> *find on the job training the most effective way to upskill digital staff.*

Figure 8 Most effective methods of developing organisations digital capabilities.
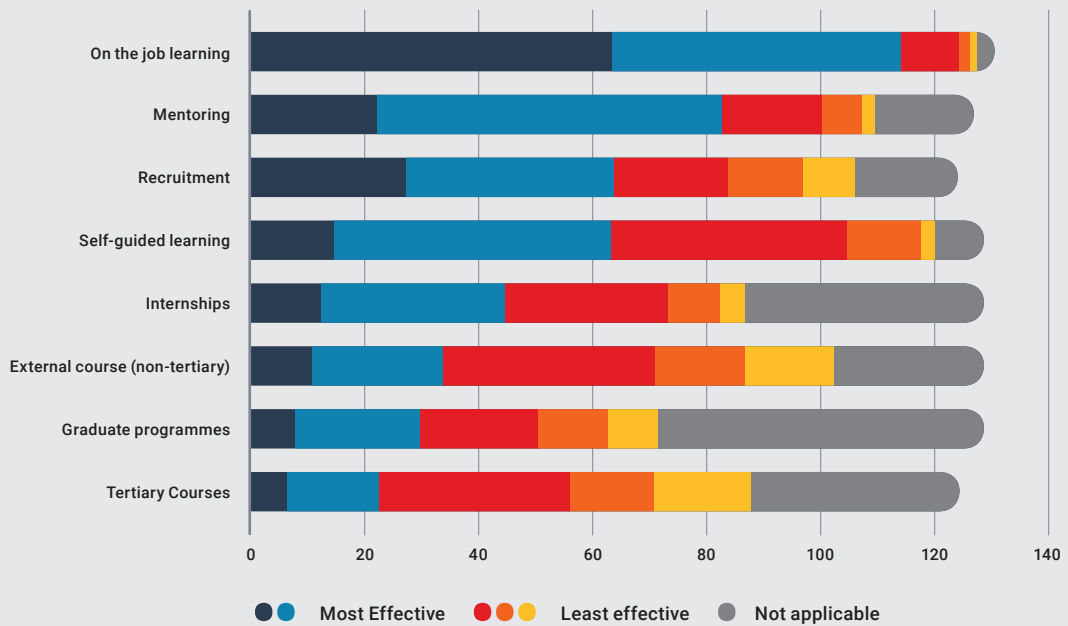
Legend: Most Effective · Least effective · Not applicable

SOURCE: New Zealand Digital Skills Survey, New Zealand Digital Skills Forum, October 2017. n = 107.

Challenges in meeting resource requirements

Respondents were asked to identify the three biggest challenges they faced in meeting resource requirements within their organisation over the past 12 months. The difficulty in finding talent with the right level of skills and experience for the role was the core challenge. The tech businesses also identified that access to funds and balancing recruitment with business as usual were also key challenges when trying to meet resource requirements. These responses are not indicative of a skills shortage, rather a reflection of the challenges firms face in a fast changing market.

Figure 9 Biggest challenges to meeting resource requirements.
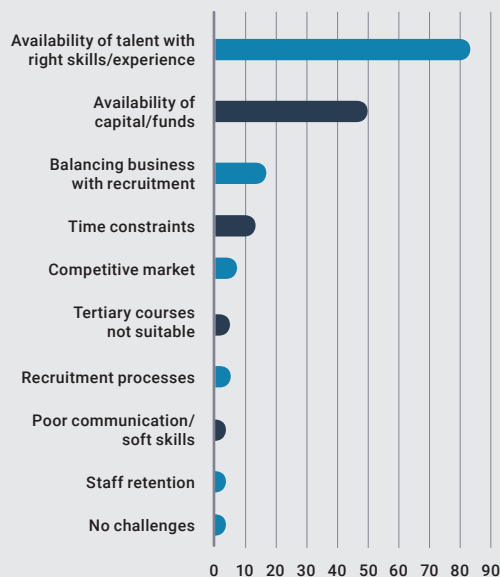
Availability of talent with right skills/experience	
Availability of capital/funds	
Balancing business with recruitment	
Time constraints	
Competitive market	
Tertiary courses not suitable	
Recruitment processes	
Poor communication/ soft skills	
Staff retention	
No challenges	

0 10 20 30 40 50 60 70 80 90

SOURCE: New Zealand Digital Skills Survey, New Zealand Digital Skills Forum, October 2017. n = 107.

Importance of soft skills

There has been much written about the importance of soft skills in partnership with digital skills. Typically, soft skills refer to skills such as problem solving, collaboration, the ability to present and communicate well. The survey asked respondents how important a range of soft skills were for the future development of their workforce.

Problem solving and critical thinking skills are the most important 'non-technical' or 'soft' skills with communication skills and collaboration also rating highly. Creativity and the ability to present were seen as less important skills.

Figure 10 Importance of soft skills.
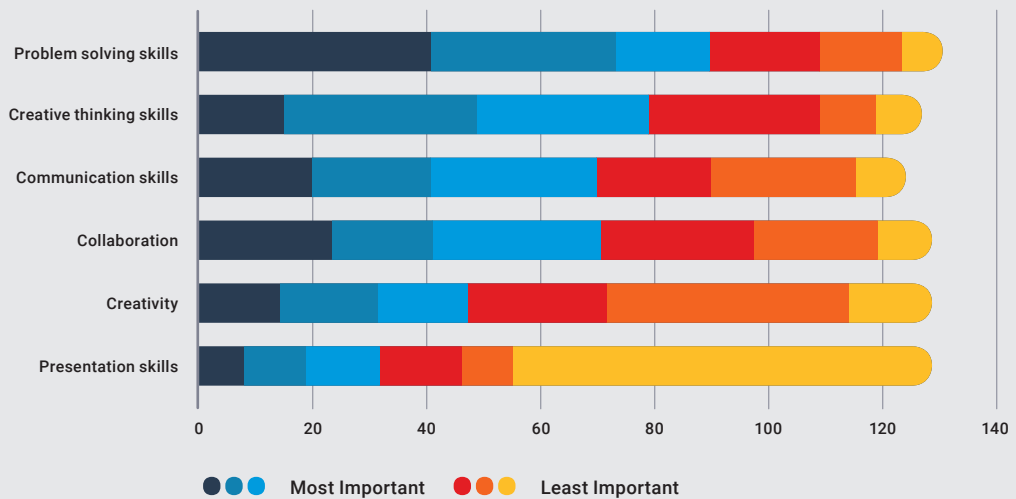
SOURCE: New Zealand Digital Skills Survey, New Zealand Digital Skills Forum, October 2017. n = 121.

Impact of emerging technologies

There are many fast growing technologies which will require the development of new capabilities as their uptake increases. To gauge which emerging technologies will create the strongest skill demands in the near future, respondents were asked to identify the disruptive technologies that were likely to have a material impact on their business in the next few years.

Tech firms are forecasting that artificial intelligence (AI) and the Internet of Things (IoT) are most likely to impact their businesses in the near future. Augmented Reality and Virtual Reality (AR/VR) was also noted.

It was predicted in Forbes magazine earlier this year that the massive productivity improvements available from practical applications of AI will continue to fuel the demand for machine learning

Figure 11 Disruptive technologies most likely to create skills demands.
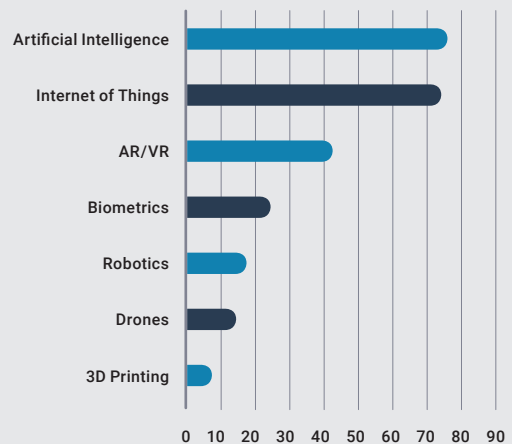
SOURCE: New Zealand Digital Skills Survey, New Zealand Digital Skills Forum, October 2017. n = 76.

engineers, machine learning researchers and all other professions related to the field, and may effectively replace computer science altogether[38]. The New Zealand tech sector is also predicting AI to be critical, and as such, should be working with the education sector with urgency to start developing the necessary skills for the New Zealand market.

Limited use of skills frameworks

The final survey question considered the use of skills frameworks by organisations to help them develop their workforce. Only 31 respondents currently use a skills framework of which 61% or 19 firms, have developed their own – version, six use the Skills Framework for the Information Age (SFIA) and the others use frameworks provided by their multinational parent companies.

Government Demand for Digital Skills

The tech sector only accounts for a portion of the digitally skilled workforce. As noted earlier, according to Statistics New Zealand there were 72,208 jobs in IT services and related occupations across all sectors in 2016. As the economy becomes increasingly more digital, this places further demand on digital capabilities. One of the largest employers of people with digital skills is the Government.

New Zealand Government digital skills profile

The New Zealand Government conducted a survey of its agencies in 2016 to quantify and understand current availability of digital skills and digital leadership within Government, and to identify future growth areas. This provides an interesting comparison to the tech sector survey.

The Department of Internal Affairs surveyed 135 digital leaders (CTO's, CIO's) from 39 Government

23,946
IT and digital workers in 39 Government agencies.

agencies on digital leadership, digital skills gaps and challenges to developing digital capabilities. Further detail on the survey demographics and methodology is included in the appendix.

The responding organisations had almost 80,000 employees of which an estimated 23,946 staff are involved in IT or digital roles. Of these, 7,134 or 30% were female.

The Government survey was similar to the tech sector survey in that it sought to establish the number of people currently working across a range of skills and an estimate of future needs. Given the responses come from a small number of organisations and that the numbers were collected in categories not as raw numbers, i.e. 1-5 (and highest in each category was used), these results should only be interpreted as indicative.

Figure 12 Current and future digital skills profile in New Zealand Government.
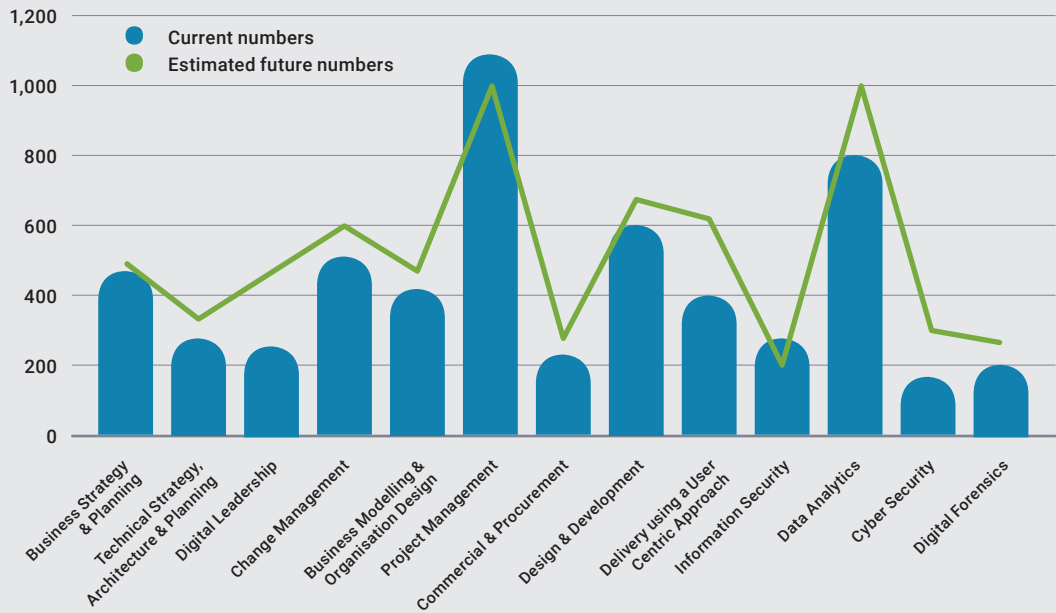
- ● Current numbers
- ● Estimated future numbers

SOURCE: Information, Technology and Digital Skills Survey, Department of Internal Affairs, November 2016. n = 37.

Figure 12 shows the biggest potential skills shortages for Government will be in digital leadership, cybersecurity and delivery using a user centred service delivery approach. Respondents also noted that capability improvement was needed across 87% of the skill categories. Consequently, an increased use of partner organisations and systems integrators were seen to be the likely drivers of change over the next four years, whereas use of consultants and contractors would largely remain at the same level.
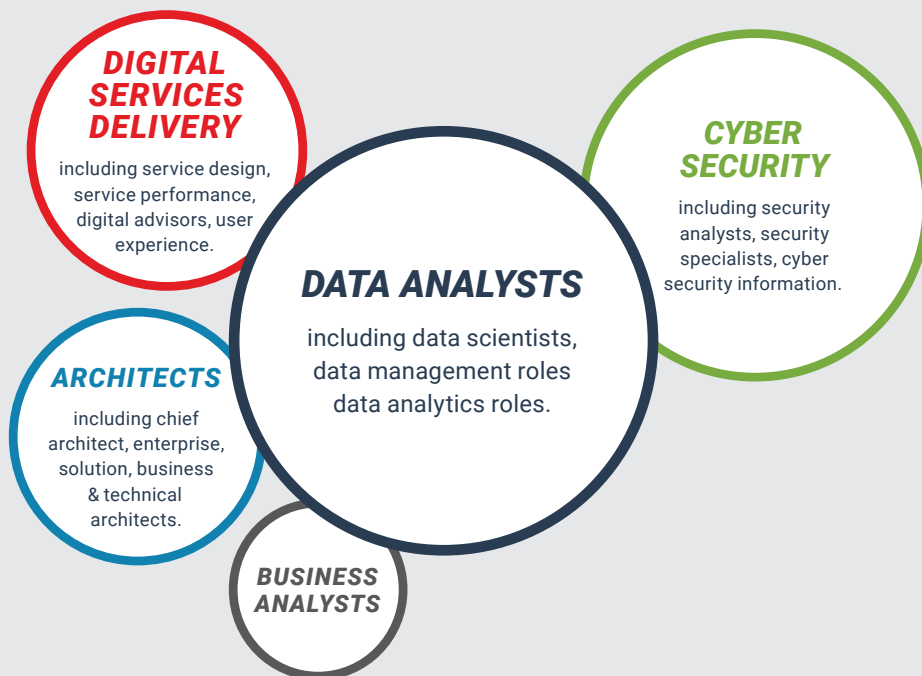
Government respondents were also asked what specific job roles are currently required. While the tech sector indicated a large number of software developers were required, in Government the

primary roles being sought are data analysts and cybersecurity specialists. Like the tech sector, architect roles are also in high demand.

Development of Government digital skills

Like the tech sector, the most effective method of developing an organisations digital capability appears to be on the job training followed by mentoring. Government agencies also find the use of secondments and internships effective in developing their organisations digital capabilities. The tech sector could learn from this, as there are a growing number of internship opportunities as more universities include elements of work placement within their computer science courses.

Figure 13 Type of digital roles currently needed in Government.

DIGITAL SERVICES DELIVERY including service design, service performance, digital advisors, user experience.

CYBER SECURITY including security analysts, security specialists, cyber security information.

DATA ANALYSTS including data scientists, data management roles data analytics roles.

ARCHITECTS including chief architect, enterprise, solution, business & technical architects.

BUSINESS ANALYSTS

SOURCE: Information, Technology and Digital Skills Survey, Department of Internal Affairs, November 2016. n = 37.

47

Figure 14 Most effective methods of developing agencies digital capabilities.
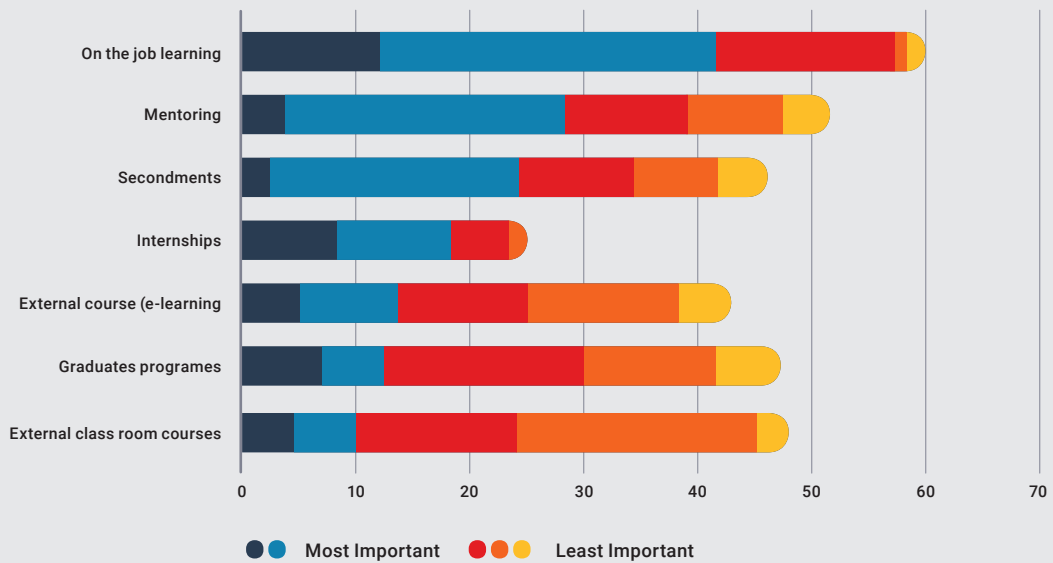
SOURCE: Information, Technology and Digital Skills Survey, Department of Internal Affairs, November 2016. n = 68.

Key observations from Government digital skills survey

The Government's main focus for avoiding a digital skills shortage will be on the development of digital leadership. The Government is facing a significant workforce challenge as they have been given an imperative to digitally transform the public service, yet some leadership still view digital technology as IT support and desktop applications. The study estimates that there is a need to double digital leadership capacity across Government within the next four years. Additionally, investment would be needed in critical skills such as cybersecurity and service delivery.

Like the tech sector, more focus should be placed on training, development and upskilling current staff. Currently, there is insufficient investment spent on training and development for successful digital transformation to occur. Less than 10% of agency training is being spent on digital skills and 40% of respondents did not feel that their organisations workforce planning would prepare them for digital transformation.

National Information Technology Recruitment Trends

In July 2017 LinkedIn undertook an analysis of the skills profile and recruitment trends of the New Zealand technology sector in comparison with leading international tech markets. The study was commissioned by Immigration New Zealand to inform the development of policy and programmes to

90,000+

IT professionals in New Zealand (30% female).

help reduce tech sector skills shortages. The methodology can be found in the appendix.

The analysis of New Zealander's LinkedIn profiles established that there are more than 90,000 IT professionals, of which 30% are female. The workforce is concentrated in Auckland (38%), Wellington (16%), Christchurch (8%) and the Waikato (4%), with the remainder spread across other regions. As at July 2017, demand growth was highest in Wellington, closely followed by Auckland.

According to LinkedIn data, job switching for IT professionals is higher than the New Zealand average. Eighteen percent of IT professionals have changed employers in the past twelve months versus the national average of 13%. The average tenure for an IT professional is 27 months prior to changing jobs. This could help to explain, in part, why employers tend to under invest in the training and development of the digital staff.

Demand coming from every sector

The study found that the biggest employers of IT professionals are a mix of tech firms, large corporations and Government departments. The top 20 organisations employ over 10% of New Zealand's IT professionals. The biggest employer is Datacom, however the variety of large organisations that are employing digital skills reinforces the fact that the digital skills shortage is not just a concern for the tech sector, it is critical for the entire economy.
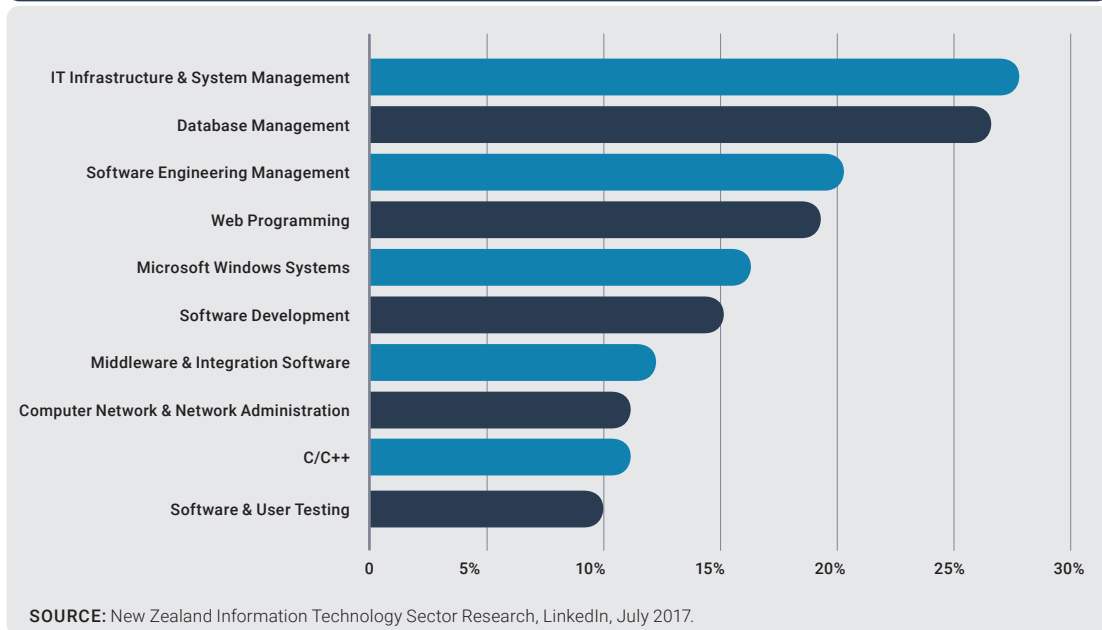
Examining the profiles of over 90,000 IT professionals can help identify the top skills that they detail on their profiles. This provides an indication of the current skills base in the market. There are hundreds of IT skills, so to be included in the analysis at least 50 profiles had to display the skill. Skills were then grouped into standard groups. The top five individual skills were; SQL, software development, integration, requirements analysis and javascript.

When grouped, the top skills currently in the market are IT infrastructure and systems management, database management, software engineering, web programming and Microsoft Windows systems.

Table 2 Biggest employers of IT professionals in New Zealand.

Large Local Tech Exporters	Large Multinationals	Large Local ICT Firms	
1. Datacom	6. Orion Health	11. HP Enterprise	16. Intergen
2. Spark Digital NZ	7. Vodafone	12. Trade Me	17. Fujitsu New Zealand
3. Xero	8. Stats NZ	13. Air New Zealand	18. ASB Bank
4. Spark New Zealand	9. Auckland Council	14. MSD	19. BNZ
5. IBM	10. Fonterra	15. ANZ	20. Inland Revenue NZ

SOURCE: New Zealand Information Technology Sector Research, LinkedIn, July 2017.

Figure 15 Top 10 IT skill groups on New Zealand IT professionals' profiles.

Skill Group	
IT Infrastructure & System Management	
Database Management	
Software Engineering Management	
Web Programming	
Microsoft Windows Systems	
Software Development	
Middleware & Integration Software	
Computer Network & Network Administration	
C/C++	
Software & User Testing	

SOURCE: New Zealand Information Technology Sector Research, LinkedIn, July 2017.

To gain a sense for in demand skills, an analysis of the most added skills was undertaken. Specialised technical IT skills were some of the fastest growing skills being added to profiles in New Zealand. The fastest growing are those added to profiles the most in the past twelve months, compared with base skills already on profiles. Table 3 shows that the fastest growth IT skills are very specialised.

27 months

The average tenure for an IT professional before changing jobs.

Table 3 Top 20 fastest growing IT skills on New Zealand IT professionals' profiles.

Top 20 Fasted Growing Skills			
1. Adobe Photoshop	6. Selenium WebDriver	11. DevOps	16. Amazon Web Services
2. Adobe Illustrator	7. Ansible	12. Laravel	17. Swift
3. React.js	8. Xamarin	13. ASP.NET Web API	18. Mobile Application Dev
4. TypeScript	9. API Development	14. Front-end Development	19. Cucumber
5. Docker	10. Tableau	15. ElasticSearch	20. Oracle Database

SOURCE: New Zealand Information Technology Sector Research, Linkedin, July 2017.

Identifying future demand

To better understand which skills are growing in demand, an analysis of total demand by demand growth was carried out. Total demand is expressed as a Demand Index, which is based on the average number of recruitment messages sent to LinkedIn members within a skills group in the past twelve months. Demand growth is based on the growth of the number of InMails sent to members with a skill group in the last twelve months compared to the previous twelve month period.

Figure 16 shows the supply, demand and demand growth for IT skills groups for New Zealand IT professionals as at July 2017. The size of the bubble represents the relative supply of New Zealand IT professionals for each skill group. The larger the circle, the greater the supply.

Figure 16 Supply, demand & demand growth for IT skills groups (New Zealand).
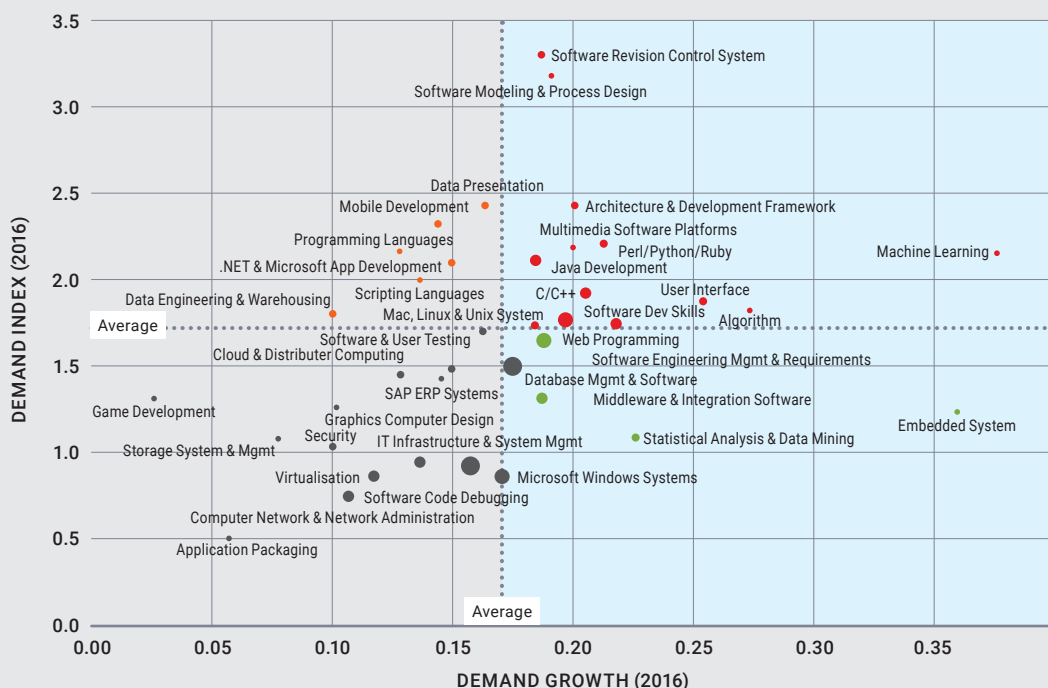
SOURCE: New Zealand Information Technology Sector Research, LinkedIn, July 2017.

Skill groups in green may not be the most in demand skills today, however demand for these skill groups is still growing. For example, there is a relatively low current demand for Statistical Analysis and Data Mining professionals, but this skill group has had the fifth largest growth in demand in the last year.

This analysis shows that there is massive demand growth for skills in embedded systems and machine learning, while the supply for both skills is currently low. Software developers, web programming and software engineering have relatively large current supply as well as strong demand and continued demand growth. As shown in the earlier surveys, architects are in high demand and also a relatively high demand growth.

International comparison

An assumption was made that the New Zealand market is probably tracking in delay to some of the larger international tech markets. On this basis it was assumed that a comparison of key markets overseas might provide insight into which skills will have the strongest future demand.

Using the same methodology employed in Figure 16, an analysis of the San Francisco Bay, Greater New York and London regions was undertaken.

Figure 17 Supply, demand and demand growth for IT skills groups (International).
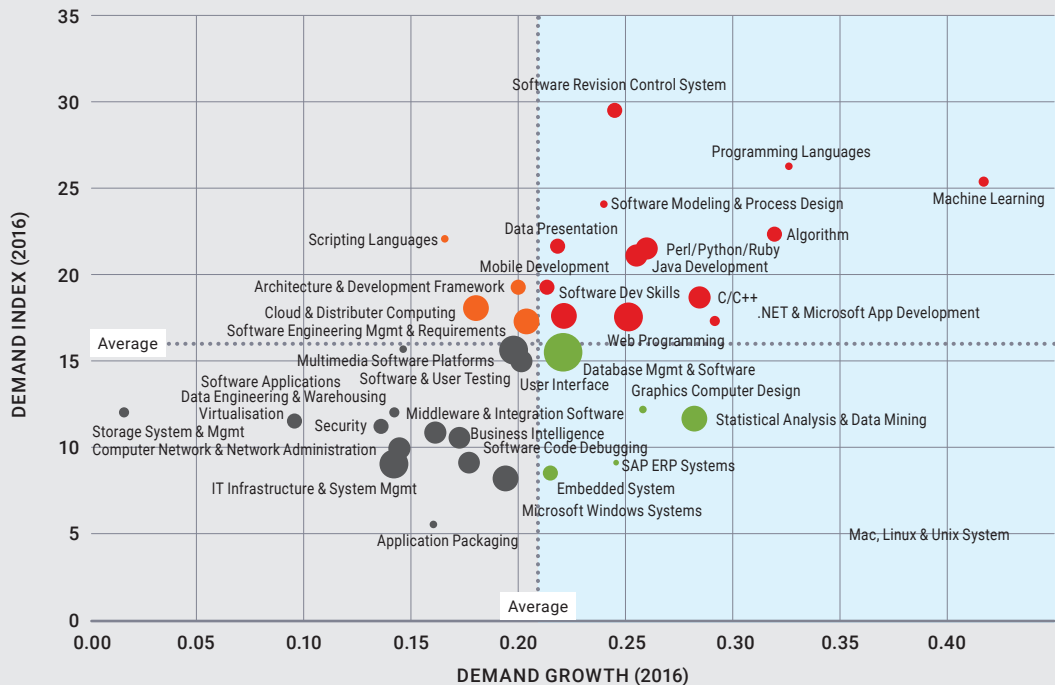
SOURCE: New Zealand Information Technology Sector Research, Linkedin, July 2017.

The results show that the New Zealand market has a very similar skill group profile in terms of demand and demand growth, just a much smaller supply. Machine learning is in high demand everywhere and this demand is growing fast. A range of software development skills are also in high demand, so are data management and analysis skills.

While New Zealand has a similar tech profile to some of the key tech markets in the world, it means we will face growing pressure on the required skills. If we are to avoid critical skills shortages in areas like machine learning in the immediate future,

we need to ensure our education system is capable of developing these skills today.

The LinkedIn data also found that Zealand is a net importer of talent from India, South Africa and Singapore and a net exporter of IT professionals to Australia, the United Kingdom and the United States.

MACHINE LEARNING SKILLS
Highest demand growth globally and in New Zealand.

Summary

Across all three surveys, there is evidence of strong demand for digital skills and significant growth in demand for some of these skills. This is important information, as not all skills are growing in demand. There appears to be large numbers of workers in the market doing 'keep the lights on' IT work such as infrastructure support and network management. These jobs are important, but their demand is reducing. Logically, organisations should be able to reskill some of their staff over time, toward the skills they expect to see increasing demand for.

Unfortunately, there is evidence that both private and public organisations under invest in the development of their staff. One argument is that with such a high rate of job changing by IT professionals, most organisations would prefer to maximise their return on their staff investments before they leave, and then return to market for the new in demand skills.

However, research did not consider if companies that invest in staff have lower turnover. Research across other sectors tends to suggest that investment in developing staff increases their length of tenure by choice.

So long as the supply of digital skills continues to be constrained and as demand continues to increase, both the tech sector and the other large employers of IT professionals will need to seriously consider how they can best invest in upskilling staff.

CONCLUSION:
Invest in Digital Skills for a Digital Nation

Evidently, the supply of digitally skilled talent for the New Zealand economy is insufficient. Given this is a global issue too, we cannot rely on immigration to fill future skills gaps. More focus needs to be placed on developing a strong domestic pipeline of talent through our education system and other education initiatives.

The tertiary education system requires support to better align its courses with the future demands of the sector. Using insights from this study, tertiary education providers can be better placed to make informed decisions about current and future skill demands. An effective method of reviewing this information annually is required to ensure both education and immigration are informed, and that industry and Government can collaborate efficiently to meet digital skills challenges.

This study has highlighted that not only are insufficient numbers of tertiary students studying computer sciences or information technology, but they also struggle to transition into roles following their graduation. Further focus should be applied to both increasing the number of students and assisting in the placement of tertiary graduates, including internships.

Concurrently, as a nation we could do better at showcasing a variety of pathways into digital technology roles. For example, not every software developer needs to attend university and the tech sector highly ranks 'on the job training' as a means of development. Therefore, alternative programmes that connect well with industry need to be better supported by the industry itself.

Many of the recommendations from the Future of Work Commission are also relevant for addressing the digital skills shortage. The future of work is a digital workforce, so the digital skills shortage is in effect, a national skills issue too. As policy developed for the Future of Work is turned into actions, this will no doubt help address skills shortages in the long term.

RECOMMENDATIONS:
From the Tech Sector

The tech sector members of the Digital Skills Forum, NZTech, NZRise and IT Professionals NZ, have reviewed this study and its conclusion and have the following recommendations. The tech sector is committed to working with the Government via the Digital Skills Forum to continue to address the digital skills gap with both short term and long term policies and initiatives. Our recommended actions are:

Building the talent pipeline

1. Make sure every child is exposed to digital technologies

In the long term, we need to dramatically increase the supply of digitally skilled people in New Zealand. Therefore, the successful introduction of the digital technologies/hangarau matahiko curriculum is critical. Increased investment should be made to ensure teachers and principals are actively driving the new learning into their schools as quickly as possible.

2. Help all Kiwis to understand the importance of digital skills

The skills issue is not about the tech sector, it is about the future of work. We recommend investment to increase the understanding of the importance of lifelong learning and digital technologies.

3. Increase the numbers studying advanced digital skills

The number of students who study computer science or information technology at a tertiary level needs to increase. A national campaign should be designed to encourage more students into relevant tertiary study.

4. Actively encourage a more diverse group of Kiwis into digital technology

The tech sector is actually very diverse thanks to immigration. Rather than import diversity, we must invest in the untapped potential of our own population. We recommend the development of significant policy approaches and initiatives to increase women, Māori and Pasifika in digital roles. Consideration should be made to applying positive discrimination to incentivise and encourage individuals into computer sciences and information technology courses, in the same way as it is applied for other nationally critical skills, such as medicine.

5. Undertake a programme of constant digital attraction

New Zealand should invest in building its Digital Nation brand and use ongoing digital campaigns to target and attract the best possible talent from abroad. After all, digital people use digital tools to find their next job. We recommend investment into building a database of digital talent looking to come to New Zealand and a programme of constant engagement.

Supporting the transition to work

6. Develop and promote pathways into digital tech roles

As there are multiple pathways into digital roles, these need to be clearly promoted. We recommend investment into updating pathway information and ongoing promotion of the various pathways into digital technology roles including ways to upskill or reskill into in demand areas.

7. Develop a platform to support internships

To help students transition faster into productive employees, most tertiary courses now include work experience and internships. However, this part of the market is fragmented with businesses being approached by multiple education providers. In addition, it is often unclear what to expect from an intern, which can lead to lower rates of participation. It is recommended that a neutral platform is developed to provide a central location for engaging with students looking for internships or work experience. The platform should be used to create consistency in the experience and help employers understand ways to get the best return from different experience levels.

Upskilling and Reskilling

8. Develop programmes to support re-entry to work

With less than 30% of the tech workforce being female, significant opportunity exists to improve gender balance and help address the skills shortage. We recommend developing programmes to help women return to the workforce and into digital roles.

We recommend extending the pilot Return to IT programme to include support from education providers to help women without digital skills to develop them, so they can return to the workforce in digital roles.

9. Create upskilling programmes for those likely to be hit by automation

The growth in demand for digital skills presents a unique opportunity in that the number and type of roles emerging is broad. Against this backdrop, the Government and tech sector should work together now, to create and pilot programmes specifically targeted at groups within society that may be hit hardest by potential automation of jobs. The focus should be on developing skills that the market will need most, not just on filling education quotas.

10. Educate the market on importance of training and development

The value of investing in training and development of existing staff needs to be promoted explicitly. The Government and industry should consider co-investing in a study on the economic benefits obtained by organisations that develop their digital staff. Successful high profile tech firms who have a policy of ongoing development should be highlighted as exemplars.

Appendix

New Zealand Digital Skills Survey

During August and September 2017, the Digital Skills Forum surveyed the tech sector to create an evidence based picture of the skills needed across technology and digital roles. It also set out to forecast the skills in demand in the short/medium term to better inform education and immigration policy.

The New Zealand Digital Skills 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. The New Zealand Digital Skills Survey was structured to contain a few similar questions and common definitions. A broad industry advisory group was also established to help assess the questions prior to taking them to market.

For the purposes of the survey, information, technology and digital are used interchangeably and to describe the application of computing and related technologies to capture, organise and share information electronically.

The target respondent was the most senior person in a tech/digital organisation who could answer details about their employee base and planned or future needs.

The survey was emailed to over 400 tech organisations that are members of NZTech, NZRise and IT Professionals. The survey was also promoted widely via social and other media channels.

Over a two month period, 142 organisations completed the survey, 21 partially and a further 121 in full. While the overall response rate was lower than hoped, the seniority of the respondents provides a good indication that the survey was taken seriously by the market. All respondents held senior roles with 77% being at C-Level or above and a further 11% being HR leads.

Figure 18 Are you a member of your organisations leadership team and what is your role?
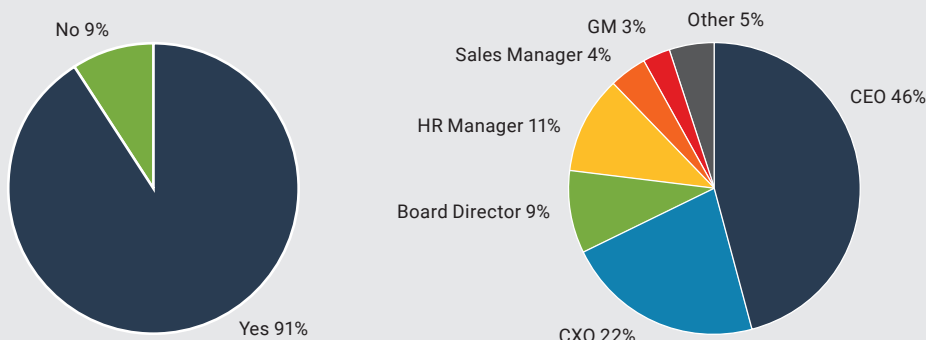
No 9%
Yes 91%

GM 3%
Other 5%
Sales Manager 4%
HR Manager 11%
Board Director 9%
CEO 46%
CXO 22%

SOURCE: New Zealand Digital Skills Survey, New Zealand Digital Skills Forum, October 2017. n = 142.

The responding firms were spread from small two people operations to a significant number of New Zealand's largest tech employers. The respondents include our largest tech exporters, local arms of large multinational tech firms and many of our largest local ICT providers. A partial list is provided below in Table 4.

The respondent base number of female employees was only 27%. If half of the population is female, then there is potentially a large unexplored resource base available to help address future skills shortages.

Figure 19 Respondents NZ based employees and proportion female.
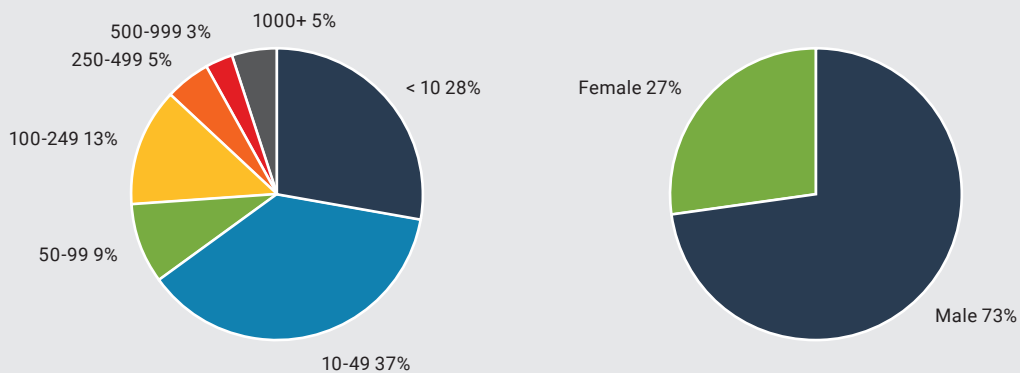
500-999 3%
1000+ 5%
250-499 5%
< 10 28%
Female 27%
100-249 13%
50-99 9%
Male 73%
10-49 37%

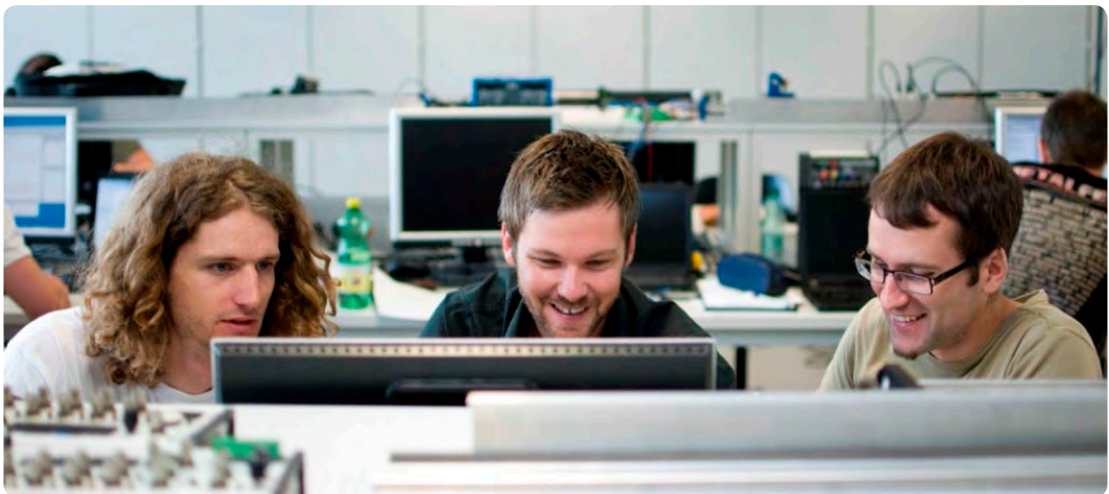**SOURCE:** New Zealand Digital Skills Survey, New Zealand Digital Skills Forum, October 2017. n = 142.

Table 4 Partial list of survey respondents – 100+ employees .

Large Local Tech Exporters	Large Multinationals	Large Local ICT Firms
Aranz Geo	Deloitte	Assurity Consulting
Datacom	Fujitsu	Catalyst IT
Gallagher Group	Google	Eagle Technology
Gentrack	Hewlett-Packard	Fronde
GPC Electronics	Huawei	Intergen
HMI Technologies	IBM	Optimation
Invenco Group	Microsoft	Qual IT
Orion Health	Tech Mahindra	Solnet Solutions
SLI Systems	Unisys	
Trimble		
Tru-Test Group		
Vista Group		
Xero		

SOURCE: New Zealand Digital Skills Survey, New Zealand Digital Skills Forum, October 2017.

New Zealand Government Skills Survey

It is a priority for Government that the public sector transforms the way it delivers services to New Zealanders. With this comes a shift to customer centred ITD services that are integral to this transformation. Many Government organisations have transformation programmes underway with large ITD components, with the focus mainly on the customer experience. To successfully deliver the transformation outcomes required, there is a need for greater levels of ITD skills and capabilities in new and emerging areas across the public service.
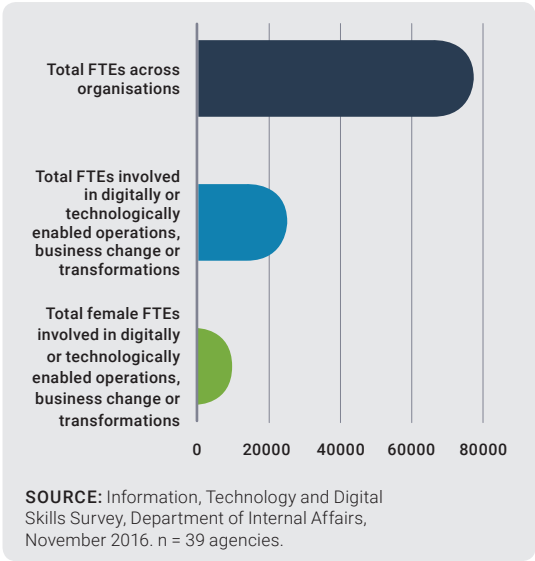
Consequently, the DIA within the New Zealand Government developed a survey to quantify and understand current availability of digital skills and leadership, and to identify future growth areas.

The Government survey was based on a similar survey conducted in 2015 by the UK Government. The survey sought information across five areas:

- Digital and technology leadership
- Digital and technology as an emerging profession
- Digital skills gaps/shortages
- Barriers and challenges
- Central initiatives and guidance

135 Government digital leaders (e.g. CIOs, CTOs, service delivery and business transformation teams) from 47 Government organisations were approached, of which 39 responded.

Figure 20 Government agencies ITD staff and proportion female.

SOURCE: Information, Technology and Digital Skills Survey, Department of Internal Affairs, November 2016. n = 39 agencies.

Across the 39 agencies that responded in full, there are 335 active senior ITD leadership roles. These agencies have 23,946 members of staff in ITD roles, of which 30% are female.

LinkedIn New Zealand IT Skills Analysis

In 2017, LinkedIn was contracted by Immigration New Zealand analyse the demand and supply of information technology (IT) professionals in New Zealand with a view to identifying potential skills gaps and emerging trends. This data was also compared with key international markets to see if additional insights could be made.

The research data in the report is largely based on profile data and recruiting activities related to members in New Zealand and three key international regions – San Francisco Bay Area, Greater New York City Area and London. The key

Table 5 LinkedIn industry and function classifications.

Technology industries	Function
Computer hardware	Information technology
Computer software	Software Engineer
Computer networking	
Internet	
Semiconductors	
Consumer electronics	
Information services	
Information technology and services	
Computer games	
Electrical and electronic manufacturing	
Wireless	
E-learning	
Computer and network security	

SOURCE: New Zealand Information Technology Sector Research, LinkedIn, July 2017.

analysis inputs utilised on the LinkedIn member profile are the location and industry of current role, the occupation functions and company industry of previous roles, education and skills.

IT professionals in New Zealand, in the three key international regions, and globally are identified based on the following LinkedIn industry and/or function classifications on the members latest primary profile position.

To gain a sense for which skills are growing in demand, an analysis of total demand by demand growth was undertaken. Total demand is expressed as a Demand Index which is measured based on the average number of recruitment messages which a LinkedIn member within a skill group received in the past twelve months. Demand growth is based on the growth of the number of InMails sent to members with a skill group in the last 12 months compared to the previous 12month period.

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