Cyber Security Skills Report

Wellington Regional Strategy Office: Samantha Seath and Colin Drew

A review and identification of the issues in the development of a cyber security workforce that is able to meet the demand of the future and enable growth across the region.

Greater Wellington Regional Council

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About the Wellington Region Strategy Office

The Wellington Regional Strategy Office is tasked with reporting, research and monitoring functions in relation to the Wellington Regional Strategy. The strategy is set and governed by the Wellington Regional Strategy Committee, on behalf of the councils in the region. Our role is to continually look for opportunities to partner on research projects that have a clear application for councils' and/or WREDA economic development interests. We also provide regional economic data and research products.

The Wellington Regional Strategy Office would particularly like to acknowledge the following contributions to this report:

Eleanor Laban from Immigration NZ for immigration statistics and contribution to the research

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John Dow of Agenda Marketing for the initial interviews with businesses

A full list of contributors and workshop participants is available in *Appendix 2*.

WRS Wellington Regional Strategy

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Executive Summary

The aim of this report is to understand what opportunities there are for the Wellington Region in growing the cyber security sector, and what skills constraints might exist in achieving this objective.

Research was focused on discussions with industry as well as analysing data from multiple sources. Wellington was the prime focus for the research, however due to the national and global nature of this sector most of the findings are relevant nationally. In 2015 cyber security transactional activity in New Zealand was estimated at $1.67 billion, of which at least 16% was attributed to Wellington.

Growth in employment numbers in Wellington over the last two years was 19% and this is forecast to be at 38% over the next two years. This represents around 270 additional full time jobs in Wellington alone.

Initial industry discussions and information analysis identified skills as of primary importance if the cyber security sector were to respond to workforce demands and growth pressures. Therefore this report focuses on the systemic issues around skills and workforce development.

Research was based on the following factors:

- Understanding the scope of the cyber security workforce pipeline;
- Establishing a baseline of current cyber security capabilities and proficiencies; and
- Identifying the general training needs of the cyber security workforce.

A collaborative approach was adopted in informing the report. This acknowledged a national imperative driven by implementing the NZ Cyber Security Strategy, TechNZ's Digital Nation work and momentum from the private and tertiary sectors to be engaged in supporting the development of the industry. The need for continued collaboration between government, business, training institutions and the regions was continually reinforced in workshop discussions.

Traditionally, organisations have taken a reactive approach to cyber security – responding to threats as they occur, rather than pro-actively protecting and managing cyber risk. To be fully effective there is a need to move cyber security to a proactive demand-driven system. This will require information on where the jobs are, what skills they require and what credentials are most relevant to in-demand occupations. Timely and reliable information will be critical as will partnerships, articulation of careers ladders and using research and evaluation to guide future development.

New Zealand is not alone. International evidence points to a huge gap in the skills required to fill cyber security roles and this is predicted to increase further over the next few years. The 2015 Global Information Security Workforce study[1] identified a likely shortfall of **1.5 million** professionals by 2020. By comparison, tertiary student enrolment numbers in New Zealand across the technology sector has seen little if no growth over the last 5 years and the number enrolled in cyber science for 2014 only represents 2% of the total. And of those nearly 50% are international students. Furthermore the numbers graduating across the sector have been declining.

A review of Immigration and the numbers coming into Wellington (and New Zealand) under a skilled migrant visa identified a low number and a difficulty in being able to recruit for roles that are not identified within the ANZSCO system. Recruitment based on job titles was also seen to be largely irrelevant as skills were a much better measure of fit for purpose.

Such limitations on the skills supply side coupled with a skills gap among workers in their understanding of the business itself (not just the technology issues) has significant workforce and training implications for New Zealand.

Businesses identified that the education for cyber security roles was falling short in what was needed in the workplace. They supported a greater focus on training while on the job as the technical elements where changing at such a pace that the traditional training regimes had difficulty remaining relevant to the sector.

Countries like the United Kingdom and the United States provide appropriate models and both have invested heavily in skills and workforce programmes. Similarly they have moved their training and development of individuals to be more focused on what industry is looking for with the introduction of apprenticeships and internships. Professional qualifications are important for parts of the sector and more emphasis is put on these than graduate qualifications. New movements are underway to develop the school sector so that career pathways are obvious to secondary school aged pupils.

In light of the evidence provided, industry feedback and reviewing international practice a series of recommendations is provided. The proposed approach to be adopted for cyber security could readily be applied to other emerging technology sectors where ANZSIC and ANZCO based data is insufficient to be meaningful from a skills and workforce development perspective.

Recommendations

Recommendations are presented on the basis of a process of firstly meeting information gaps, then developing a framework for action and then delivering initiatives designed to address constraints to future sector development as identified in this report.

The key recommendations are:

1. That Wellington works with the central government agencies and business to develop an agreed skills framework for cyber security. The framework would be piloted in Wellington with the view of demonstrating effectiveness such that it is adopted nationally.

2. That a project be undertaken to develop a skills-based demand profile for the cyber security sector in Wellington. This would include Statistics NZ looking at data collection options across the cyber security in addition to other data sources and business surveys.

3. That Immigration New Zealand (MBIE) and Wellington use the skills framework to develop a skilled migrant pathway for the cyber security sector

4. That Wellington works with business and education on delivering internships for the current Summer of Tech programme, with a focus on cyber security businesses. At the same time investigation on international intern exchange programmes as a potential option for bringing in and building local skills should be completed.

5. That pilot programmes be developed with Wellington secondary schools to raise awareness of opportunities for employment; and with Victoria University and WelTec to develop the future pipeline of security professionals through shorter programmes with industry experience.

The above recommendations all require detailed planning and resourcing. Developing a skills and workforce framework can be readily modelled on international examples and populated with the information provided in the report. Information gaps have been identified and the WRS Office is currently working with industry to collate further skills related data as a basis for informing future interventions.

1. Introduction

This report presents insights into the cyber security sector in Wellington (and New Zealand). Its focus is on skills and workforce development challenges and opportunities in building this growth sector. The report:

- reviews the nature and scale of cyber security activity
- identifies the key opportunities and issues across the sector
- attempts to quantify potential skills demand and supply
- researches international practice related to cyber security workforce frameworks and
- provides recommendations to deliver on opportunities and help address constraints to growth

This exercise stemmed from a sector profiling project started in late 2014 looking at the Creative Digital Industry (CDI) in Wellington. The aims of the research are to understand the growth opportunities for Wellington region by having a broader range of business metrics at a deeper sector level that was available through traditional statistical information.

Cyber security stood out as a potential area for investigation as it has a strong focus in Wellington. Transactions for 2015 are estimated at around $300 million. Also it represented a business activity that was relevant and embedded across all parts of the economy. Hence it presents challenges to how we classify a “sector” in a traditional sense and attach metrics to this.

The investigation with industry identified a number of areas for consideration: sector capability, cyber security awareness and innovation. Sector capability related to skills and workforce demand was identified as a critical issue for growth and hence the focus on this report.

Both internationally and locally, cyber security is increasingly becoming a key concern. Expansion in technology ecosystems has led to the emergence of several new segments such as big data, cloud computing, social media and mobile services (apps etc.). This paradigm shift in technology and mobile applications has created many new opportunities in cyber security. However the inadequate supply of people with critical skills is emerging as a risk for organisations, making their networks and digital information systems more vulnerable to cyber threats for example.

Cyber security is one of the most challenging aspects of risk management. According to the Global Risks Report 2016 (World Economic Forum) cyberattacks and related incidents have been entering the global risks landscape as among the most likely and most potentially impactful risks over the past two to three years.[2] In 2015 it was estimated that the average annual losses to companies worldwide now exceeds $7.7 million (a 19% increase on 2014), and the number of successful attacks per year per company showed a 46% increase over 4 years.[3]

These trends are significant in themselves but another related trend is the time to resolve these attacks with the mean time in 2015 being 46 days, up from 14 days in 2010. It is predicted that global annual cybercrime costs will grow from $3 trillion in 2015 to $6 trillion annually by 2021.[4]

Desktop research, industry discussions and the analysis of many data sources identified a range of problems that this report attempts to highlight and suggest solutions to. Rapidly evolving information technology jobs are often unique and therefore difficult to quantify and benchmark by traditional means.

The lack of standardised job titles and what technology professionals actually do on the job is a common problem. The UK and US have tried to solve this for the Cyber Security sector, however part of the problem remains that some skills command higher value than others and matching of job titles doesn’t necessarily mean the same work is done. Understanding the skills required for roles is more important and will become critical for companies entering into the market for cyber security specialists.

A consideration for the immediate future will be the training and retraining of security professionals. The objective of training is to prepare a person for future roles. This means adequate resources for training and development need to exist.

The need to move into a demand-driven system where we have information on where the jobs are, what skills business requires and what credentials are most relevant to in-demand occupations appears an imperative. This will require timely and reliable information, the setting up of partnerships, articulation of careers and using research and evaluation to guide future development and public interventions.

2. Context

The context for this report requires both a national and sector perspective. From a workforce development angle, there is also a need to understand the baseline components that drives cyber security as a sector. These are:

- Awareness – knowing that businesses understand the risks posed from the boardroom through to a staff level. There are many international consultancies operating in this field, including in Wellington.
- Sector capability (skill sets) – this is a complex and rapidly evolving sector that requires many skill sets, many yet to emerge.
- The tools – the technology that protects systems from cyber-attacks and ensures that information is secure, yet accessible.

Analysis of the sector identified a New Zealand market of $1.7b as at Dec 2015.

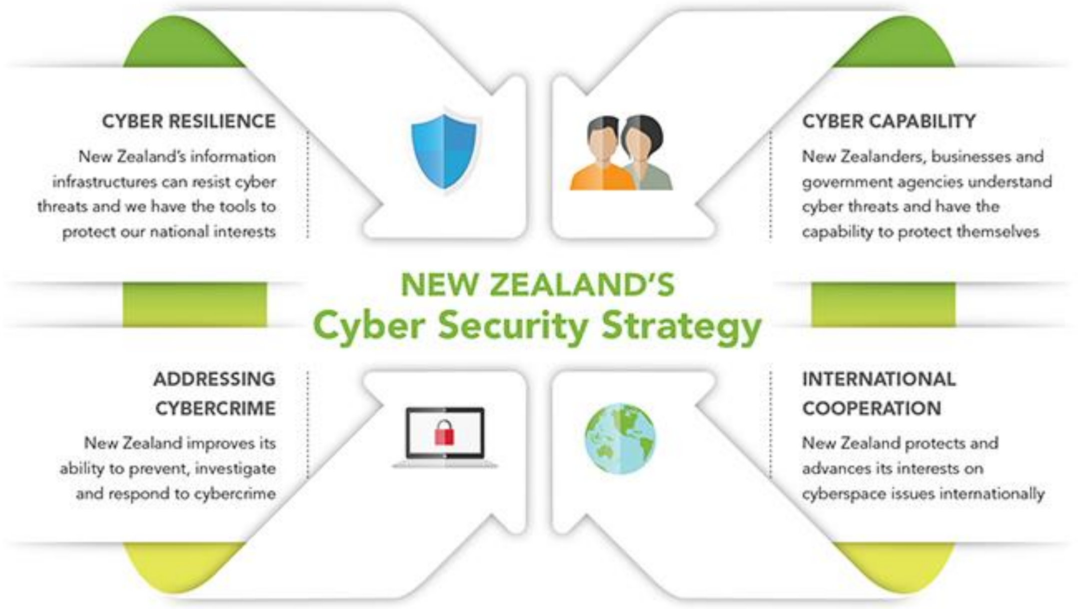
2.1. Cyber Security is critical for New Zealand

Cyber security is at the forefront of protecting critical infrastructure, business and computer networks from attack by foreign nations, criminal groups, hackers, and terrorist organisations.

The New Zealand Government has recognised this with the refreshed Cyber Security Strategy released in December 2015[5] (*figure 1*) which is accompanied by an action plan. The budget announcement in 2016 of $22m being allocated to the establishment and running of a Computer Emergency Response Team (CERT) facility within MBIE provides further support[6]. Steps have been taken to include industry in the action plan by holding a summit which resulted in a number of actions and taskforces being established[7], including:

- Cyber Credentials scheme
- Cyber security workforce
- Extend the content of Connect Smart messages and develop new tools
- CERT set up

Figure 1 – NZ Cyber Security Strategy



NEW ZEALAND'S Cyber Security Strategy

CYBER RESILIENCE

New Zealand's information infrastructures can resist cyber threats and we have the tools to protect our national interests

CYBER CAPABILITY

New Zealanders, businesses and government agencies understand cyber threats and have the capability to protect themselves

ADDRESSING CYBERCRIME

New Zealand improves its ability to prevent, investigate and respond to cybercrime

INTERNATIONAL COOPERATION

New Zealand protects and advances its interests on cyberspace issues internationally

To combat these global and local threats, Wellington, New Zealand, and the rest of the world depends on having a robust, agile, and highly trained cyber security workforce. However, the challenges facing cyber security professionals change rapidly. This means they must develop and constantly refine their knowledge and skills across a multitude of disciplines.

New Zealand is exposed to the same cyber threats, however it does not have the scale to enable a workforce development programme like the US and UK for example. This means many of our professionals will need to be specialists across multiple areas unlike our counterparts where they may specialise in one particular area.

2.2. Multiple points of interest

Within the context of the Cyber Security Strategy there are multiple organisations with interest in looking at the issues and opportunities. The Department of Internal Affairs (DIA) is taking a broader look at the skills for technology roles across government and has identified cyber security as an immediate priority. Immigration New Zealand and the sector team at MBIE are also actively involved in working with the technology sector on skills supply and sector capability factors.

TechNZ , the ICT peak body, has recently published their report "From Tech Sector to Digital Nation."[8] While focusing on technology as a whole they have identified that cyber security is a critical part of this. More importantly understanding skills and workforce development is critical to advancing New Zealand in technology and its protection.

Connect Smart[9] provides an online portal to information on cyber security. It is led by Government's National Cyber Policy Office (NCPO), part of the Department of the Prime Minister and Cabinet (DPMC). This is in partnership with a range of government agencies, non-government organisations and the private sector.

With multiple agencies and organisations working on solutions, the need for a collaborative approach is evident.

2.3. Understanding the sector

To ensure that the cyber security workforce is properly equipped to respond to barriers and opportunities, it is important to first understand the current environment and what the barriers to growth might be. In the first instance this involves developing an evidence-base to understand skills supply and demand. Along with industry support, such understanding helps inform the nature of public interventions.

Measurement of this sector is difficult due to the nature and collection of relevant data. The workforce information collected by Statistics NZ is at a higher level than cyber security, with only one ANZSCO (occupational classification) role being security related. There is limited ability to interrogate data and understand which jobs may have cyber security as their core function. Generic titles like network analysts, software testers and project managers are likely to involve a number of tasks. Therefore developing any clear understanding of what numbers are employed across this sector was not practical through ANZSIC based statistics.

The Digital Nation report[10] by NZTech also acknowledged the limitation of traditional statistics in the ability to fully understand the ICT sector (of which cyber security is part of) as easily as more traditional industries such as manufacturing.

3. Scope and Methodology

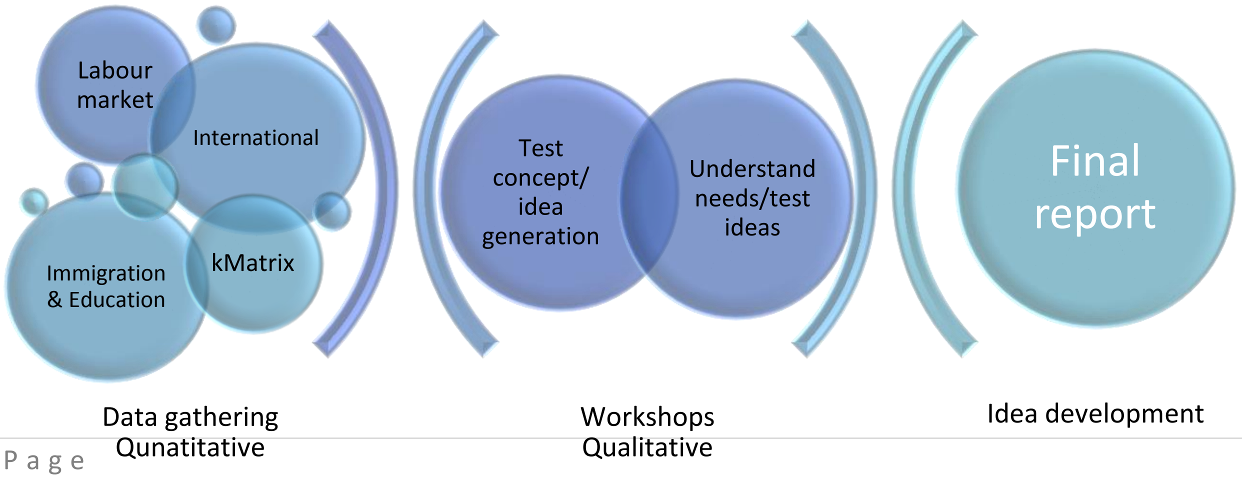
This cyber security report is the result of almost two years work looking at a new approach to quantifying sector activity and opportunities. Cyber Security is but one of these sectors and has emerged as a national priority. The area of skills supply and demand arose from industry engagement as the priority focus.

The process in compiling this report involved three stages:

1. Gathering and analysing data from both traditional and non-traditional sources; and researching international models
2. Commissioning reports on the scale of the sector in Wellington and New Zealand; and on current occupations
3. Testing data and international thinking with industry, education and government and developing thought leadership for Wellington and New Zealand.

This is summarised in *Figure 2*. Findings from these stages are incorporated throughout this report.

Figure 2: High level process



The scope of the report is limited to the labour market which includes workforce development, skills requirements and supply, and sector capabilities. This approach is consistent with part of the New Zealand strategy and issues in the Immigration area around identifying skill sets.

The focus of findings and industry discussions has been on Wellington however in the context of the national strategy and national interests.

3.1. Starting point

Problem definition: ability to measure emerging sectors.

The ability to assess, measure and monitoring business activity in emerging sectors, or sectors that were evident across much of the economy, was proving a challenge for government agencies, universities and industry bodies. In early 2015 the Wellington Regional Strategy Office partnered with Callaghan Innovation on a pilot to investigate a different way of profiling a sector and attribute economic and employment metrics to the components of a sector.

The pilot was on the creative and digital industries (CDI) for Wellington and the story around the fusion of creative and digital activities. For Callaghan Innovation the national priority was on high value manufacturing and services (HVMS).

London based company kMatrix (*Appendix 1*) was contracted to develop a sector classification system (taxonomy) that would measure the industries down to groups of like companies. Utilising the UK developed taxonomy for the creative and digital industries; Wellington stakeholders were able to refine the information to a New Zealand context. For CDI this resulted in 3000 lines of activity describing the sector. For each of these activities, sales, exports and employment numbers were attributed at a national and Wellington level. Equivalents for seven of our trading partners were also purchased. This provided details on a number of sectors that were highlighted as opportunities for growth in Wellington.

A key driver – to enable potential investment and identification of growth opportunities for the Wellington Region

Subsequent analysis and industry discussions were conducted for gaming, design, film/screen production and cyber security. This report focusses on the latter.

The initial data collected through kMatrix identified where New Zealand sat in the global market. Desktop research was undertaken to identify what was already happening internationally that was of relevance to NZ. The five-eyes partnership (an intelligence alliance comprising Australia, Canada, New Zealand, the United Kingdom and the United States) was used as a base to review education and skills development models already in place.

3.2. Cyber security reports and analysis

Wellington already has a strong presence with large suppliers located within the region as well as being the seat of Government. However to determine the size and status of the cyber security sector it was important to source multiple data sources Our initial data collection built on work previously completed with CDI.

Further reports were commissioned from kMatrix who are the official statistics provider for cyber security to the UK Government. These included data on transactional activity for NZ and Wellington, sector growth rates, occupation and export/import information. Some international comparisons were also provided and are included in this report.

This sector data was complemented with NZ statistics on education and immigration as a basis for reviewing skills supply through immigration and the tertiary sector.

3.3. Stakeholder engagement

The next phase was to test the data, assumptions and potential opportunities with industry and other key stakeholders *(Appendix 2*). An initial targeted approach was made by phone. This was followed up with individual face to face interviews to better understand the cyber security sector in Wellington, what their key issues were and what the opportunities might be. This provided a qualitative view of the sector to supplement and test the data gathered.

The key themes that emerged from these discussions were:

- Skills and education
- Collaboration and clusters
- Awareness

These themes were workshopped, out of which emerged agreement that skills and education was the priority activity for collective action.

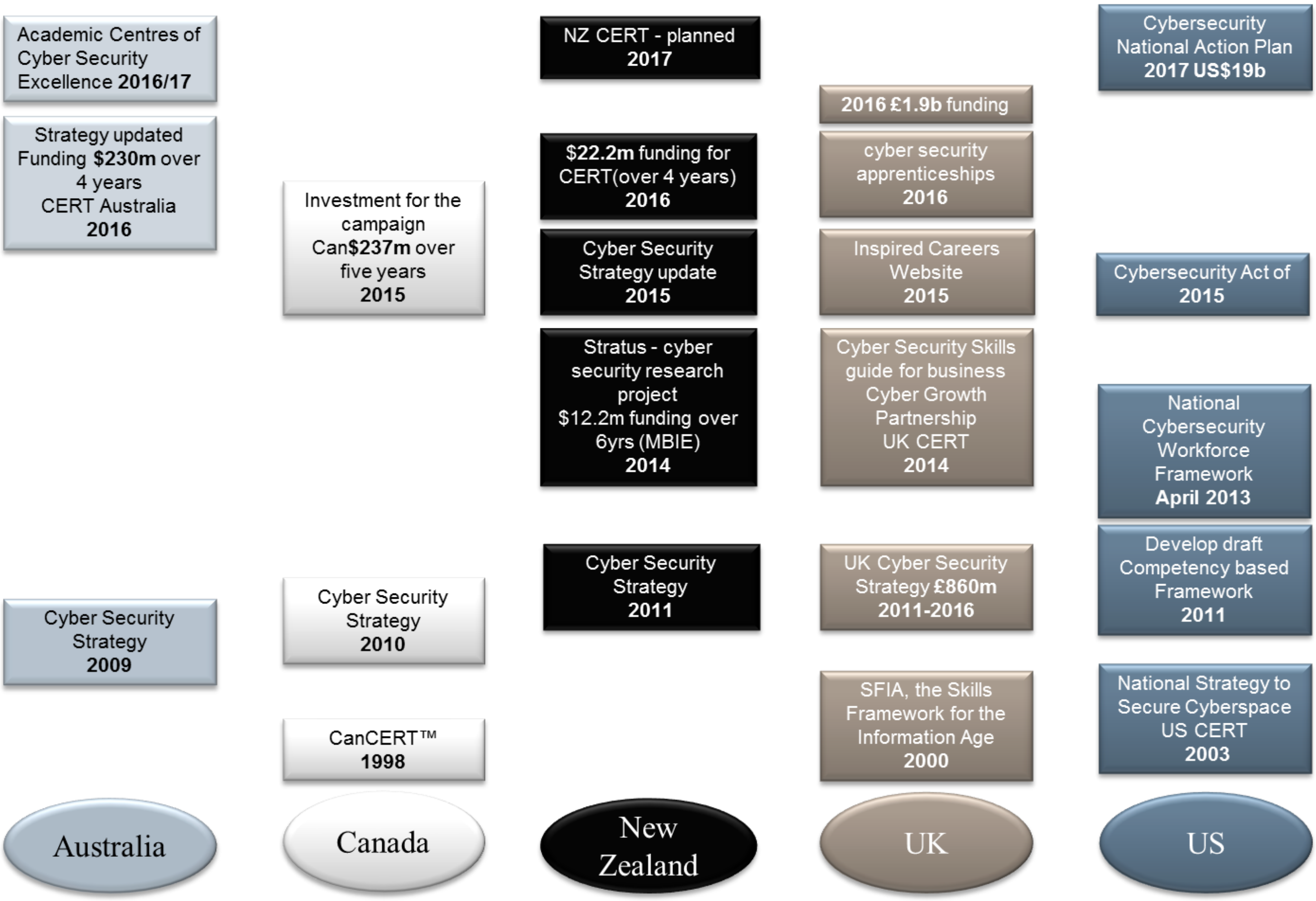
A subsequent workshop was held with industry, education institutions and Government departments to review the information collected. The workshop also focused on presenting in more detail the information gathered through the data collection and analysis stage.

4. International

To understand the key issues likely to face New Zealand in the near future, international partners provide a useful baseline. The five-eyes has developed and been delivering in the cyber security space going back to 1998 in the case of Canada. All countries have recognised the need to focus on this emerging sector and the importance of the workforce component.

Figure 2 provides a summary of each country's key investments in support of the respective strategies and national CERT arrangements. Of particular note for this project are the skills and workforce areas developed in the UK and US. The timeline also shows that while there is work happening across these countries, the most significant progress over time has been in the UK and US. This is also evident with the amount of funding that has been earmarked by the respective Governments *(Table 1).* New Zealand's current per head of population spend by comparison is low.

Figure 3: International timeline


Academic Centres of Cyber Security Excellence 2016/17
Strategy updated Funding $230m over 4 years CERT Australia 2016
Cyber Security Strategy 2009
Australia
Investment for the campaign Can$237m over five years 2015
Cyber Security Strategy 2010
CanCERT™ 1998
Canada
NZ CERT - planned 2017
$22.2m funding for CERT(over 4 years) 2016
Cyber Security Strategy update 2015
Stratus - cyber security research project $12.2m funding over 6yrs (MBIE) 2014
Cyber Security Strategy 2011
New Zealand
2016 £1.9b funding
cyber security apprenticeships 2016
Inspired Careers Website 2015
Cyber Security Skills guide for business Cyber Growth Partnership UK CERT 2014
UK Cyber Security Strategy £860m 2011-2016
SFIA, the Skills Framework for the Information Age 2000
UK
Cybersecurity National Action Plan 2017 US$19b
Cybersecurity Act of 2015
National Cybersecurity Workforce Framework April 2013
Develop draft Competency based Framework 2011
National Strategy to Secure Cyberspace US CERT 2003
US

Skills and workforce development underpin much of our future work in this area. However with 1 million cyber security job openings entering 2016[11] and a predicted demand for a cyber security workforce expected to rise globally to 6 million by 2019 with a 1.5 million shortfall, there are challenges ahead. This means for the new workforce to be developed and trained there needs to be a greater understanding of what is required, and by when.

Table 1: Government spending on Cyber Security (generally over 4 years)

Country	Population	Government spending	Per head of popultaion
US	322,762,018	$ 19,000,000,000	$ 58.87
UK	65,088,276	£ 1,900,000,000	£ 29.19
Canada	36,266,307	$ 237,000,000	$ 6.53
Australia	28,852,637	$ 230,000,000	$ 7.97
NZ	4,563,063	$ 22,200,000	$ 4.87

Source: various articles

The data accessed through kMatrix identified New Zealand's relative position to four other countries (*Table 2*) and how cyber sales as a percentage of GDP compare. Again, the level of activity suggests that New Zealand is likely to see further growth and additional investment may be required to address sector capability constraints.

Table 2: Cyber Security Sales as a % of GDP – kMatrix

Country	Sales NZ $m Year to December 2015	Cyber Sales % Share of GDP
Australia	$12,182	0.7%
New Zealand	$1,697	0.7%
United Kingdom	$47,431	1.2%
United States	$212,519	0.9%

Due to the size of the sector in the US and UK, the number of professional industry organisations and government support there tends to be more international cyber security research. Desktop analysis of such research helps inform what a national skills framework might entail and what constraints NZ could experience.

The major global cyber security trends[12] highlight a number of areas that need to be taken into account when developing this sector. These are:

1. The unintended consequences of state intervention – varying regulation and legislation potentially restricting activities of organisations as more policing of the internet is done
2. Big data will lead to big problems – there is still a human element to big data and the ability to manipulate in secret will be of increasing concern
3. Mobile applications and the Internet of Things (IoT) are creating a prime target for malicious actors
4. Cybercrime causes the perfect threat storm – Cyberspace is an increasingly attractive hunting ground for criminals, activists and terrorists motivated to make money, cause disruption or even bring down corporations and governments through online attacks, and
5. *Skills gaps become an abyss for information security – While cybercriminals and hacktivists are increasing in numbers and deepening their skillsets, the "good guys" are struggling to keep pace*

4.1. Skills shortages

Worldwide there is a skills shortage and it is predicted to get larger. Evidence from the ISC^2 Global Information Security Workforce study[13] shows that **1.5m** more cyber security professionals will be needed to accommodate the global shortfall by 2019. Among other things it identifies top demand and growth roles as well as top skills and competencies looked for across the sector.

Top roles in 2015 that were in strong demand were:

1. Security analyst
2. Security auditor
3. Security architect – products & solutions
4. Forensic analyst
5. Incident handler – organisation

Top growth roles:

1. Security analyst
2. Security Consultant – Management
3. CISO – Chief Information Security Officer
4. Security Auditor
5. Information assurance Manager

Top skills and competencies needed over the next three years

1. Risk assessment and management
2. Incident investigation and response
3. Governance, risk management & compliance
4. Analytical skills
5. Architecture

Top skill required over the next 3 years is risk assessment and management

Matching these roles to the New Zealand market can best be done through qualitative information since current statistics do not provide such detail. Generally the various roles above are strongly represented in the Wellington cyber security sector (*Table 5, p23)*

International information was tested with industry to identify whether these trends were in fact similar in New Zealand. While on the most part the trends do follow in New Zealand, the size of our businesses means many of these roles are merged.

A recent report by Intel Security[14] which reviewed 8 countries (including Australia) identified that demand is outpacing the supply of qualified workers in all countries with Australia sitting at the top of the list. The effect of this is pushing wages up internationally with some countries paying up to a **9%** premium for cyber professionals.

The study also identified that companies would like to see a bachelor degree as a minimum requirement for entry into this field, however there is limited availability with only **7%** of top universities in the countries surveyed offering undergraduate majors or minors in cyber security. While companies were keen to see a bachelor's degree, only **23%** of respondents thought that these education programmes were preparing students to enter the sector. The results of the survey identified that the degree was more of a signal of general competence and in fact hands on experience with the addition of professional certifications was preferred.

Another issue which is causing concern globally is the lack of diversity across the sector with only **10%** of professionals' being women[15]. This has led to conversations around how to widen the horizon and look beyond technical skills alone as these skills while important are insufficient in resolving complex risk management. In the research women tend to take more of the roles that are focused on governance, risk and compliance.

While industry is demanding new skilled workers with a greater emphasis on practical learning (as opposed to theoretical) another issue is manifesting itself in academia. A recent IBM report looking at cyber security education for the next generation[16] has highlighted that while there is growth in the programmes being offered, there are insufficient skilled and qualified instructors. This is coupled with the issues of staying aligned with a fast changing area and therefore needing our education organisations to deal with changing programmes to keep up.

New Zealand is not immune to such skill's issues. In the global market we will be competing to attract the required skills and likewise international companies will be trying to attract our graduates and staff.

4.2. Skills frameworks

Both the UK and the US have invested in the development of skills frameworks to help address the shortages across the cyber security sector.   They have also built a number of support structures aimed at creating a stronger sector.

4.2.1. United Kingdom (Appendix 3)

Through CESG[17] (National Technical Authority for Information Assurance) a certification framework for Information Assurance (IA) professionals that work in the UK public sector has been developed. The framework has been aligned with the Skills Framework for the Information Age (SFIA).   The framework is also available to the private sector and encourages all professionals to apply for certification. As this was built as a certification framework it focuses more on the role and describes the competencies and skills needed for that role.

The SFIA framework[18] requires businesses to buy a licence. SFIA does not attempt to cover all of the things that an individual may be required to do, as it doesn't describe any product or technology-specific skills or knowledge, sector experience or qualifications.

Inspired Careers[19] has been developed with the support of BIS (Department of Business Innovation & Skills) and CREST to provide an interactive careers hub for people looking to enter the Cyber Security sector straight from education; those who want to move into Cyber Security from other industries; or those already working within the sector who want to further their careers.

InfoSecSkills Cyber Career Academy (an information security training and education company) has also developed a career path in a one page document[20]. This is again focused on roles but provides a professional pathway and identifies the different certificates and development needs at a high level.

The UK Government recently announced apprenticeships[21] in security that sit alongside other apprenticeships already up and running in the Tech sector. There is an emphasis on building the sector from the ground up and has taken into account that there are multiple ways to create the right skills i.e. apprenticeships, degrees, degree apprenticeships, accredited degrees and training programmes.

The key is to get young school students interested in these career paths and to do that the Tech Partnership has developed a number of tools for both teachers and students, including a careers hub that takes kids on a journey of discovery.[22]

However a recent industry survey in the UK, showed just 14 per cent of respondents said the British education system was adequate in preparing IT professionals for cyber security with 75 per cent of professionals saying there was a shortage of talent in the UK.

Despite that, the country is ranked highest in current investment in cyber security education and is thought to be best situated to institute educational reforms.[23]

The UK has a number of certification and training bodies including:

- The Chartered Institute for IT
- The Institute of Information Security Professionals (IISP)
- CREST (Council of Registered Ethical Security Testers) – Also has a chapter in Australia
- InfoSec Skills Cyber Career Academy

Immigration policy has enabled cyber security specialists to come into the country by adding the occupation 'cyber-security specialist' to the official skills shortage list from November 2015. If the business becomes a 'qualifying company' this would make them exempt from having to advertise for 28 days to recruit non-EU workers. However this is still seen by many as too little to fill the large gap currently in this sector.

Finally the UK Cyber Security Forum was created as a place for cyber security companies to connect and share. Their focus is on small companies and over time they have developed into regional clusters. The clusters are for providing valuable networking and knowledge exchange opportunities for:

- Government, academia and industry
- Specialist cyber security professionals
- Start-ups and entrepreneurs
- SMEs and larger organisations
- Mentors and investors

4.2.2. United States (Appendix 4)

There is rising demand for qualified cyber security talent and industry is calling for a common definition of the scope of work covered in cyber. The National Initiative for Cybersecurity Education (NICE) led by the National Institute of Standards and Technology (a partnership between government, academia, and the private sector) has developed a framework for skills which is available freely to all on their website[24].

The workforce framework provides a common language to describe cybersecurity work regardless of organisational structures or job titles. It lists and defines 31 specialty areas of cybersecurity work and provides a description of each. It also identifies common tasks and knowledge, skills, and abilities associated with each specialty area. The Workforce Framework provides a common language to describe cyber security work regardless of organisational structures or job titles.

Apprenticeships have been introduced and in a recent article the following conclusions were made “The use of apprenticeships to accelerate workers into the cybersecurity workforce so that students can earn as they learn is an exciting and promising practice that employers and academic organizations should explore.”[25]

Recently the National Integrated Cyber Education Research Center[26] which focuses on curriculum design, professional development, and collaboration in K-12 education has been set up. An important part of their function is to enable teachers to gain hands-on experience with projects and technology that provide new, innovative ways to engage students in the classroom.

The Advanced Cyber Security Center[27] is a cluster initiative that brings together industry, university, and government partners to address the most advanced cyber threats. "We focus on sharing cyber threat information, engaging in next-generation cybersecurity research and development, and creating education programs that will address the shortfall in cyber talent."

Their goal is to help establish New England as a major region for cybersecurity research and development, education, and thought leadership by building on the considerable cyber security strengths already existing in the region.

The development of a cyber security sector model[28] was designed to represent the competencies needed by individuals whose activities impact the security of their organisation. The model's tapered shape *(figure 4*) represents the increasing specialisation and specificity of proficiencies covered. Its tiers are further divided into blocks that represent competency areas i.e. groups of knowledge, skills, and abilities. These are defined using critical work functions and technical content areas.

This type of model is used across a number of industries to allow employers and employees to understand not just the technical skills that are required but also to identify the soft skills needed by individuals working in these areas.

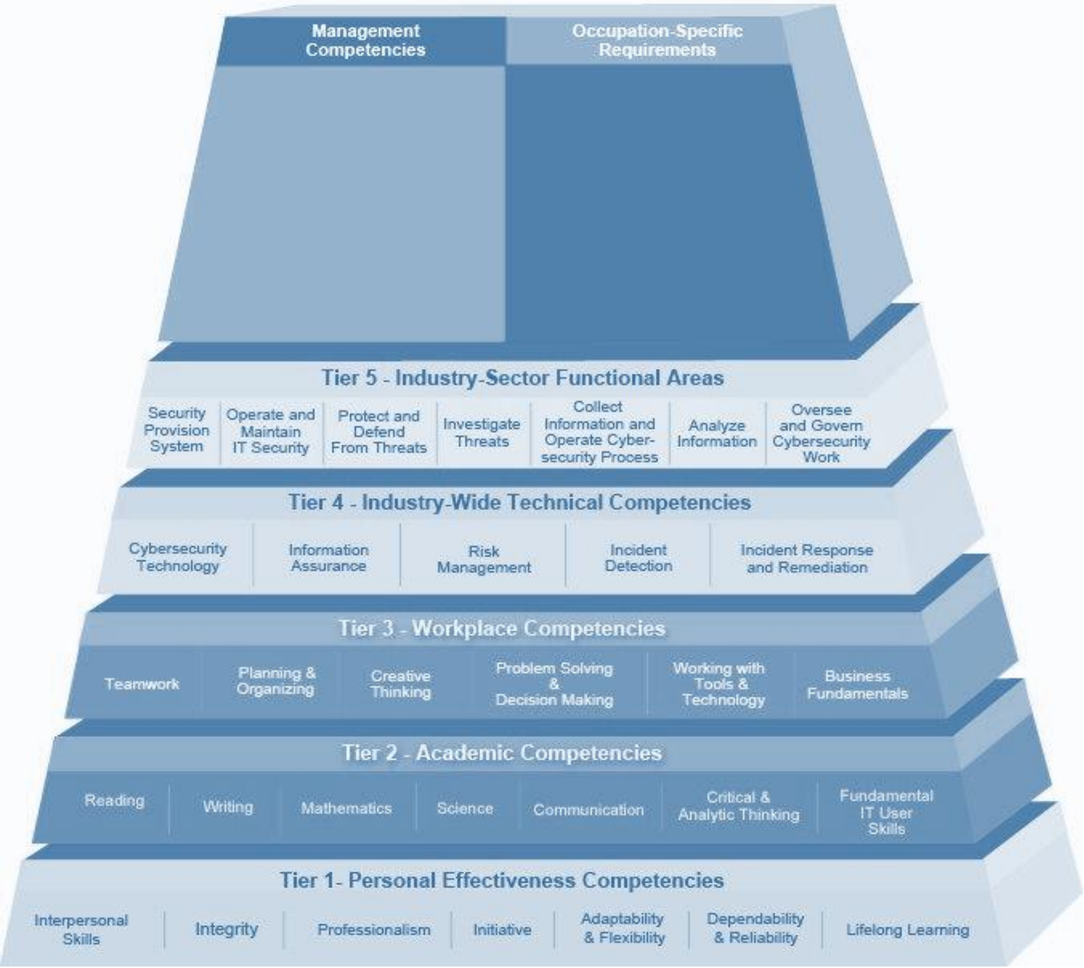
This model summarises quite neatly the issues that are seen across this sector. Mainly with ensuring that people not only have the skill sets for their particular job but are also developing the mind-set to enable them to be strategic and develop into senior roles.

> *More than 209,000 cybersecurity jobs currently sit unfilled in the US today and often of those that apply for the jobs 75% are unqualified.*

The US also has a number of certification and training bodies including:

- International Information System Security Certification Consortium (ISC)²
- Information Systems Security Association (ISSA)
- The SANS Institute
- ISACA (international and includes a Wellington Chapter)
- Software Engineering Institute (SEI)

Figure 4: Cyber security sector model



Management Competencies
Occupation-Specific Requirements
Tier 5 - Industry-Sector Functional Areas
Security Provision System
Operate and Maintain IT Security
Protect and Defend From Threats
Investigate Threats
Collect Information and Operate Cyber-security Process
Analyze Information
Oversee and Govern Cybersecurity Work
Tier 4 - Industry-Wide Technical Competencies
Cybersecurity Technology
Information Assurance
Risk Management
Incident Detection
Incident Response and Remediation
Tier 3 - Workplace Competencies
Teamwork
Planning & Organizing
Creative Thinking
Problem Solving & Decision Making
Working with Tools & Technology
Business Fundamentals
Tier 2 - Academic Competencies
Reading
Writing
Mathematics
Science
Communication
Critical & Analytic Thinking
Fundamental IT User Skills
Tier 1- Personal Effectiveness Competencies
Interpersonal Skills
Integrity
Professionalism
Initiative
Adaptability & Flexibility
Dependability & Reliability
Lifelong Learning

Source: United States Department of Labor

While the size and scale of these markets is substantially different to New Zealand there is increasing reliance on skills and qualifications that can be used globally. Much work has been done in understanding new ways of identifying the cyber security sector and developing systems and policies that will support this growth sector. By comparison, New Zealand is just starting this journey so learning from international models provides a logical pathway.

5. Wellington Situation

As outlined in *Section 3 Scope and Methodology* section, information gathering has been done to identify what the size of the Wellington market is in comparison to New Zealand and internationally. This information has largely been of a quantitative nature.

However because of the exploratory nature of some of the information, it was tested with industry to gain confidence that it represented a true picture of the scale and nature of cyber security activity, particularly for Wellington.

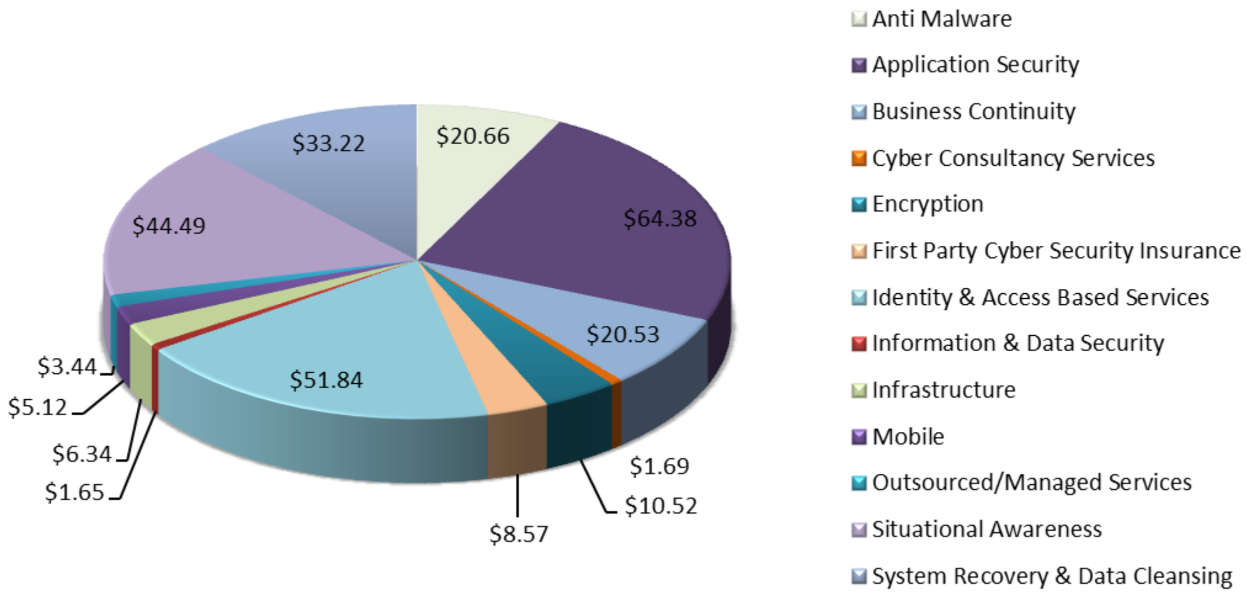
5.1. Quantitative Information

Data collection for Wellington was initially focused on understanding the different activities that make up the sector and identifying where there may be potential growth opportunities for the region. Using the kMatrix international taxonomy data to level 2 (*Appendix 1 for definitions*) was obtained showing the size of each defined activity area. *Figure 5* shows the different sector categories across cyber security and the sales value for the year to December 2015 at **$272m.**

This sales figure represents 16% of the NZ total and 19% of national exports. The volume of transactions supports the proposition that there is significant expertise in Wellington and potential for further growth.

The full data set is included in *Appendix 1.*

Figure 5: Wellington Cyber Sales (2015 $m) by category – kMatrix

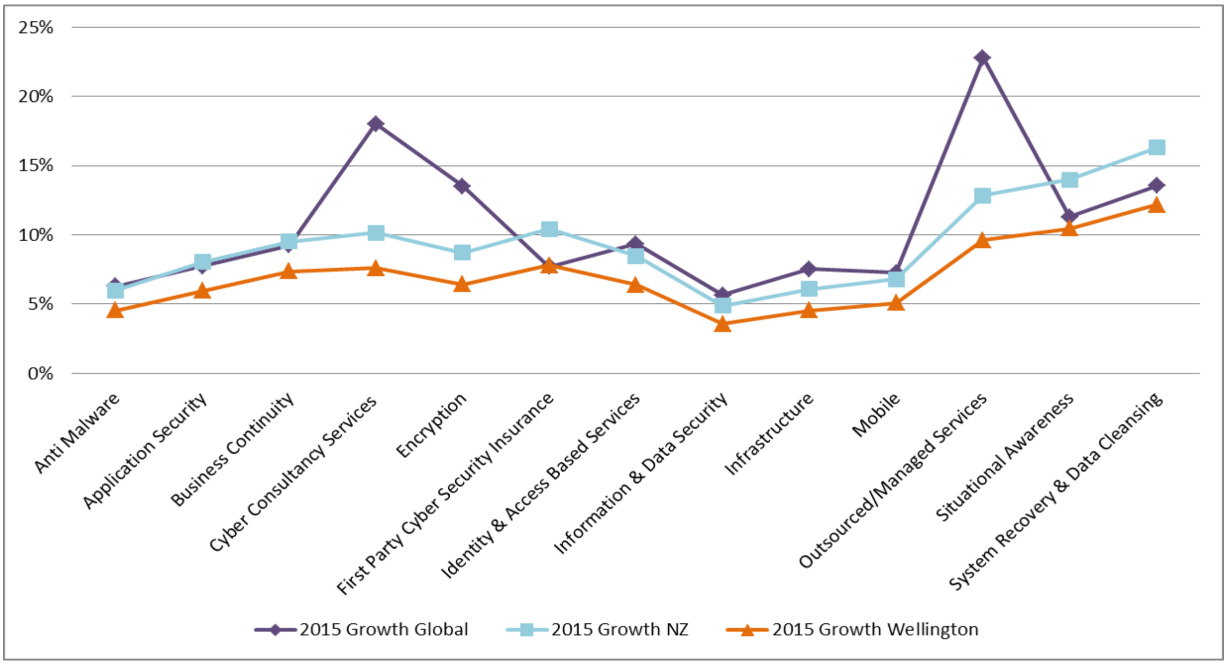


Comparisons by activity area for global, New Zealand and Wellington growth *(figure 6)* demonstrates how the region is tracking. Wellington and New Zealand follow a similar pattern but the graph identifies where global growth is happening at a much faster rate with some areas showing almost 25% growth in 2015.

This gives more reason for the development of a well resource strategy and the development of a skills base to enable future development of the sector.

Understanding where the growth opportunities are led to further investigation into understanding the skills supply and demand across these activities. This included employment projections and the supply component from the tertiary sector and immigration.

Figure 6: Growth in Cyber Security Sales (%) for 2015



Data was obtained from the short term employment forecasts, migration trends in specialist areas as well as education enrolments and graduations across the technology sector.

Short term employment forecasts produced by MBIE (*Table 3*) are only broken down at a high level and include only one area that is distinguishable as cyber security. This is ICT security specialist which is added into a category that also includes Database and Systems Administrators. Potentially cyber security roles will sit within other technology categories and in industries such as finance and data storage. Thus the ability to measure skills in the cyber security is challenging with traditional information sources.

Table 3: Short-term employment forecasts: 2016-2019

Wellington - March 2016 Update					**2016-19 Changes**	
Regional Occupational Employment Levels	2016	2017	2018	2019	Levels	Rates
135 ICT Managers	2,404	2,503	2,610	2,712	308	4.1%
261 Business and Systems Analysts, and Programmers	10,453	10,867	11,314	11,742	1,288	4.0%
262 Database and Systems Administrators, and ICT Security Specialists	1,603	1,634	1,669	1,699	97	2.0%
263 ICT Network and Support Professionals	1,612	1,674	1,740	1,803	190	3.8%
313 ICT and Telecommunications Technicians	1,588	1,567	1,550	1,528	- 61	-1.3%
Total	17,660	18,245	18,883	19,483	1,823	3.3%

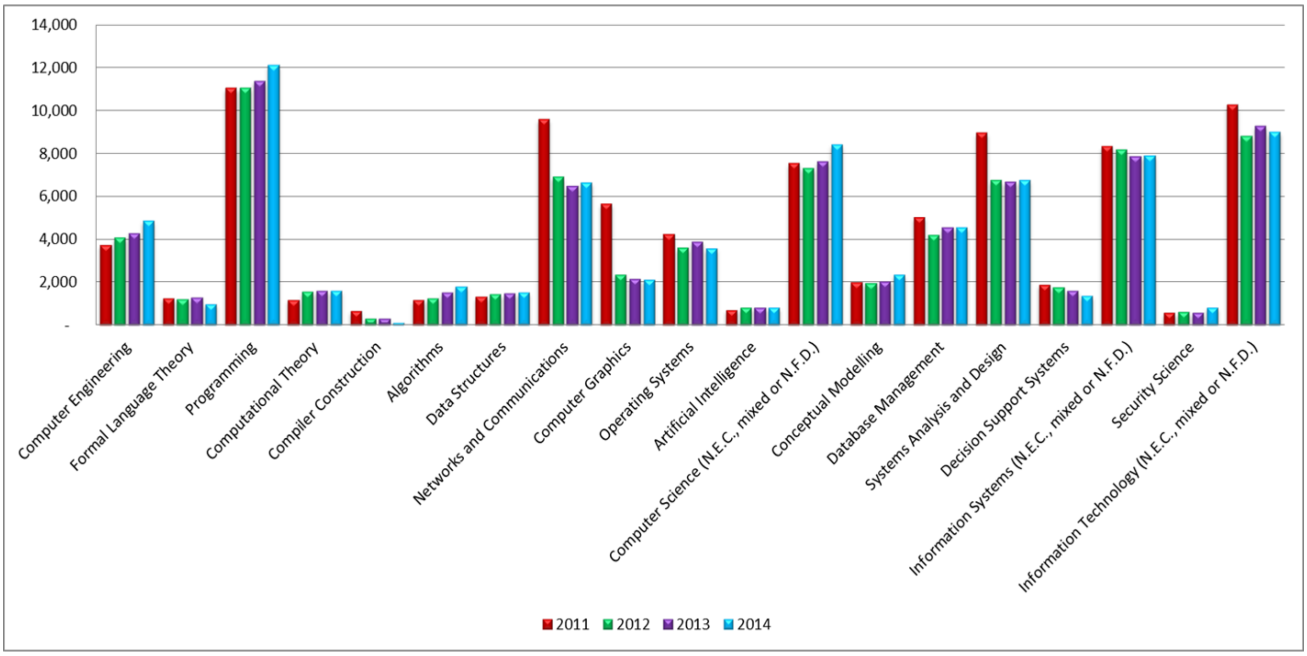
New Zealand - March 2016 Update					**2016-19 Changes**	
Regional Occupational Employment Levels	2016	2017	2018	2019	Levels	Rates
135 ICT Managers	8,620	9,015	9,444	9,856	1,236	4.6%
261 Business and Systems Analysts, and Programmers	39,575	41,367	43,302	45,180	5,604	4.5%
262 Database and Systems Administrators, and ICT Security Specialists	7,244	7,447	7,671	7,877	633	2.8%
263 ICT Network and Support Professionals	7,522	7,842	8,189	8,523	1,001	4.3%
313 ICT and Telecommunications Technicians	9,080	9,048	9,043	9,008	- 71	-0.3%
Total	72,041	74,720	77,648	80,445	8,403	3.7%

Source: Ministry of Business, Innovation and Employment[29]

The granularity required to understand this sector from an employment perspective was not available. As an example, taking the short term employment forecasts would assume a small 2% increase for wellington in the only role identified as a security specialist. This does not correlate with the 5-12% sector growth rates in 2015 nor what is predicted to 2018.

An indicator of future skills supply is the level of tertiary education enrolments across technology based fields. This demonstrates a low proportion of enrolments in the security science relative to other ICT qualifications (*figure 7).* There will be a need to understand what technology related skills and disciplines outside security science are transferrable to cyber security activity before any relatively between sector demand and graduate supply could be assessed.

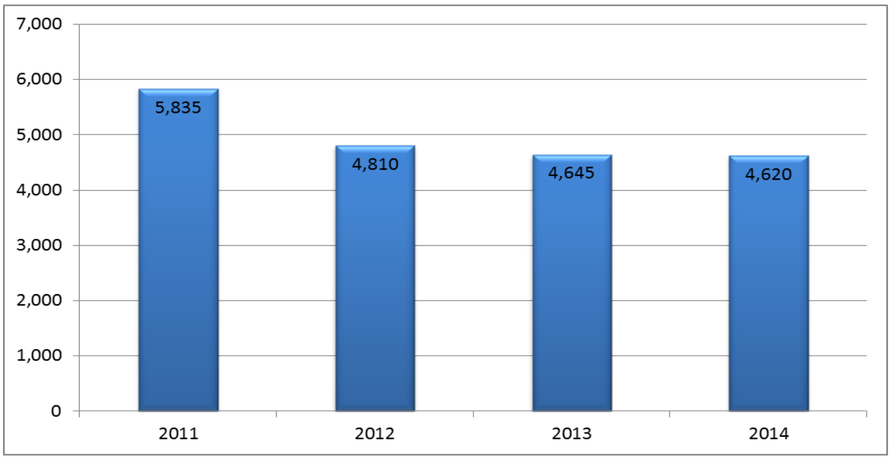
Figure 7: Student numbers by field of study (Enrolled - NZ)



Source: Education Counts 2016, Ministry of Education

In the data obtained at graduate level the trend showed a decreasing number of graduates across the technology field (*figure 8*). If we assume that this is a trend across all fields of study in technology our focus on security (and technology) as a growth sector will be tested in the future.

Figure 8: Information Technology Graduates (NZ Domestic)



Source: Education Counts 2016, Ministry of Education

Data collection also includes the number of migrants arriving in New Zealand and Wellington on the skilled visa category *(table 4*). These numbers are for the technology sector and only show one role for cyber security as outlined above with the forecast growth numbers. This data also identifies that the numbers coming in on skilled visas are both declining and low for Wellington relative to sector growth.

Table 4: Migrant arrivals Wellington & NZ

	Number of people granted Essential Skills work visa and working in tech jobs			Number of approved SMC principal applicants working in tech jobs		
Wellington Region only						
Occupation	**Financial Year Decided**			**Financial Year Decided**		
	2012/13	**2013/14**	**2014/15**	**2012/13**	**2013/14**	**2014/15**
ICT Business and Systems Analysts	21	21	19	31	30	19
Multimedia Specialists and Web Developers	339	328	75	17	28	20
Software and Applications Programmers	79	68	75	88	103	128
Database and Systems Administrators, and ICT Security Specialists	**21**	**15**	**8**	**26**	**28**	**23**
ICT Support and Test Engineers	28	35	28	31	21	35
Telecommunications Engineering *and* Computer Network	11	12	15	18	22	18
ICT and Telecommunications Technicians*	**26**	**35**	**36**	**67**	**67**	**52**
Total in "tech"-related occupations (Wellington only)	**525**	**514**	**256**	**278**	**299**	**295**

Note: *Due to small numbers, these two occupations have been grouped together.

New Zealand overall						
Occupation	**Financial Year Decided**			**Financial Year Decided**		
	2012/13	**2013/14**	**2014/15**	**2012/13**	**2013/14**	**2014/15**
ICT Business and Systems Analysts	94	100	74	353	427	391
Multimedia Specialists and Web Developers	401	396	151	128	200	183
Software and Applications Programmers	263	277	289	965	1241	1529
Database and Systems Administrators, and ICT Security Specialists	**61**	**61**	**42**	**218**	**316**	**255**
Computer Network Professionals	54	45	33	222	330	295
ICT Support and Test Engineers	67	90	74	253	246	380
Telecommunications Engineering Professionals	20	18	18	130	309	305
ICT Support Technicians	234	253	326	792	787	856
Telecommunications Technical Specialists	30	11	7	91	75	55
Total in "tech"-related occupations (New Zealand)	**1,224**	**1,251**	**1,014**	**3,152**	**3,931**	**4,249**

Source: Ministry of Business, Innovation and Employment

One of the issues around immigration is knowledge of what skills a sector requires. Currently cyber security is an emerging sector with no developed and published skill base. It does not feature in the ANZSCO codes in any detail and therefore not only is it hard to measure but the information needed to make resourcing decisions is not apparent.

kMatrix was subsequently contracted to identify the numbers of people in Wellington undertaking cyber security roles. These roles were based on international job titles and in particular those currently showing high growth and demand. Industry tested these roles based on what they were currently seeing in the workforce. This data provided the number of people employed (FTEs) across roles for Wellington and New Zealand. The methodology (kMatrix) was also used to forecast growth across these roles over the next 2 years (*table 5*). Growth figures are calculated from historical trends and triangulating sales against people numbers.

The data identifies forecast growth rate that is consistent with what is happening internationally. The average growth for the two years 2014-16 was around **20%** while the forecast growth for the two years 2016-18 is nearer to **40%.** This is a strong indicator of future demand.

Table 5: kMatrix Job title statistics (Wellington)

Job Title	Heads 2014	Heads 2016	Growth last 2 years	% growth last 2 years	Forecast Heads 2018	Forecast Growth over 2 years	Forecast % Growth over 2 years
CISO – Chief Information Security Officer	18	22	4	22%	32	10	45%
Cryptographer/Cryptanalyst	11	14	3	27%	20	6	43%
Cyber Incident Response Specialist	14	17	3	21%	23	6	35%
Cyber Security Forensic analyst	14	17	3	21%	24	7	41%
Cyber Threat Intelligence Analyst	29	35	6	21%	45	10	29%
Database Security Manager	20	24	4	20%	36	12	50%
Deputy CISO/CIAO	9	10	1	11%	12	2	20%
Incident handler	29	34	5	17%	40	6	18%
Information assurance Manager	15	18	3	20%	30	12	67%
Network security administrator	29	35	6	21%	48	13	37%
Penetration tester	28	33	5	18%	51	18	55%
Project manager	35	40	5	14%	48	8	20%
Security advisor	22	25	3	14%	29	4	16%
Security analyst	47	56	9	19%	78	22	39%
Security Architect – Consulting	17	21	4	24%	33	12	57%
Security architect – products& solutions	12	14	2	17%	20	6	43%
Security Auditor	16	19	3	19%	25	6	32%
Security Consultant – Management	38	44	6	16%	60	16	36%
Security engineer	16	19	3	19%	26	7	37%
Security Operations Manager	11	13	2	18%	18	5	38%
Security Software Developer	54	65	11	20%	91	26	40%
Security strategist	18	22	4	22%	30	8	36%
Security systems administrator	14	16	2	14%	22	6	38%
Security tester	29	33	4	14%	43	10	30%
Technical security consultant	13	16	3	23%	27	11	69%
Web security	35	42	7	20%	58	16	38%
	593	**704**	**111**	**19%**	**969**	**265**	**38%**

Roles were chosen as a measure due to no readily available skills classification for New Zealand in this sector. Ultimately skills will be a better measure for future as:

- Education sector “trains” skills not job titles
- Employers “employ” for skills and experience
- Skills can be measured better than titles
- Job titles change across organisations

The challenge is that skills classifications need to be agreed across industry, education and government before such an approach could be adopted.

Timing will be critical in delivering a new generation of skilled cyber security specialists. Currently there is negative growth in students with technology qualifications and low numbers of migrants coming into both the country and Wellington with specific security skills. This is against a backdrop of predicted short term growth across the sector of around 40%. Identifying where these new workers come from should be a priority for Wellington, and indeed NZ.

5.2. Qualitative information

This first workshop and industry interviews established a baseline for the skills related work. There were some key themes related to skills needs, sector collaboration and raising awareness. The nature of discussions is summarised in the table below:

Key Findings

Skills and Education

- Plenty of business demand
- A growth area
- Opportunity to leverage off our “Capital” status
- Need to understand the international reach
- Focus on “mind-set” skills & training as a differentiator
- Lifelong learning – start at primary, develop through tertiaries and business
- Intern and apprenticeships need to be considered more

Collaboration and clusters

- Value chain is likely to be a better option for collaboration, including international links
- Need to understand what collaboration is already happening
- Needs to be strong collaboration around establishment of the CERT

Awareness

- There is a big need to educate people – individuals, business and company boards
- Can Wellington be the NZ hub for cyber security? Virtual centre for excellence and expertise
- Can we get security specific courses into junior schools?

Issues across the above areas

- People don’t know what they don’t know
- International demand for skills – competition
- Low awareness of career opportunity
- Poaching of staff, challenge around the shortage of skills
- Cost of services biggest obstacle for small businesses

# One Concern – Someone needs to take the lead in the development of the sector
This will be a rapidly changing and growing sector that, to maximised opportunity, will require government and sector leadership in tandem.

The subsequent workshop that focussed on skills and workshop development highlighted the diversity of activity that was happening in Wellington (and nationally).

Many tertiaries are building upon their security offerings and a number of partnerships and individual trainers have come into the market. However, industry was not convinced that a degree structure is the only or best option for cyber security and this has been identified as an area that should be reviewed. This is consistent with international evidence and solutions have been developed that could help New Zealand develop the right structure (discussed under international).

Much of the current education in cyber security has been built on the basis of general knowledge that something is needed; however there is no current career path development that identifies clear steps and training needs to meet the future demand of the sector.

One of the key areas that business wants to see a change is in the capability of students when they come into the work place. This is partly driven by the expectation that they have the right knowledge and some work experience. The possibility of apprenticeships appeals to many businesses as it enables students to come into the workplace and learn about the organisation and at the same time learn the technical aspects.

Internships are already offered through the Summer of Tech programme. However they struggle to find sufficient businesses to take on interns with only **15%** of them being placed in 2015 across the tech sector. In 2016 the application numbers are looking similar but only 3 internships offered in cyber security.

The Summer of Tech intern programme had over 3000 registrations in 2015, 895 completed their profile but only 137 interns were placed.

Also lacking is an understanding of skill requirements for individual jobs. There is a current surge of businesses going to the market for security staff which is testing an already tight market both in New Zealand and worldwide. However imprecise job descriptions and lack of metrics to assess skills complicate the hiring process.

A wide range of backgrounds and skills are needed to build an effective cyber security workforce. This opens the opportunity for experienced people to retrain into this area, but for this to happen there needs to be a pathway developed for career changes.

Wellington is somewhat unique in that it has two of 10 accredited trainers for specific cyber security training. These are aligned to the Carnegie Mellon University and the only ones outside the US. This provides Wellington and New Zealand a great opportunity to build services in the Asia Pacific region and help build specific skills in a professional environment.

New Zealand and Wellington have a number of informal cyber groups that meet but no industry organisation that has a key focus on cyber security. There are no clusters which support the development of the sector and there is no industry training model to support the development of skills pathways. Development in this area is something that industry believes could be an advantage.

Immigration is the other option that businesses rely on to fill immediate vacancies. Currently cyber security does not feature as a skills shortage for New Zealand. There is also the challenge that some organisations only want to employ New Zealand citizens or permanent residents. Of benefit to the sector would be skills mapping and the ability to bring in migrants not based on their qualifications but rather on the skills they have that match a need.

What was also clear from some businesses (especially smaller ones) is that the immigration process could be more streamlined and supportive at a firm level. This was particularly evident for companies that were well down the track of employing someone only to find out they did not meet the qualification framework.

Overall is the importance of us moving to a skills demand-driven system. This first requires an understanding of where the jobs are and what the necessary skill sets for these jobs are. A sector focus at a Wellington level will be needed to drive the development and implementation of a cyber security workforce and skills action plan. This would be closely aligned with any national programme.

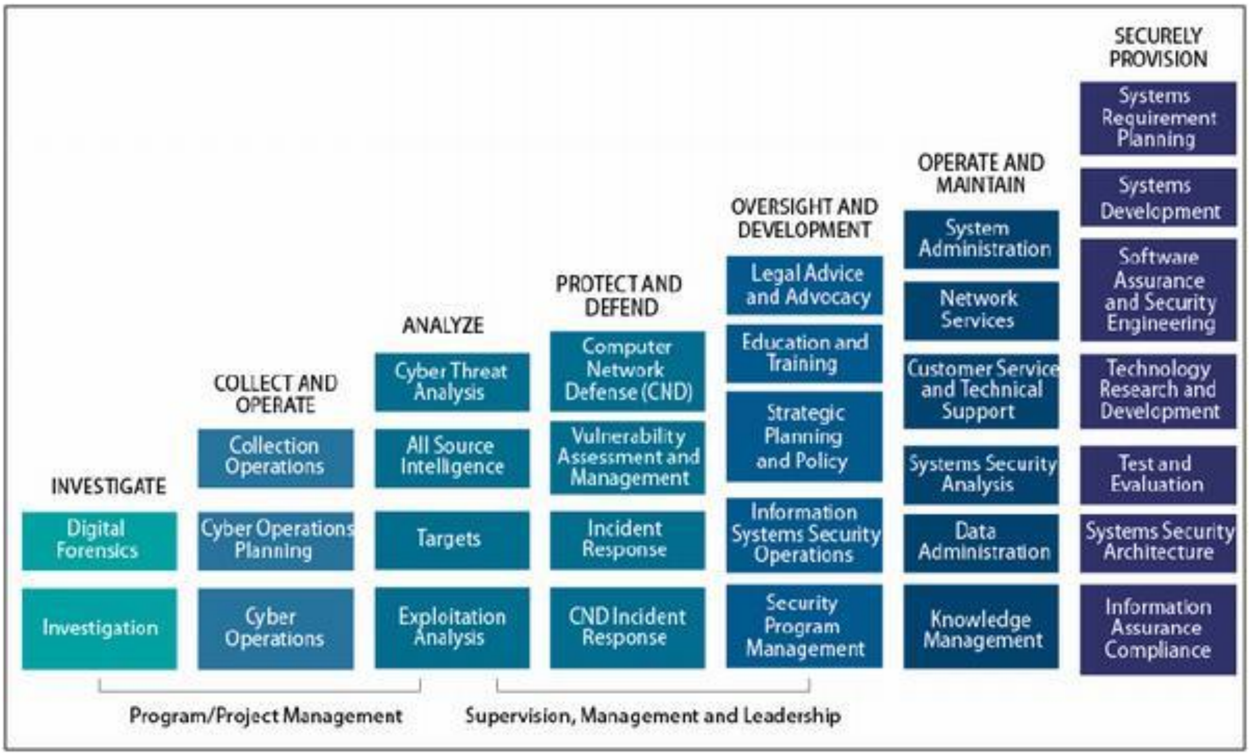
6. Framework for Skills

Both the UK and the US (*Appendix 3*) have built extensive frameworks around the development of skills for cyber security. They have focused on building frameworks that enable people to train in specialty areas. By connecting the training available with the skills one is able to easily identify what further work is required for a specific skill set.

In the development of a New Zealand framework it will be important for there to be a lead organisation that builds on and directs the work as needed. The connection of education courses to the skills framework will be critical as will the development of a careers pathway.

Based on the US model, security can be split into seven core areas of activity from *Investigate* through to *Securely Provision* (*figure 9*). These areas are then further broken down into specialty areas which have knowledge, skills, and competencies developed for them.

Figure 9: US framework for cyber security workforce development



SECURELY PROVISION
Systems Requirement Planning
Systems Development
Software Assurance and Security Engineering
Technology Research and Development
Test and Evaluation
Systems Security Architecture
Information Assurance Compliance
OPERATE AND MAINTAIN
System Administration
Network Services
Customer Service and Technical Support
Systems Security Analysis
Data Administration
Knowledge Management
OVERSIGHT AND DEVELOPMENT
Legal Advice and Advocacy
Education and Training
Strategic Planning and Policy
Information Systems Security Operations
Security Program Management
PROTECT AND DEFEND
Computer Network Defense (CND)
Vulnerability Assessment and Management
Incident Response
CND Incident Response
ANALYZE
Cyber Threat Analysis
All Source Intelligence
Targets
Exploitation Analysis
COLLECT AND OPERATE
Collection Operations
Cyber Operations Planning
Cyber Operations
INVESTIGATE
Digital Forensics
Investigation
Program/Project Management
Supervision, Management and Leadership

Source: The figure is excerpted from Partnership for Public Service, Cyber In-Security II, Closing the Federal Talent Gap, April 2015, p. 8.

Of note is that they are not job titles but rather skills needed to do certain types of work. In a New Zealand context this may mean multiple specialty areas built into one role given the size of the market here; however the key is to understand what the tasks are when trying to build the role.

From an immigration policy perspective, recognition of skill rather than qualification would require reviewing. This would enable those that do not necessarily have a qualification in cyber security but do have identified skills that are needed to help the sector grow gain entry to New Zealand.

The development of a framework needs to incorporate government, private sector, tertiary and regional interests. It also needs to be internationally compatible as this is a field which cannot only be thought of in a New Zealand (or Wellington) sense.

7. Summary of Findings

The cyber security sector requires getting the right workers with the right skills to the right place at the right time. That is, developing the talent supply chain. The outcome for Wellington is a growing sector contributing to a resilient regional economy. This needs to be a collaborative effort involving education, training and migrant attraction with the long term view of keeping the sector competitive and attractive for Wellington.

The key findings of this report relate to:

1. There is a global race to develop and attract skills in the cyber security sector and New Zealand is starting behind many developed economies
2. In New Zealand (and Wellington) there are multiple activities and interests active in the workforce and skills area. Collaboration is sought and interventions will be based on sound evidence and industry support.
3. Skills and workforce planning and development needs to be comprehensive. New approaches will be required in order to respond to rapid changes in business needs.

Each of these areas is expanded on below.

Sector context:

- The digital world will only increase and that brings with it a new risk paradigm
- Cyber-attacks are growing but the talent pool of defenders is not keeping pace
- New Zealand is well behind some of our key partners in the development of skills and career models in cyber security
- We need to keep up with international research to guide our way forward as well as completing our own research

There are information gaps in the way that the sector is described, and that provides an evidence base for future public and private investment in the sector.

The need for collaboration

- There are international models that can be taken advantage of
- There are a number of initiatives happening across the country but none currently linked
- We have access to data from UK company kMatrix who are leading the data collection in this area for the UK Home Office
- Partnerships across industry, education and government will be important

Collaboration and agility is required to keep pace with the global growth in this sector.

Skills and workforce development issues

- New models of training are required to build the new generation of cyber security professionals
- Understanding the skills requirements across the sector is critical for the development of training
- Development of a career pathway for school leavers as well as career changers is needed
- Early career advice is important to get young people interested in cyber security

- Both apprenticeships and internships are needed to help build the right skills
- Industry training needs to be developed for cyber security
- Professionalisation of the sector would be of a benefit, especially when looking at immigration and the ability for international work
- Development of a skills framework is needed
- Education needs to be built around what is needed
- Movement to a demand-driven system is critical – requires timely relevant information on where the jobs are and the skills required – talent supply chain.
- The data available is at a much higher level than that which is needed to drill down into cyber security for jobs and sales
- Immigration needs to be based on skills not just qualifications, but we need an effective way of measuring this

Building a capable fit for purpose workforce is an immediate issue for the sector. This requires some longer term thinking as well as some short term actions.

8. Key Wellington Recommendations

The following recommendations have a Wellington focus and are intended to support the growth of cyber security sector in that region. However this will require a national perspective in that any business, government or training interests will be predominantly at this level. However it is suggested that urgency by business and Government in progressing the growth of this sector warrants special consideration. This may take the form of a Wellington pilot programme for example.

Thus recommendations are presented on the basis of a process of firstly meeting information gaps, then developing a framework for action and then delivering initiatives designed to address constraints to future sector development as identified in this report. This is all outlined in summary table below of issues and recommended solutions.

The key recommendations are:

Recommendation 1

That Wellington works with the central government agencies and business to develop an agreed skills framework for cyber security. The framework would be piloted in Wellington with the view of demonstrating effectiveness such that it is adopted nationally.

Recommendation 2

That a project be undertaken to develop a skills-based demand profile for the cyber security sector in Wellington. This would include Statistics NZ looking at data collection options across the cyber security in addition to other data sources and business surveys.

Recommendation 3

That Immigration New Zealand (MBIE) and Wellington use the skills framework to develop a skilled migrant pathway for the cyber security sector

Recommendation 4

That Wellington works with business and education on delivering internships for the current Summer of Tech programme, with a focus on cyber security businesses. At the same time investigation on international intern exchanges programmes as a potential option for bringing in and building local skills should be completed.

Recommendation 5

That pilot programmes be developed with Wellington secondary schools to raise awareness of opportunities for employment; and with Victoria University and WelTec to develop the future pipeline of security professionals through shorter programmes with industry experience.

The above recommendations all require detailed planning and resourcing. Developing a skills and workforce framework can be readily modelled on international examples and populated with the information provided in the report. Information gaps have been identified and the WRS Office is currently working with industry to collate further skills related data as a basis for informing future interventions.

Summary of All Recommendations

	Key challenges	*Solutions/Recommendations*	*Process*
Data/ Information needs	Inability to define and understand the sector: • Timeliness • No ANZSIC or ANZSOC codes • Market verticals • Limited evidence base for interventions	Understanding "skill" sets vs occupations (job titles) Understanding future demand across the entire economy (i.e. government, finance. Insurance, ICT, manufacturing etc) Required: • Business surveys • Investigate with Statistics NZ opportunities for business surveys as well as collection of other data – pilot for Wellington	**1. Information gaps** Wellington specific pilot project
Policy	Immigration policy settings constrain skills supply. • Occupations vs "skills" • Timeliness • Source countries	Develop skills framework and action plan in collaboration with business, government, education – include EDAs, Chambers, and business organisations. ? Lead agency ? Regional or National project ? Cyber security project vs Tech/Digital project Leads to: • Cluster development • Professional Industry body	**2. Develop framework for action** (Wellington pilot then National)
Collaboration	Overlap of activities by Government Agencies, business and regions • No professional industry body • ? lead government agency • No clustering		
Responsiveness	Lack of supply from the education sector has led to low capability and capacity in the cyber security sector • Secondary – lack of awareness and opportunity • Tertiary – timeliness and no/very little links to industry	1. Establish a project to identify opportunities around apprenticeships and internships, including international opportunities. 2. Increase business participation in the Summer of Tech intern programme. 3. Develop training for businesses on how to work with interns. 4. Look at a new model of industry training that focuses on cyber security. 5. Develop courses for the ICT grad schools that are short term and create a cost effective way to upskill and change careers. 6. Develop a career pathway to inform secondary and tertiary students 7. Establish an sector profile for use in secondary schools 8. Develop teacher training on cyber security 9. All businesses need to understand their threat environment and the risks they face to be able to hire the most appropriate people to do the job.	**3. Addresses high level constraints and establishes programmes**
	Limited engagement of business in developing future workforce: • Not taking interns • Informing universities/trainers • SME limited capability		

Appendix 1 – kMatrix information

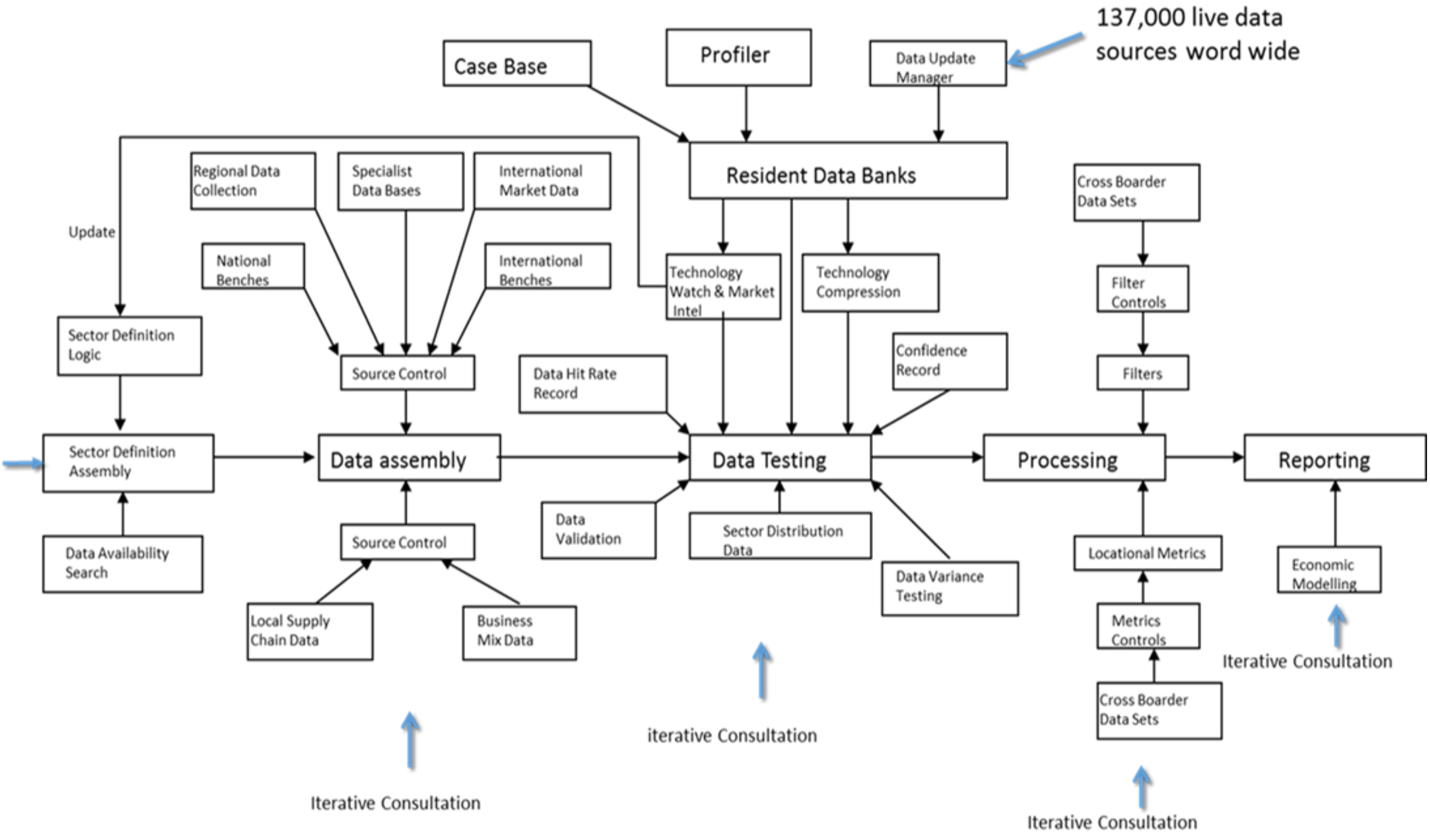
kMatrix Methodology[30]

kMatrix uses a core analytical process called Profiling. This is based upon a 25 year international research programme that started in Harvard University and was subsequently developed in countries across Europe.

Profiling can be used to provide evidence in depth (for companies) or breadth (for a sector). The major difference between the two is in how the target product and/or service markets are defined i.e. narrow/ small number for companies and broad/ large number (including both supply chain and value chain activities) for a sector.

5 Stage Iterative Process

1. Define- Identify, select and group the target market activities, an initial check for the right volume and quality of data sources
2. Assemble- Populate the data measures for each market activity check core data sources to ensure that confidence levels are within bounds
3. Check- Apply quality assurance checks to ensure data accuracy/ consistency across market activities and different countries
4. Validate- Sense-check and spot-check market data values against specific projects/ authoritative sources/ expert knowledge/ customers or clients
5. Publish- Recalculate, update confidence levels and publish research data set.



kMatrix level 2 taxonomy definitions

Anti Malware	Includes development, supply, management, training and consulting for anti-malware, anti spam, firewall, antivirus/ worm and forensic software/ services for corporate/ small business/ public/ cloud/ smart communications and other networks.
Application Security	Includes development, supply, management, training and consulting for application code security/ patch management/ content filtering & monitoring/ vulnerability assessment software and services for corporate/ small business/ public/ cloud/ smart communications and other networks.
Business Continuity	Includes development, supply, management, training and consulting for business continuity & recovery/ IT & Cyber forensics/ computer forensics software and services (manual and automated) for corporate/ small business/ public/ cloud/ smart communications and other networks.
Encryption	Includes development, supply, management, training and consulting for identity management/ digital signature/ digital certificate/ storage security correction/ detection/ prevention software and services for corporate/ small business/ public/ cloud/ smart communications and other networks.
Cyber Consultancy Services	Includes consulting for cyber audit/ insider threat/ security policy/ risk & compliance/ training & awareness/ legislation, standards and strategy for threat avoidance, threat detection and compliance
Identity & Access Based Services	Includes development, supply, management, training and consulting for access management/ intrusion detection & response/ intrusion & anomaly prevention/ messaging security software and services for corporate/ small business/ public/ cloud/ smart communications and other networks.
Mobile	Includes development, supply, management, training and consulting for mobile endpoint security/ mobile device management/ VPN/ Wireless security software and services (local/ remote access) for corporate/ small business/ public/ cloud/ smart communications and other networks.
Outsourced/Managed Services	Includes development, supply, management, training and consulting for cyber threat/ internet platform/ systems access/ mobile systems/ network
Infrastructure	Includes development, supply, management, training and consulting for infrastructure monitoring/ data management/ network security/ infrastructure resilience testing/ security applications/ web services security/ enterprise risk assessment for corporate/ small business/ public/ cloud/ smart communications and other networks.
Information & Data Security	Includes development, supply, management, training and consulting for compliance monitoring/ digital rights management for corporate/ small business/ public/ cloud/ smart communications and other networks.
Situational Awareness	Includes development, supply, management, training and consulting for high & low level situational awareness/ internal & external cyber threat intelligence/ proactive cyber surveillance/ social media monitoring/ deepweb investigations software and services (automated and manual) for corporate/ small business/ public/ cloud/ smart communications and other networks.
System Recovery & Data Cleansing	Includes development, supply, management, training and consulting for system recovery/ date recovery/ data cleansing/ data validation & verification software and service for corporate/ small business/ public/ cloud/ smart communications and other networks.
First Party Cyber Security Insurance	Includes loss or damage to digital assets, business interruption from network downtime, cyber extortion (through data release, network damage, network restriction or false communication), reputational damage and theft of money or digital assets.

kMatrix – Global Summary

	Growth	Total Sales
Global	2015	$m NZ
Anti Malware	6%	48,168
Application Security	8%	194,106
Business Continuity	9%	122,952
Cyber Consultancy Services	18%	19,186
Encryption	14%	113,653
First Party Cyber Security Insurance	8%	35,374
Identity & Access Based Services	9%	207,270
Information & Data Security	6%	6,594
Infrastructure	8%	37,795
Mobile	7%	21,147
Outsourced/Managed Services	23%	39,428
Situational Awareness	11%	342,106
System Recovery & Data Cleansing	14%	308,933
Grand Total		**1,496,712**

kMatrix – New Zealand Summary

			Export	Import
	Growth	Total Sales	Total $m	Total $m
New Zealand	2015	$m NZ	NZ	NZ
Anti Malware	6%	139	47	26
Application Security	8%	361	38	120
Business Continuity	10%	134	51	31
Cyber Consultancy Services	10%	15	5	2
Encryption	9%	76	10	20
First Party Cyber Security Insurance	10%	57	17	18
Identity & Access Based Services	8%	345	120	43
Information & Data Security	5%	11	4	1
Infrastructure	6%	44	5	13
Mobile	7%	44	16	9
Outsourced/Managed Services	13%	15	3	2
Situational Awareness	14%	250	26	98
System Recovery & Data Cleansing	16%	206	38	22
Grand Total		**1,697**	**380**	**403**

kMatrix – Wellington Summary

Wellington	Growth 2015	Total Sales $m NZ	Export Total $m NZ	Import Total $m NZ
Anti Malware	5%	21	9	6
Application Security	6%	64	9	6
Business Continuity	7%	21	7	4
Cyber Consultancy Services	8%	2	1	1
Encryption	6%	11	4	3
First Party Cyber Security Insurance	8%	9	2	3
Identity & Access Based Services	6%	52	20	5
Information & Data Security	4%	2	0	0
Infrastructure	5%	6	2	2
Mobile	5%	5	1	2
Outsourced/Managed Services	10%	3	1	1
Situational Awareness	10%	44	6	12
System Recovery & Data Cleansing	12%	33	12	11
Grand Total		**272**	**74**	**55**

Notes:

Wellington makes up:

- 16% New Zealand Total Sales
- 19% of exports
- 14% of imports

Appendix 2 – Engagement with experts

To build a qualitative understanding across this sector involved discussions with many individuals, both in a workshop format and individual meetings

Workshop attendees

Name	Company
Anu Nayar	Deloitte
Bianca Grizhar	VicLink/Dakai
Brenda Lazelle	Victoria University
Bridget Mac Donald	NZ Bankers' Association
Chris Lipscombe	Porirua City Council
Cliff Gibson	kMatrix
Colin Drew	Greater Wellington Regional Council
Colin James	Vodafone
Dave Wasley	TradeMe
Eleanor Laban	MBIE, Immigration
Fran Wilde	Independent Chair
Geoff Todd	VicLink
Heather Ward	DPMC
Jim Shaw	Axenic Ltd
Joanne Lu	Deloitte
Joanna Milne	Internal Affairs
John Dow	Agenda Marketing
Jon Duffy	TradeMe
Joshua Vial	Enspiral Dev Academy
Kate Pearce	Security Consultant
Kendra Ross	Duo Ltd
Lisa Turner	Total Risk Management
Lynda Byrne	DPMC
Mark Keegan	Aura Information Security
Patrick Hung	Westpac
Paul Bryant	WelTec
Paul Grover	Red Shield
Rees Ward	Wellington ICT Graduate School
Rohan Wakefield	Enspiral Dev Academy
Ross Hughson	Personal Information Management Ltd
Ruth McDavitt	Summer of Tech
Samantha Seath	Greater Wellington Regional Council
Simon Howard	ZX Security
Tan Huynh	Wellington Regional Economic Development Agency (WREDA)
Tim Newman	kMatrix
Tony Crewdson	i-lign software

Other key conversations

Name	Company
Adrian van Hest	PwC
David Eaton	HPE
Barry Brailey	New Zealand Internet Task Force (NZITF)
Graeme Muller	NZTech
Peter Bailey	Aura Information Security
Greg Rudd	CREST Australia
Joy Cottle	Institute of IT Professionals (IITP)
Phil Cutforth	Internal Affairs
Craig Young	TUANZ

Appendix 3 – UK International Framework

Example of the UK frameworks for cyber security

CESG, in consultation with government, business and academia has developed a framework for certifying Information Assurance (IA) professionals who meet competency and skill requirements for specified IA roles. Covers the IA roles most commonly used across the public sector, many of which have equivalent roles in the private sector. Aligns each role level with responsibility levels defined by The Skills Framework for the Information Age (SFIA).

1. ***Accreditor Role***
2. IA Auditor Role
3. IA Architect Role
4. Security & Information Risk Advisor Role
5. IT Security Officer Family of Roles
6. Communications Security Family of Roles
7. Penetration Tester Role

Accreditor Role Purpose

Accreditation provides a risk owner with the basis to make an informed business decision on whether they should accept the risks associated with a given capability, balanced against the business opportunities it presents.

The role of the Accreditor is to:

- Act as an impartial and independent assessor that the risks associated with the adoption of an information system, service or business process are acceptable to the business, and to accredit that system on behalf of the board
- For the public sector, ensures that the risk management process follows HMG Security Policy Framework (SPF) outcomes, compliance or Codes of Connection, or any other sector specific standards: but ensures that the depth and rigour required is proportionate and matches the business situation

Responsibilities

To achieve a particular responsibility level the candidate should meet the standard in the headline statement.
Accreditor – SFIA Responsibility Level 3

Accreditor Headline statement

Makes routine accreditation decisions (where empowered to do so), accepting residual risk on behalf of their organisation where it is clearly within the normal risk appetite as declared by the Senior Information Risk Owner (SIRO) or the Board

Accreditors meeting the headline statement above will normally demonstrate all of the attributes below:

- Follows HMG SPF (reference [f]), compliance or Codes of Connection or any other sector specific standards
- Works as part of a risk assessment team, consistently and proportionately applies the approach across the organisation, adapting to the challenges that the business faces, under direction, etc

Appendix 4 – US International Framework

Example of the US framework for cyber security

Cyber Security within any organisation is a process of continuous improvement. The US Workforce Framework provides a common language to speak about cyber roles and jobs and helps define professional requirements in cybersecurity.

It is organised into seven high-level Categories, each comprised of several Specialty Areas

- *Securely Provision*
- Analyse
- Collect and Operate
- Investigate
- Operate and Maintain
- Oversight and development
- Protect and defend

Each of these categories is then further developed into 31 common types of work

Securely Provision

1. ***Information Assurance Compliance***
   Oversees, evaluates, and supports the documentation, validation, and accreditation processes necessary to assure that new IT systems meet the organization's information assurance and security requirements. Ensures appropriate treatment of risk, compliance, and assurance from internal and external perspectives.
2. Software Assurance and Security Engineering
3. Systems Development, etc

*Professionals involved in **Information Assurance Compliance** perform the following tasks:*

- Develop methods to monitor and measure risk, compliance, and assurance efforts
- Develop security compliance processes and/or audits for external services (e.g., cloud service providers, data centers)
- Develop specifications to ensure risk, compliance, and assurance efforts conform with security, resilience, and dependability requirements at the software application, system, and network environment level
- Draft statements of preliminary or residual security risks for system operation, etc

*Experts in **Information Assurance Compliance** have the following Knowledge, Skills, and Ability:*

- Knowledge of applicable laws
- Knowledge of Computer Network Defense and vulnerability assessment tools, including open source tools, and their capabilities, etc

***Information Assurance Compliance** Competencies*

- Computer Network Defense
- Contracting/Procurement
- Criminal Law
- Enterprise Architecture, etc

*Persons working in **Information Assurance Compliance** may have job titles similar to:*

- Accreditor
- Analyst/Manager
- Auditor, etc

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