Perceived Value of ICT Skills within New Zealand Organisations

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Abstract

Today, information and communication technology (ICT) plays a critical role in economic growth. The ever changing technology and heavy investment in ICTs has resulted in increased demand for various ICT skills. In the last few decades, numerous studies have attempted to address issues related to ICT skill needs. However, a lack of standard classification of ICT skills has made the research outcomes inconsistent and difficult to compare. The research reported in this thesis seeks to overcome this lack of consistency by using a standard skills framework (SFIA, Skills Framework for an Information Age) to establish the demand for ICT skills within New Zealand. This study is intended to benefit the education sector and industry training organisations in planning their educational programs to align the industry needs. The research findings can also benefit the economic development agencies in assessing and resolving the ICT skill needs within New Zealand.

A questionnaire survey was adopted as the research instrument. The aim of the survey was to identify the demand for various ICT skills by ascertaining the perceived value of those skills to organisations in both the short and longer term. In total, 590 questionnaires were distributed to the organisations, randomly selected from Kompass Database via Massey University's website, with 100 or more employees nationwide. The total of 90 responses achieved a response rate of over 15%. With 16 not being considered due to the respondents being unable to answer the questions or incomplete questionnaires, 74 valid questionnaires were used in the analysis of the results. The research findings reveal that, in both the short and longer term, there is moderate to high demand for the majority of skills examined in this study. The top 3 skills that were rated as being the most valuable in both the short and longer term are "Managing the ICT function", "Application support" and "IT operations, network operation & network support". The 2 skills rated as being the least valuable in both timeframes are "Solution safety design and safety assessment" and "Marketing, sales & sales support". The skills that are directly related to technological specialties are in higher demand in the short term than the non-technological knowledge/skills. However, the non-technological knowledge/skills are seen as being more important than the direct technological skills in the longer term.

This study did not address the supply side of ICT skills in the industry. Therefore, the demand measured by ratings of values cannot be used as an indication of skills shortage. It is recommended that a study on supply of the same skills (preferably using the same standard skills framework) will be beneficial as it identifies the areas of shortage that should be planned for.

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Chapter 1

Introduction and Background

1.1 INTRODUCTION

Beginning with a number of statistic results both in New Zealand and worldwide, this chapter sets out the background to this research. The evidence in the contribution of effective use of ICTs to economic growth as a global phenomenon, coupled with the significant decline of ICT costs, has encouraged business to invest heavily in ICTs during the last few decades. This large investment has in turn raised organisations' concerns of ineffective use of ICTs causing major problems and potentially losses within the business. Consequently, having access to personnel with suitable ICT skills to ensure the effective use of ICTs have been seen as a solution by both private business and public sector. Today, with the rapid development and diffusion of technology, the demand for various ICT skills is continuously changing. Numerous studies in an attempt to investigate issues related to ICT skills have shown inconsistency in the research outcomes, as a result of a lack of a standard benchmark of the skills that have been examined. Aimed to investigate demand for ICT skills within New Zealand, this research was initiated in early 2010. In order to be able to compare the research findings with previous and future studies, this research was conducted using a standard classification of skills adopting SFIA (Standard Framework of Information Age), one of the internationally recognised ICT skill frameworks. A survey questionnaire was designed based on SFIA and 590 copies were distributed to a randomly selected sample of New Zealand companies.

1.2 BACKGROUND

1.2.1 Lack of Relevant ICT Skills as A Barrier to ICT Solutions

From providing access to new markets and services, to reducing poverty in developing countries (Africa Partnership Forum, 2008), the benefit of effective use of ICT solutions has

been witnessed over the last few decades. Organisations have become increasingly reliant on technology as fundamental and often strategic part of the businesses. Effectiveness of ICT solutions is influenced by not only suitability of solutions but also by availability of suitably trained and skilled support personnel. In other words, to minimize risks associated with the use of ICT solutions, both private and public sectors need to ensure that they have skilled ICT support staff available on an ongoing basis. A survey conducted by Statistics New Zealand (2006) shows that one of the most common barriers to implementation of new ICT initiatives by government organisations is availability of qualified ICT personnel. Another survey carried out by the Ministry of Economic Development with assistance of New Zealand Information and Communication Technology Group reveals that more than 50% of companies were planning to appoint ICT related technical staff while 83% stated that difficulties in recruiting qualified, skilled and experienced staff is having a medium to major effect on business (NZICT, 2009).

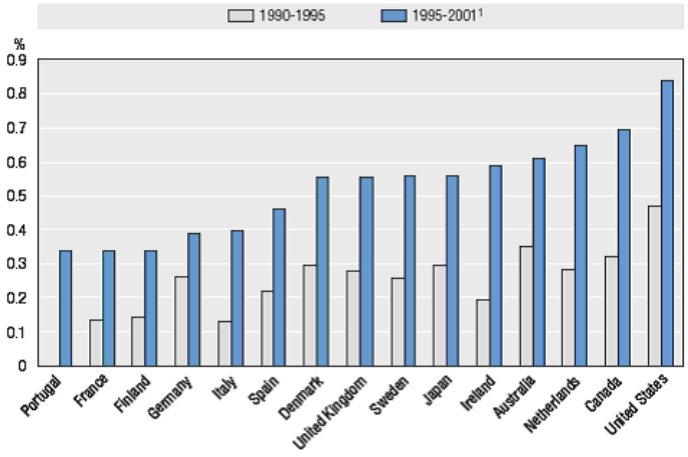
1.2.2 Contribution of Effective Use of ICTs to Economic Growth

Today, technology plays a critical role in economic growth. Business functions such as production, distribution, exchange and consumption are experiencing transformation from industrial economy to knowledge-based economy (Foray, 2004; Rooney, Hearn & Ninan, 2005). This transformation in economic structure is characterised by the increasing importance of information, communication, knowledge management and knowledge streams (Sellens, 2009). The transformation to knowledge-based economy has been accelerated by the use of Information and Communication Technology (ICT) solutions and applications worldwide. Some scholars have examined and consequently established a positive correlation between the use of ICTs and economic growth (Neef, Siesfeld & Cefola, 1998; Bresnahan, Brynjolfsson & Hitt, 2002; Colecchia & Schreyer, 2002; van Ark, Inclaar & McGuckin, 2003; van Ark & Piatcovski, 2004; Sellens, 2009).

It is increasingly recognised that economic success relies on organisations' capacity to create and exploit knowledge (Boreham & Lammont, 2000). ICT as an important tool contributes to the development of this capacity. Within the last two decade or so, an ongoing stream of ICT

solutions and e-Technologies have contributed towards significant business process transformation within many organisations and communities. The benefits of this transformation can be witnessed through a strong GDP growth by investment on ICTs across countries. As a result of deep decline in ICT technology solutions' prices (hardware and software in particular) the investment in ICT has been encouraged significantly. The intensive investment in ICTs has created the opportunity for establishing sound infrastructure so as to effectively put in use ICTs – over an ever increasing number of functions in both private and public sectors. According to the Organisation for Economic Co-operation and Development's (OECD), investment on ICTs accounted for about a fifth of growth in GDP among OECD countries between 1995 and 2003 - with Australia, Sweden and the United States benefiting the most with a quarter or more of growth in GDP being as return of investment on ICTs (Vegso, 2005). Figure 1.1 shows the comparison of contribution of growth in ICT capital assets to GDP growth in OECD countries between early 1990s (1990-1995) and late 1990s to early 2000 (1995-2001). As can be seen, the GDP growth through investment in ICTs in almost all the countries doubled within the observed period of time. In 2009, it was estimated that for every dollar invested in broadband (fixed and wireless), the U.S. economy was expected to see a tenfold return (ARRA, 2009).

Figure 1.1: The contribution of growth in ICT capital assets to GDP growth



Source: OECD Productivity Database, OECD Capital Services Database, 2003
http://www.oecd.org/document/40/0,3343,en_21571361_34590630_34888424_1_1_1_1,00.html

Today in Australia, more than 554,000 people work in ICT occupations (ACS-CIIER, 2011), contributing 4.6% of Australia's GDP and 4.9% of economic gross value add (ADFAT, 2008).

OECD and Productivity Commission and Australian Bureau of Statistics (ABS) studies estimate that 50% of all Australian business productivity can be attributed to the application of information and communication technologies (IBSA, 2012). Looking to the future, in the UK, the IT spend is expected to grow at 1.8% compound annual growth rate (cagr) through to 2013 (skillSet in UK, 2009).

In New Zealand, the expenditure on ICT as a percentage of GDP throughout the 1990s was ranked as being the highest in the world with 9% in 1992, 8.7% in 1997 (WITSA/IDC, 1998) and 10.2% in 2001 (Barton, 2002). In 2002 financial year, the total value of the New Zealand ICT industry, excluding telecommunications, was 14.2% of GDP (Chu et al. 2005).

In addition to what was discussed above, increased productivity, enhanced competitiveness and obtained global market as a result of access to ICTs have added a great deal of business value to today's globalized world. Web 2.0 solutions reinforcing global collaboration, innovation and information sharing have spawned new business models. It is evident that ICT, as a transformative economic catalyst, has a positive impact on both micro- and macro-economic growth (World Economic Forum, 2009).

1.2.3 Increased Investment in ICT Creates Increased Demand for ICT Skills

The adoption of ICTs has not only enabled businesses to improve their services but also increased their competitiveness. This competitive nature of private business has driven private sector companies into the digital world. Public awareness of the benefits of ICTs in organisations has resulted in expectations that the public sector matches the improved business processes and services offered within the private sector. Today both private sector corporations and public sector organisations rely heavily on the use of ICTs for delivery of their products and services. The use of ICTs is also important for the regional development of New Zealand both socially and economically.

With the increased awareness of the benefits of ICTs, the investment in ICTs has become a large component of capital expenditure within organisations. The extent of this investment

has in turn raised organisations' concerns. This is because misused applications and poorly directed decisions can not only risk poor returns on the investment, but even result in losses. Many companies have been challenged by the lack of effective use of e-Technologies and ICT solutions. As a result, organisations strive to minimize the risks and potential losses by ensuring the effective use of the ICTs. Having access to people with adequate and suitable ICT skills (as one of the critical factors that can impact on the use of ICTs) has become crucial to today's business. This has consequently created increasing demand for suitably skilled workers. In addition to this increasing demand, the pace of change in technology requires ongoing training to keep skills relevant and current. Moreover, as the technologies have continued to advance the demand for various ICT skills has changed over time.

This rapid development of technology and therefore ever changing demand for ICT skills has drawn attention from numerous academic researchers and industry practitioners, aiming to identify the skills (roles) in demand, so as to help the relevant groups (such as economic development groups and education sector) direct their effort towards developing an adequate ICT workforce in order to increase the effective use of ICT solutions. The previous studies (as discussed later in Chapter 2 – literature review) seem to be in disagreement on their outcomes. For instance, a study examining current trends in tertiary ICT education (Asgarkhani & Wan, 2008a) reveals that the skills students (of a focus group) were learning (or expected to learn) appeared to be somewhat out of synch with that of industry needs. However, this study was a pilot investigation based on the analysis of 205 randomly selected ICT jobs advertised in New Zealand, working with a small focus group of 35 graduating students. What's more, the skills were looked at based on job descriptions of advertised roles – they did not represent any standard framework. Another study which looked at the use of application development tools in companies within New Zealand (Asgarkhani & Wan, 2008b) did not match the findings to that of tools taught at universities.

As pointed out by Trauth, Farwell and Lee (1993, p. 294) "in such a rapidly evolving field, there is a need to continuously and systematically examine the fit between the skills and knowledge possessed by IS graduates and the requirements of industry". The ever changing

ICT related skills, that have been a result of rapid development and diffusion of ICTs (Hwang, 2003), need investigations on an ongoing basis to not only establish a clear understanding of the gap between demand and supply, but also to identify possible solutions to minimise the gap.

1.3 RESEARCH QUESTIONS

New Zealand is a small economy that can benefit significantly from the use of technology for economic development. As evidence, New Zealand regions have relied heavily on the use of technology to grow economically and stay competitive within the global marketplace. The correlation between access to ICTs and business growth has been observed within New Zealand businesses (Statistics NZ, 2002). As a result, the government has continued to emphasise the role of ICTs in the economic growth. Therefore, it seems appropriate to conduct a research project investigating the trends in the demand for ICT professionals within New Zealand. The current research was initiated to answer the broad question expressed as:

What is the demand for various ICT roles and skills within New Zealand?

The outcome of this study is to clarify (either accepting or rejecting) the theory established in the next section. Furthermore, the results may be used to assist agencies (including government organisations) responsible for development of suitably skilled ICT professionals.

The review of various industry reports discussed earlier and in chapter 2 (literature review) establishes that the high demand for ICT skills is a global phenomenon. Some evidence from New Zealand surveys (DoLNZ, 2005, 2006 and 2012; Absolute IT, 2012) also indicates a strong ICT job market. Thus, it seems reasonable to expect that this high demand for ICT skills also exists within New Zealand organisations. This leads to the first hypothesis:

> *There is high demand worldwide for ICT skills. New Zealand is part of the global economy; therefore there must be high demand for ICT skills in New Zealand consistent with international trends.*

In addition, the literature review also highlights the discrepancies in the outcome of studies on demand for various areas of ICT skills. Whilst some studies reveal that non-technical skills (i.e. personal attributes, management and business skills) are seen as being more valuable to organisations (e.g. Zwieg et al. 2006; Goles et al. 2008); others suggest that the demand for technical skills by the industry is higher (e.g. Asgarkhani & Wan, 2008a). This view is supported by the outcome of a survey conducted by the Ministry of Economic Development with assistance of New Zealand Information and Communication Technology Group (NZICT, 2009). An August 2010 review of one of the New Zealand's leading online ICT recruitment sites (www.seek.co.nz) indicated that an overwhelming majority of advertised positions are technical roles. Consequently, the second hypothesis is established as follows:

> *In the New Zealand ICT industry, the areas in higher demand are those that are directly associated with technological specialties.*

One of the issues with previous studies (as will be discussed in chapter 2) is the challenge of comparing the findings. There seems to be inconsistency in what has been the outcome of their analysis. The key factor that causes the observed inconsistency is that there are no standards in roles, skills and positions that have been examined. In order to achieve a more consistent outcome, this particular study was carried out based on a standardised classification of skills. More specifically, this research adopted SFIA as a standard skills framework to investigate 45 skills grouped in 4 categories, which are "S*olution Design / Development / Release skills*", "*Operations Management skills*", "S*trategy and Business Alignment skills*", and "*Department Management skills*".

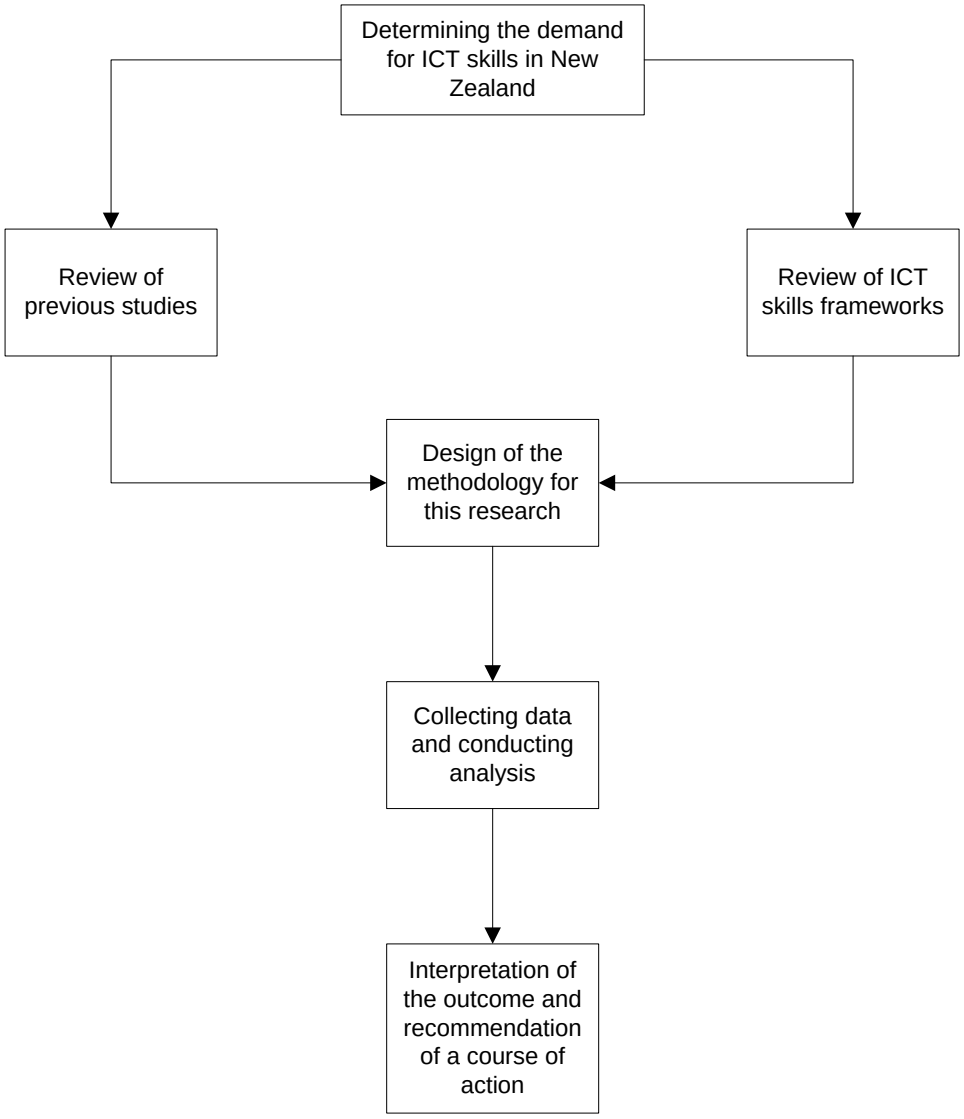
1.4 RESEARCH PROCESS

The research was carried out in four main phases. Phase 1 focused on a review of previous academic studies and industry reports to establish the research questions. Chapter 2 – literature review, discusses in detail the outcome of phase 1. Based on the research objectives and questions in phase 1, phase 2 aimed to 1) adopt a suitable framework to standardise the skills to be examined in the research; 2) design a questionnaire using the chosen ICT skills framework. In phase 3, following a random sampling strategy that was

decided to form the sample of the population for the survey, 590 organisations' postal addresses were collected and then the questionnaires were distributed to these companies. Phases 2 and 3 are covered in chapters 1, 2 and 3 outlining research design and methodology, including investigation on and choice of a standard ICT skills framework. Phase 4 concentrated on results analysis and discussion of the research findings, including possible recommendations to economic development agencies and the tertiary education sector, and finally discussion of limitations of this research and recommendations for the future studies in the field. This is covered in chapters 4 and 5 – results analysis and discussions.

An outline of the research design and process is demonstrated in figure 1.2.

Figure 1.2: Research design and process



1.5 SUMMARY

ICT plays a major role in today's businesses. With the awareness of the benefits that ICTs can bring to the business, along with a deep decline of ICT costs, organisations have increasingly invested in technologies. This increased investment has resulted in a growing demand for various ICT related skills. This is because successful ICT solutions rely on suitably skilled ICT personnel to implement the technology and fulfil the role of ICTs. At the same time, the fast development of technology also requires the ICT related skills to be continuously updated and relevant. The impact of a lack of access to ICT related skills on the effective use of technologies has drawn the attention of New Zealand businesses. In order to address issues related to the demand for the relevant skills, some investigations have been carried out by organisations both in New Zealand and worldwide. The current research, based on a standard skills framework (SFIA), was proposed to establish an understanding of demand for ICT skills within New Zealand. The use of a standard skills framework is to ensure the comparison of the research findings between the projected study and future research in the same field.

Chapter II

Literature Review –

An Overview of Issues Impacting on the Demand for ICT Skills

2.1 INTRODUCTION

In this chapter, previous work and studies are reviewed. The focus is on key issues that could potentially impact on ICT labour market dynamics. The chapter begins with a review on a number of industry reports providing facts about increased investment in ICTs, which leads to the perception of the increased need for ICT skills. This increased demand has brought about numerous issues and consequently has drawn the attention from ICT academic researchers and industry practitioners. For the last four decades, a series of academic studies and industry investigations on those ICT skills related issues have been carried out on an on-going basis. However, the lack of standard ICT skill sets has made the outcomes of the studies inconsistent and difficult to compare. SFIA (Skills Framework for the Information Age) as a standard ICT skills framework is therefore introduced, with the intention of resolving this inconsistency, to be the basis of the current research.

Following a review of international industry reports on demand for ICT skills, a discussion of various reports from the industry in New Zealand is presented. Then, the facts that can potentially impact on the perception of demand for ICT skills are discussed. Next is a review of changing demand and trends for those skills that are directly related to technological specialities and non-technological knowledge/skills. The last section of this chapter outlines a number of standard skills frameworks and the choice of SFIA to standardise the classification of skills to be examined in the current research.

2.2 PRIOR STUDIES AND INDUSTRY FINDINGS

This section starts with numerous industry reports providing the facts that the increased

investment on ICTs has resulted in the increased need for ICT skills. Then following a review of prior academic studies on various issues related to ICT skills and international industry reports on demand for ICT skills, the section presents a number of industry findings within New Zealand.

2.2.1 Global ICT Spending

With the remarkable benefits brought about through adopting ICT solutions, organisations have had to invest heavily in ICT infrastructure and other technology solutions. The significant drop in the cost of ICT solutions (both hardware and software) has also triggered considerable increase in the total ICT capital expenditure – due to ICTs being seen as affordable. There has been an ongoing growth in ICT investment (spending) over the last few decades. For instance, from 1985 to 1996, ICT prices declined at around 10% per year. This resulted in the share of ICT capital goods within total investment expenditure (in all G-7 countries – i.e. United States, United Kingdom, France, Germany, Italy, Japan, Canada) by 1996 to increase steadily to account for around 10% of total non-residential gross fixed capital expenditure (source: OECD STI/EAS estimates). On the other hand, the percentage of ICT capital expenditure expanded from 19% of the total business investments in 1980 to 35% in 2003 (source: US Department of Commerce, Bureau of Economic Analysis, National Income and Product Accounts). In the United States alone, the capital expenditure on ICT equipment and infrastructure in 2005 estimated to have reached US$1.8 trillion (Lauden & Lauden, 2006). With the emergence of post PC technology (i.e. cloud-based technology, tablet PC, 3G and 4G connectivity) over the last 3 years, the expenditure on ICTs has been witnessed yet another boost. According to Gartner's 2012 IT Spending Forecast, worldwide IT spending totalled $3.7 trillion, up by 6.9% from 2010 and will continue to grow another $3.8 trillion in 2012, a 3.7% increase from 2011 (Gartner, 2012). Table 2.1 shows the global IT spending in 2011 and a forecast spending in 2012.

Table 2.1: Worldwide IT Spending Forecast (Billions of U.S. Dollars)

	2011 Spending	*2011 Growth (%)*	*2012 Spending*	*2012 Growth (%)*
Computing Hardware	404	7.6	424	5.1
Enterprise Software	268	9.6	285	6.4
IT Services	848	6.9	874	3.1
Telecom Equipment	444	7.7	475	6.9
Telecom Services	1,701	6.1	1,740	2.3
All IT	**3,664**	**6.9**	**3,798**	**3.7**

Source: Gartner (January 2012)

As the investment in ICTs has continued to grow, there is an increasing expectation of high returns on ICT investments. Organisations' management are concerned with risks and possible pitfalls of using ICT solutions – more specifically that poorly directed decisions on solutions and misused applications risk poor returns or losses on considerable investment in ICTs.

Many companies have been challenged by the lack of effective use of e-Technologies and ICT solutions. The lack of access to suitably trained and skilled ICT workers has been identified as one of the challenges that reduces the uptake and effective use of ICTs. Availability of adequately skilled support personnel is essential to ensure proper use of ICT solutions and service continuity. More specifically, to minimize the risks associated with the use of ICTs, both private sector companies and public sector agencies need to ensure that they have skilled ICT support staff available on an ongoing basis. Access to suitable technology alongside adequately trained and skilled ICT personnel can not only minimize risks but also maximize benefits from the investment in ICTs. This can be supported by Forth and Mason's (2006) study, which establishes that "ICT skills shortages have an indirect negative impact on [companies'] performance through the restrictions that such deficiencies place on ICT adoption and on the intensity of ICT use post-adoption" (p.1).

2.2.2 Previous Academic Studies on ICT Skills

Over the last few decades, numerous industry practitioners and academic researchers have

been studying and investigating issues related to demand for ICT skills. Since the 1970s, as awareness of potential benefits of information systems (IS) grew, academic scholars and industry practitioners (foreseeing the potential high demand for information system and technology skills) attempted to address the knowledge and skill requirements of IS personnel (Henry, Dickson & LaSalle, 1974; Bryant, 1975; Elliot, 1975; Benbasat, Dexter & Mantha, 1980; Cheney & Lyons, 1980; Bartol & Martin, 1982; Baroudi, 1985; Nelson, Kattan & Cheney, 1991).

Today, technical and non-technical issues concerning ICTs are vastly different from the 70s. However, general issues raised by the studies above are still seen as being relevant and applicable. Since the 80s, there has been considerable debate that education providers need to align their teaching strategies with industry needs. The IS education process was seen as being incapable of producing qualified and employable graduates (Archer, 1983; Cardinali, 1988). This suggested that the right balance between technical and business knowledge became the focus for designing curriculum in IS tertiary institutions (Rogow, 1993). Some researchers believe that the fast pace of technological advancements increases the need for professionals to be skilled so as to work with state-of-art technical solutions made available on an ongoing basis (La Plante, 1986; Sullivan-Trainor, 1988). On the other hand, some believe advanced computerized technology can result in added intelligence and increased automation (e.g. software application tools) which in turn reduces the need for low level (direct hardware and operating systems related) technological expertise (Young, 1988).

We are witnessing a change in culture and attitudes within the ICT job sector. A study on ICT workforce skills carried out by Goles, Hawk and Kaiser (2008) indicates that both IS service provider firms and non-IT organisations value business-oriented skills more than technical ones. This is consistent with the findings of a number of other studies (Abraham et al. 2006; Zwieg et al. 2006). A study on perception gaps between IS academics and IS practitioners (Lee, Koh, Yen & Tang, 2002) reveals that as IS practitioners increasingly value non-technical skills, IS academics still rate IS related technical skills to be more important. This indicates an ongoing change in demand for types of skills within the sector. That is to

say, studies conducted a number of years earlier in order to determine skills needs may no longer be an accurate representation of current market requirements.

The next section investigates both international and local industry reports and academic studies.

2.2.3 International Industry Reports on Demand for ICT Skills

In Australia, the Department of Employment and Workplace Relations (DEWR) Vacancy Report for February 2007 reveals that the one-year growth in ICT vacancies for Australia was 35% since August 2001(DFA, 2007). According to the Australian Computer Society's (ACS - CIIER) 2011 Statistical Compendium, 14,000 ICT jobs will be created by a booming digital economy in 2012 with another 21,000 expected in 2013. Coupled with declining university ICT enrolments and the drop in skilled ICT migration, the demand and supply gap will be consequently deepened.

In Europe, the estimated unfilled vacancies in IT and e-business increased to 3.67 million in 2003 from 2.23 million in 2001 (EITO, 2001, cited in López-Bassols, 2002). In the UK, as revealed in the e-Skills UK report (e-Skills, 2006) new job vacancies in ICT sector increased from 60% in 2005 to 72% in 2006 nationwide. This increase continued through 2007 with a decline in 2008 and the second quarter 2009 due to the global recession (e-Skills, 2009). By the third quarter of 2009 the rising ICT job vacancies resumed (e-skills, 2009). By the end of 2010, the demand for ICT staff had increased for six successive quarters, rising by almost 50% (e-skills, 2011). Using a conservative "downside" scenario, it is predicated that the technology professional workforce will grow at an average of 1.2% p.a. between 2009 and 2019. This is four times the forecast for the UK as a whole. Over the period of the year 2009 to 2013, an average of 110,500 jobs each year need to be filled by people moving into technology professional roles. Over half are expected to come from another profession and a fifth from the education system (skillSet, 2009).

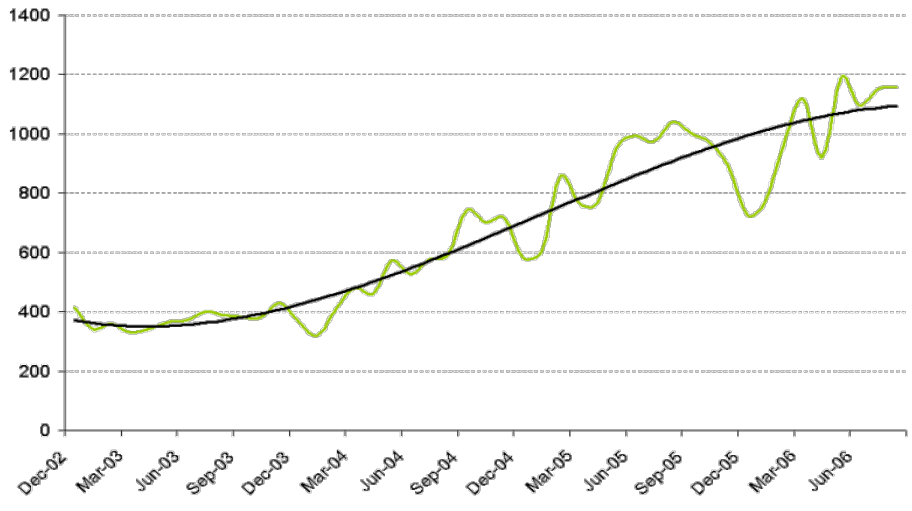
In the Asia-Pacific region, the demand for ICT skills is high and persistent (Young, 2010). This is supported by a study undertaken by the United Nations Economic and Social

Commission for Asia and the Pacific. The results indicated that, while the total demand for professionals in the ICT industry was expected to be at a level of 17 million, the number of professionals in the ICT user sectors was estimated to be about 73 million in 2010 (APDIP, 2007). Countries with developing economies, such as India and China (which are recognized as being the major source of ICT products and services to the world ICT markets) are also facing difficulties in access to ICT skills (Shankar, 2006; Trombly & Marcus, 2006; APDIP, 2007).

2.2.4 Industry Reports in New Zealand on Demand for ICT Skills

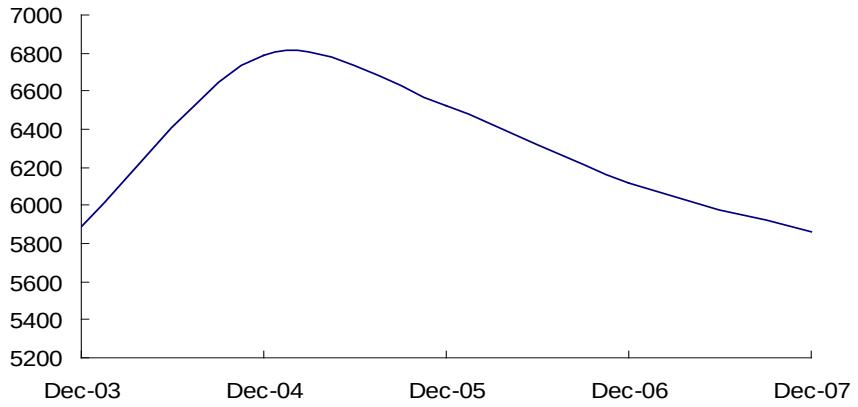
A survey conducted by the Department of Labour New Zealand (DoLNZ, 2005) reported a strong rise of IT job vacancies. According to the survey results, fill rate for IT professionals dropped from 89% in 2003 to 53% in 2004. Almost 70% more vacancies measured in January 2005 compared to the same month in 2004. This growth continued through 2005, with annual growth rates exceeding 40% in the first four months of 2005. In contrast with a 4% drop of total job vacancies from December 2006 to December 2007, IT vacancies continuously increased another 22% during the same period of time (see Figure 2.1 and 2.2) (JVM Report, 2007). After the 2008 recession, IT job vacancies started to climb again. Through June 2009 to January 2012, the vacancies increased over 100% (see Figure 2.3) (DoLNZ, 2012).

Figure 2.1: IT Job Advertisements New Zealand, December 2002 – August 2006



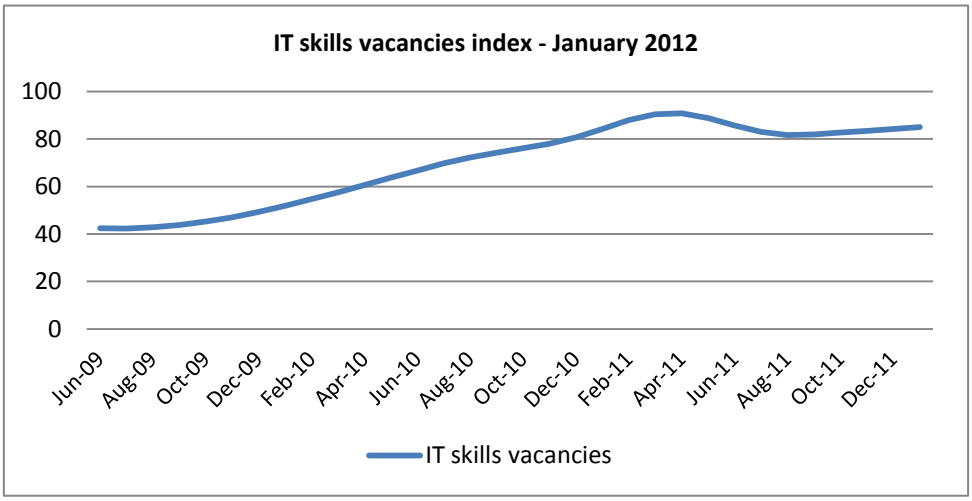
Source: JVM Report by DoLNZ. http://www.dol.govt.nz/publications/jvm/professionals/2005/ict.asp#fig2

Figure 2.2: Total Job Vacancy New Zealand, December 2003 – December 2007



Source: JVM Report by DoLNZ. http://www.dol.govt.nz/publications/jvm/job-ad-monthly-report.asp#_ftnref3

Figure 2.3: IT Job Vacancies Index Report, New Zealand, June 2009 – January 2012



Source: Jobs Online Monthly Report by DoLNZ http://www.dol.govt.nz/publications/jol/report/index.asp#fig4

According to Department of Labour New Zealand, occupations (roles) with fill rates lower than 80% are typically regarded as being in shortage (DoLNZ, 2006). According to this definition and considering a fill rate of 53% for advertised IT roles, New Zealand ICT job market has been experiencing a considerable gap between demand for and supply of ICT skills.

A recent survey completed in February 2012 by an IT recruitment company in New Zealand reveals that, among the 550 employers surveyed, 62.5% of Hamilton respondents are looking to recruit IT staff in the next 3 months, followed by Wellington and Christchurch at 50% each,

and Auckland at 46.7% (Absolute IT, 2012). The findings include the key reasons for the recruitment. Adoption of new technology is the leading reason (35%), followed by new projects (25%) and increased demand for IT from the business (19%).

2.3 FACTORS IMPACTING THE PERCEPTION OF DEMAND FOR ICT SKILLS

Considering what was discussed above, it is apparent that organisations both in New Zealand and worldwide are facing a challenge in filling ICT vacancies. However, these reports seem to have overlooked a number of factors in investigating the demand for ICT skills.

One factor that needs to be looked at is employers' perspective of skills that they require. Employers look for a number of qualities in an employee – such as level of skills, relevant experience, personal attributes and motivation to work under certain circumstances. However, they often confuse skills with personal attributes - such as commitment, enthusiasm and lateral thinking. More specifically, when employers are experiencing difficulties in recruitment, it is often the difficulty of finding people with desired personal attributes rather than technical skills. What's more, with limited resources, companies, especially small and medium sized companies, often look for versatile employees to maximize the organisation's productivity. The following job ads are examples used to demonstrate what was discussed above:

Example 1 – C# developer

- C# .NET, Win Forms, WCF/Web Services
- ASP.NET, JS, Ajax, CSS
- Strong OOD/OOP skills
- RDB design & optimisation
- 2 years proven commercial experience
- Background in financial services
- Testing frameworks
- Service Oriented Architectures (SOA)

- B.Sc. (Computer Science) or similar

Example 2 – IT professional:

Currently they (the company) have an excellent opportunity for an IT professional who is an all rounder. You will have technical knowledge and experience in Windows Server, Exchange Server and Small Business Server technologies, along with Microsoft desktop applications and IT Hardware experience. To be successful in this role you will need to have the ability to communicate at a high level with business owners, and you will be looking to advance your skill set within your chosen profession. Ideally you will have a drive for sales and your administration skills will be great too. This role involves drafting technical proposals for clients, and seeing those proposals through to successful implementation, along with related IT tasks and fault resolution.

Example 3 – project manager:

Technically astute and innovative, and supported with a tertiary qualification in engineering or technology, you may be a professional member of the PMI or related association and you will have a record of delivering what project stakeholders asked for on time and to budget…Your enthusiasm and self-motivation, along with your ability to lead, coach and mentor project team members will favourably enhance your working relationships with both your internal and external customers… In addition to the skills you bring to the job, your passion for learning and winning will help our team grow and contribute to our continued success.

Example 4 – Test analyst (3 month contract)

Urgent requirement for an experienced Test Analyst… You'll need strong testing experience across the SDLC including the ability to write detailed test plans, test cases and test results as well as performing test execution and fault tracking. We are interested in candidates with automated testing tools experience.

These examples illustrate that 1) employers' expectations for a technical role are more than just technical capacities; 2) positions requiring management related skills are often placing an emphasis on personal attributes. A person with sound C# development skills who does not have knowledge of non C# related skills (testing frameworks, service oriented architectures or background of financial services) will not be qualified for the position in example 1 (C# developer). The title for the position in example 2 is ambiguous – IT professional is not a job title or role for a position. In addition, to be qualified for this position, a person with knowledge of servers across a number of different platforms also needs to have sales and administration skills. This also shows that the level of responsibility and autonomy for a particular position needs to be defined when assessing demand for a skill set. To be a project manager, the qualification is a tertiary qualification in engineering or technology, but the required skills are management and personal qualities. In example 4, "strong" experience is required for a three month contract role. This may indicate that employers have developed a high expectation of the level and range of skills from ICT workforce, which in turn may indicate abundance of ICT workers. This is because "when workers are abundant, employers develop a high expectation of the level and range of qualities that new workers should possess. When workers become scarce, employers are forced to accept to consider workers with lesser qualities. Employers experience this as a shortage of suitable workers" (NCVER, 2007, p.7).

2.4 CHANGING DEMAND AND TRENDS FOR TECHNOLOGICAL SKILLS AND NON-TECHNOLOGICAL KNOWLEDGE/SKILLS

Although there have been concerns worldwide about the sharp growth of demand for ICT skills, some predict a declining need for technological skills in the industry. According to Gartner (Thibodeau, 2006), the need for specific IT skill workers is expected to decline 10 percent per year as companies move to commodity and virtualized systems. This predicted decline has been seen as a result of changes in technology and a shift away from IT specialty skills toward employees with more business and management related skills. This is supported by a number of studies aiming at identifying the areas of ICT skill needs (Abraham et al. 2006; Zwieg et al. 2006; Bullen et al. 2009; Goles et al. 2008).

On the other hand, previous studies have shown some inconsistency when comparing their findings. For instance, a study of demand for ICT skills in New Zealand (Asgarkhani & Wan, 2008a) reveals that technological skills related to system development of applications, networking and database are the most required skills by the industry (see Figure 2.4). As a contrast, an industry report from a recruitment company in Australia (Diversiti, 2008) finds that skills related to project management (project manager, project officer and development manager) and business analysis/consultant/architect are required more than technological speciality skills in system development, database and networking. In fact, those non-technological knowledge/skills are the most sought-after skills in the Australia ICT job market (see Figure 2.5). As discussed in Chapter 1 these two examples highlight inconsistency in findings of various studies – which can be a result of an inconsistent set of parameters and categories of skills being considered.

Overall, the lack of standardised classification of skills made it difficult to identify the areas of skill needs. For example, in the first study (Asgarkhani & Wan, 2008a), amongst the ICT professional skills, "*communication*", "*documentation"* and "*business skills*" are general skills that may be required by many other types of occupations. What's more, the "project *management in methodologies*" as a skill is not defined and seems overly specific comparing with other skills in this study. The same problem is seen in the second study (Diversiti, 2008). For instance, "*business development manager*" and "*development manager*" are in two separate sets of skills. "*Multimedia designer*" and "*multimedia specialist*" are also defined as two different sets of skills. These examples also demonstrate that it is difficult to compare the outcome of the studies without a standardised classification of skills.

Figure 2.4: Skills Rated in ICT Job Market in New Zealand, 2006 (Asgarkhani & Wan, 2008a)

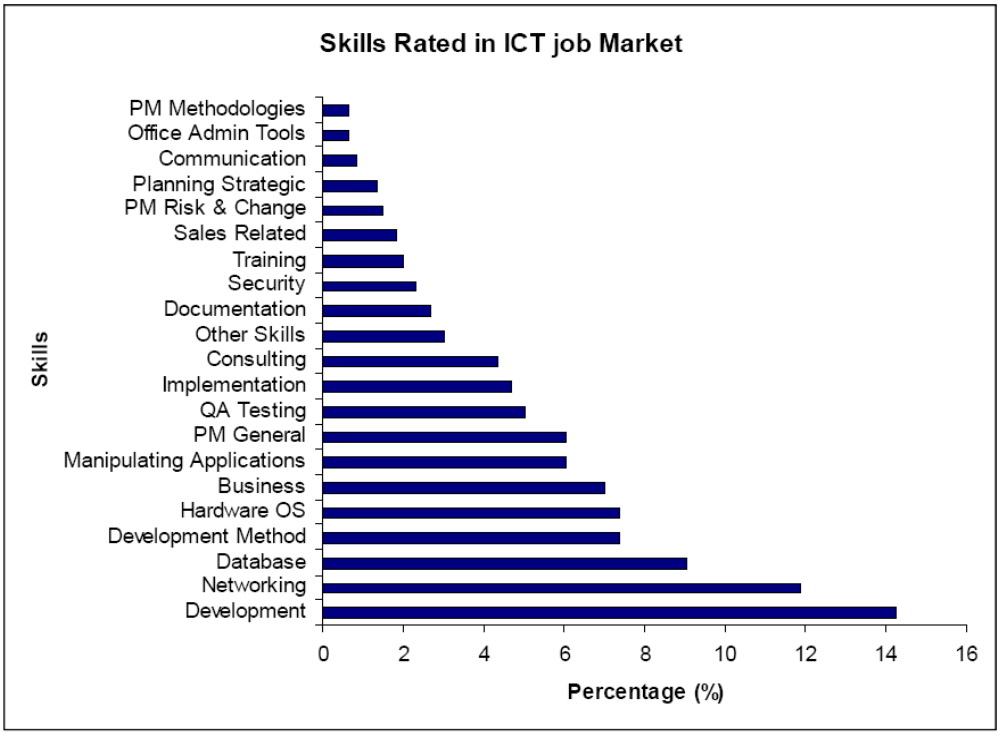
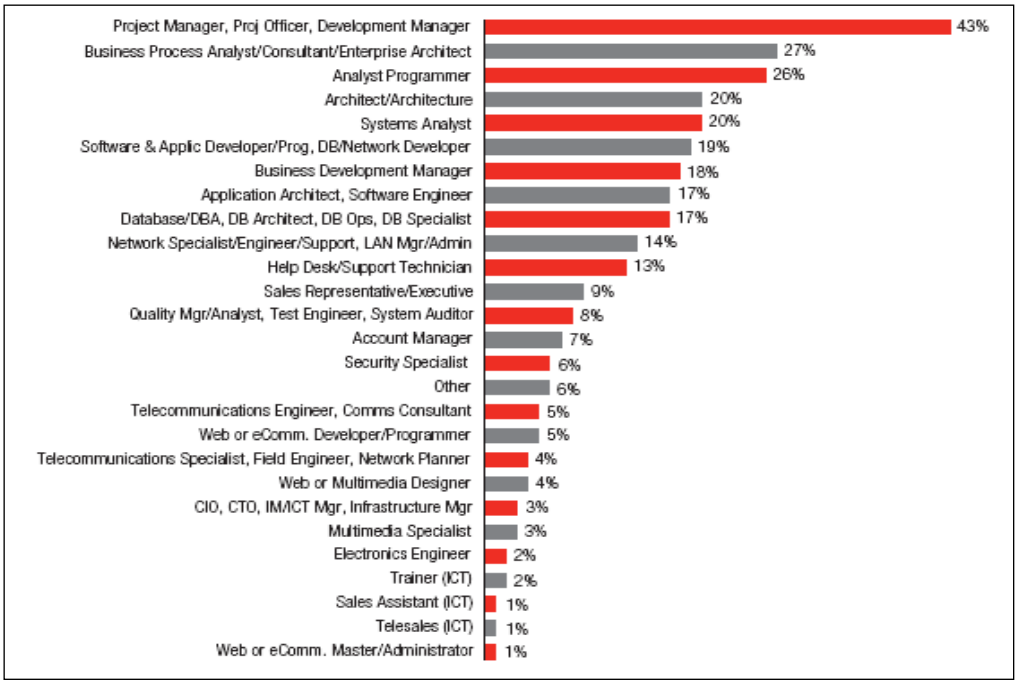


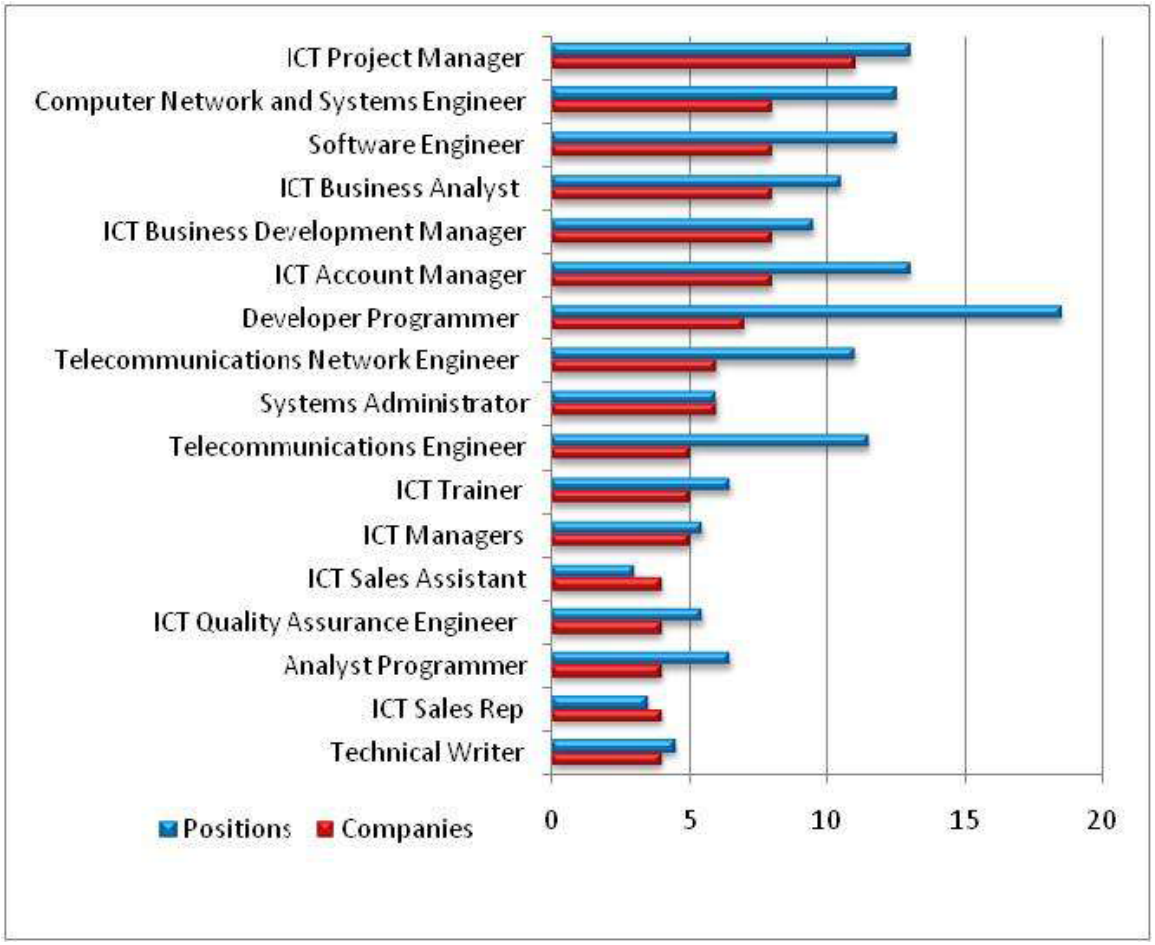
Figure 2.5: ICT Occupations Most in Demand in 2008, Australia (Diversiti, 2008).



The survey conducted by the Ministry of Economic Development with assistance of New Zealand Information and Communication Technology Group (NZICT, 2009) is further

evidence for the lack of consistency in considering the categories of ICT skills that are investigated. As can be seen in Figure 2.6, the roles such as "*Software Engineer*", "*Developer Programmer*" and *"Analyst Programmer*" were observed as different sets of skills and examined individually. However, in the New Zealand ICT job market they are often related to the same group of roles and skills. That is to say, they do not necessarily represent different sets of skills. This also applies to "*Telecommunication Network Engineer*" and "*Telecommunication Engineer*".

Figure 2.6: Technical staff increases in next six months (NZICT, 2009)



In concluding the review of previous research, it appears that there are few studies in assessing the demand for *standardised* ICT skills. The term "standardised" refers to using a set of ICT roles or skills as defined by one of the internationally recognized skills frameworks (e.g. Skills Framework for Information Age, Australia and New Zealand Standard Classification

of Occupations, e-Skills UK). Thus, this research project was launched to study demand for ICT skills within New Zealand based on a selected standard framework. The term “demand” is used to differentiate the study from those claiming the assessment of shortage of skills.

This research is to investigate the projected demand for ICT skills. The outcome may be of benefit to organisations which are charged with New Zealand economic growth and development when they are planning for supply and access to critical skills that have been identified by this study. As mentioned earlier, this study is based on a standard set of skills defined by one of the frameworks that is recognized and adopted internationally.

2.5 THE CHOICE OF AN ICT SKILLS FRAMEWORK

As discussed earlier in this chapter, a lack of standardised classification of ICT skills made the results from previous studies inconsistent. More specifically, previous work on assessment of ICT skills needs in general used different categories of skills to assess issues and trends. Consequently, it is difficult to compare the outcomes of these studies – as categories of skills are different. In order to avoid confusion about categories of skills and to achieve consistency, it was decided that the survey should be designed based on an internationally recognized framework for ICT skills.

Over the last decade, numerous classifications have been developed and introduced. Some were developed by academics for research and others put together by the ICT industry practitioners to introduce standards and streamline classification of skills. For instance, in ACM’s curriculum guidelines for a master’s level program in information systems development, Ashenhurst (1972) identified 37 IS skills and abilities into 6 categories: people, models, systems, computers, organisations, and society. In their study of IS job advertisements from 1970 to 1990, Todd, McKeen and Gallupe (1995) classified the IS job skills into 7 categories: hardware, software, business, management, social, problem solving, and development methodology. Nelson (1991) categorized 30 IS knowledge/skills into 6 groups: organisational knowledge, organisational skills, organisational unit, general IS knowledge, technical skills and IS product. Among the 6 groups, organisational knowledge

and organisational unit are the skills/knowledge related to the specific organisation or business environment in which the IS practitioners work. Organisational skills include the interpersonal skills such as ability to work in a team; ability to communicate effectively; ability to lead, control, manage and organize, to name but a few.

Today, both technological speciality skills and non-technological knowledge/skills are required of ICT workforce. In attempting to standardise roles and responsibilities within the sector (so as to making it easier to train, develop and drive recruitment selection processes) a number of industry supported standards for frameworks were developed.

One job roles/occupation framework that has been widely used within Australia and New Zealand is ANZSCO (Australia and New Zealand Standard Classification of Occupations). ANZSCO was developed for the transition of the former Australian Standard Classification of Occupations (ASCO) to best serve the need for skills assessment in New Zealand. It was initially utilised mainly by Immigration New Zealand in visa approval programs and then adapted by the Department of Labour New Zealand in various job vacancy analysis and reports.

eSkills was initiated at the end of the 1990s in the UK in response to a perceived shortage of ICT practitioners. It is now licensed by the government to produce and maintain National Occupational Standards (NOS) for IT. eSkills as a standard ICT skills framework is internationally recognised and widely used in Europe (i.e. England, Northern Ireland, Scotland and Wales).

SFIA (Skills Framework for the Information Age) is a not for profit body jointly owned by e-skills UK, the British Computer Society, the Institute of Electrical Engineers and the Institute for the Management of Information Systems. In June 2010, CompTIA (The Computing Technology Industry Association) joined to become a partner of the SFIA Foundation. The certifications awarded by CompTIA are used worldwide to assure employers of employee's technical competence. The result of the partnership is a mapping of SFIA skills to the CompTIA accreditations (Source: http://www.sfia.org.uk/public/File/SFIA_SU_2010-11_June_Final.pdf).

It provides a common reference model for the identification of the skills needed to develop effective information systems making use of ICT. SFIA groups 86 skills into 6 categories: “Strategy and Architecture”, “Business Change”, “Solution Development and Implementation”, “Service Management”, “Procurement & Management Support” and “Client Interface”. The 6 categories are then broken down into 19 subcategories. With 7 levels of responsibility associated to each skill/knowledge, it matches the skills of the workforce to the needs of the business.

After studying the most widely known frameworks (SFIA, ANZSCO and eSkills UK) it was decided to base this research on SFIA. Reasons being:

- SFIA seems to have considered a comprehensive range of skills and roles;
- SFIA has the advantage of recognizing the level of responsibility and authority associated with skills and roles;
- SFIA seems relevant to New Zealand professional ICT community. This framework was recently adopted by the New Zealand Computer Society (NZCS) to be the basis for issuing ICT professional certificates. That is to say, SFIA will be playing a significant role in the future of the ICT sector within New Zealand.
- SFIA is likely to be the basis of accreditation of ICT qualifications within New Zealand. New Zealand is likely to join the countries that established Seoul Accord (http://www.abeek.or.kr/accord/contents.jsp?menu_l=85) in accreditation of tertiary ICT qualifications – in accordance with SFIA.

2.6 MEASURING DEMAND

Demand can be defined as 1) the desire to possess a commodity or make use of a service, combined with the ability to purchase it; 2) the amount of a commodity or service that people are ready to buy for a given price. In relation to the demand for a service such as ICT skills, there is an issue in defining what the current requirements are at a particular point in time for an organisation, compared to how a skill is valued within that organisation. To put this in

context, if at the time of the survey there is a vacancy for a skill, the organisation may report that they have a higher demand for this skill than they otherwise would. On the other hand, when a skill is seen as being highly valuable to the business, the demand for this skill is likely to be persistent.

As a temporary need may cause biased results, it was decided that this study would rate the value (importance) of each skill to examine the demand for the skills. This correlation between value and demand can be supported by the study of Feller and his associated researchers (Feller et al. 2006). Using an example of the need for water from a person dying of thirst, they illustrated the correlation between value and demand. Value was defined as "subjective experience that is dependent on context" and value occurs where there are needs and "when [the] needs are met through the provision of products, resources, or services" (Feller et al., 2006, pp. 1). That is to say, demand creates value, therefore, value indicates demand.

2.7 CONCLUSION

There has undoubtedly been a growing demand for ICT skills across countries over the last few decades. This is a result of the significant decrease in ICT cost (both hardware and software) and the penetration of use of ICTs. There has been an on-going perception (both internationally and within New Zealand) that there is a lack of access to personnel with adequate and up-to-date ICT skills. This has consequently triggered numerous studies concerning demand for various ICT skills to be carried out. As some suggested a higher demand on technological skills, others indicated that non-technological knowledge/skills are more important to the businesses. To be able to compare the results of the studies, a standard skills framework is required. SFIA is therefore introduced in the current research to standardise the skills that are to be examined. As a temporary need for a certain skill may cause biased results, the current study analyses the value of each skill to examine the persistent demand.

Chapter III

Research Methodology

3.1 INTRODUCTION

In the previous chapters, the review of prior studies and industry reports established two hypotheses aiming to investigate the demand for ICT skills in New Zealand. This chapter outlines the research design and methodology including selection of the research instrument and sampling strategy. In order to validate the pre-prescribed questionnaire as the research instrument, a pretesting of an expert group was carried out. The design of the questionnaire was based on SFIA as a standard skills framework to enable the comparison of the research findings with peer studies. A simple random probability sampling strategy was adopted as the research sampling method with the target population formed by medium to large organisations within New Zealand. Following the discussion of the research design, methodology and sampling, the distribution and fine-tuning of the questionnaire is presented. Next, the objectives of the data analysis and interpretation are explained. Finally, the last section of this chapter addresses ethical issues that have been taken into consideration for this study.

3.2 RESEARCH DESIGN

The review of prior studies and industry reports established that ICT is a major tool for organisations and communities to develop and grow. Inadequate ICT resources can hinder economic and social development. Previous studies used different combinations of skills and roles that seem to lack standardisation and consistency. As a consequence, this makes it a challenge when comparing outcomes and identifying trends of demand for various ICT skills.

Considering the outcome of this review, it was decided that this research was to focus on studying the demand for ICT skills (assessed by the ratings of the value of skills to organisations) within New Zealand.

The proposed design for this research is as follows:

1. Establishing an understanding of general ICT skills issues, trends, developments and difficulties in access to ICT skills for businesses. This was achieved by reviewing and discussion of previous studies in this field.

2. Determining the underpinning theory to be the basis of this research. From the literature review, a number of impressions that exist in the industry were identified - with regards to the value and importance of various ICT skills. It was also noticed that there were discrepancies in the outcomes of the studies relating to the areas of demand for ICT skills. The combined impressions of the industry and previous research outcomes formed the basis of the theory for this study.

3. Developing/adopting a framework and establishing a benchmark for assessing trends in need (demand) for ICT skills – based on the value of those skills to organisations. The main criterion for choosing a framework was to be not only used as a research tool but also to add value to this research by setting a direction for recognizing skills in the future. This was accomplished by reviewing internationally recognized skills and occupation frameworks and selecting one that fits the purpose of this study.

4. Planning the data gathering strategy in order to assess the demand by applying a rating that indicates how valuable those skills were to the organisation. This includes a plan for determining which organisations and/or individuals qualify to participate in this study. Consideration was given to establish the population and sampling strategy.

5. Data to be collected via a postal questionnaire survey to selected sample organisations.

6. Analysing data using a statistics package to identify the statistical significance of the results.

7. Interpreting the findings and assessing the strategic importance of the research outcome to make recommendations on a course of action to economic development agencies, the

tertiary sector, and other interested parties.

3.3 METHODOLOGY AND SAMPLING

3.3.1 Selection of Research Instrument

The aim of this research is to answer the broad question established in chapters 1 and 2 "*what is the demand for various ICT skills within New Zealand*". Based on a review of previous academic studies and both international and local industry reports, this broad question is broken down into two hypotheses – 1) "*there is high demand for ICT skills within New Zealand*"; 2) "*the skills directly related to technological specialities are in higher demand than those non-technological knowledge/skills*".

One of the research objectives was to achieve consistency in order to compare the findings with peer studies. As suggested by Brace (2004), surveys with well-designed questions ensure consistency of data. Although a qualitative survey would ensure a free-response with respondents' own answers (Jordan, 1988; Oppenheim, 1992), it is difficult to keep the answers consistent so that comparisons between participants' views can be made. A pre-prescribed questionnaire survey, on the other hand, can provide quantitative data using fixed-response questions, where a number of alternative answers to a question are presented to the respondents to choose one that they feel is most appropriate. Fixed-response (or closed questions) have been criticised for forcing participants to answer the questions with a choice of researchers' views rather than respondents' observations (Jordan, 1988; Oppenheim, 1992). However, the advantage of being more specific by using a pre-prescribed questionnaire can help communicate the same frame of reference to all respondents, and well designed response categories can more accurately detect differences among respondents (Converse & Presser, 1986). Another argument against fixed-response questionnaire surveys is that the pre-prescribed questions may fail to provide an appropriate set of responses that are meaningful in substance or wording to respondents (Schuman & Presser, 1996). Once again, this can be overcome by a number of techniques. A pilot test (trial) on a focus group (an expert group in this study) can be used to validate the questions

and the pre-defined answers (Schuman & Presser, 1996). In addition, using open follow-up questions as probes of key closed questions can combine the advantages of both open and closed questions (Converse & Presser, 1986).

After the research questions were established, the analysis plan was initially to assess if a specific skill was needed within the organisation and at what level (i.e. entry, medium or senior) it was required. With this clear analysis design, a list of structured classification questions was developed. As suggested by Cooper and Schindler (2011), a questionnaire survey as a data collection instrument is suitable when there is a solid idea of what type of analysis will be done for the research. In addition, surveys with questions supported by pre-prescribed answers can also save participants' time spent on answering questions to motivate participation and improve response rate. Furthermore, questionnaire surveys ensure the objectivity of data collected as there is no observer bias or inaccurate interpretation by interviewers.

Having assessed advantages and disadvantages of a questionnaire survey, a strong emphasis on well-designed questions was addressed with an option of open questions that allow respondents to add their own questions and/or answers. Apart from this, a pilot survey of an expert group was considered in order to validate the questions and the pre-defined answers.

3.3.2 Pilot Survey of an Expert Group

According to Morgan (1997), data collected from a focus group can often serve as a source of preliminary data in a primarily quantitative study and can be used in designing survey questionnaires. What's more, focus groups produce concentrated amounts of data focusing on the researcher's specific interest in a short period of time (Morgan, 1998). Conducting a pilot survey using a focus group seemed appropriate for this particular research as a result of the need to "gather substantial amounts of carefully targeted data within a relatively short period" (Morgan, 1988, p.32). However, rather than adopting the form of an interactive group sitting together for collecting preliminary information, the current study used a pilot survey

with a group of experts. More specifically, a pre-testing questionnaire was sent to a group of people, with knowledge of the ICT skills needs within their own organisations or the industry as a whole, to verify the research instrument. Having decided to conduct the survey using a pre-prescribed questionnaire, this pilot survey was to validate and enhance the questions and pre-defined answers. A preliminary design of the questionnaire was tested with the expert group made up of ICT professionals from NZCS (New Zealand Computer Society), CPIT (Christchurch Polytechnic Institute of Technology) and CDC (Canterbury Development Corporation). The justification for selecting these particular respondents is supported by Morgan (1988, p.30).

> "In focus groups, the research team uses its judgment to select 'purposive samples' of participants who meet the needs of a particular project. Surveys use a fixed set of questions, and every respondent is asked exactly the same questions, with exactly the same set of predetermined response options."

The feedback from the expert group seemed positive. After a number of adjustments suggested by the results of the pilot survey, it was decided that the questionnaire based survey was to be conducted as it appeared that sufficient and valid information would be collected from the questionnaire.

3.3.3 Strengths and Weaknesses of a Postal Questionnaire Survey

A postal questionnaire survey was decided to be the data collection tool due to the geographic coverage of the sample population, which was originally considered to be the Canterbury region then extended to be New Zealand nationwide. This is supported by Jordan (1988) and Oppenheim (1992) that a postal questionnaire survey is an inexpensive and effective method for collecting data from a widely dispersed sample population. In addition, as the researcher is not present while the respondents are answering the questions, the responses are free of biased researcher effects (Oppenheim, 1992). In other words, the respondents are less likely to be influenced by the researcher and therefore also less likely to respond consciously (sometimes unconsciously) in such a way that they feel the researcher

wants them to. On the other hand, due to the lack of a researcher being present to explain the questions which appear to be unclear to respondents, it is more likely that respondents may skip a question or even answer a question incorrectly based on their lack of understanding or inaccurate interpretation of the question. To overcome this weakness, a cover letter and a skills framework information sheet were included and posted along with the questionnaire. What's more, although by large the potential inaccurate answers can be improved by incorporating the results of a pilot survey of an expert group, it is believed that the respondents may still answer questions incompletely, miss out questions or even whole sections (Oppenheim, 1992). In fact, this was experienced throughout the survey of the current research. More specifically, a total number of 16 responses were excluded in the results analysis due to the respondents being unable to answer the questions or incomplete questionnaires. Another weakness of postal questionnaire surveys is that there is a potential risk (due to the researcher not being present) that the respondents may not be the people with sufficient knowledge that can answer the questions correctly. In order to overcome this shortcoming, the position of the person to receive the questionnaire was taken into account. As pointed out by Fowler (2002), a very large sample aimed at reducing sampling error to a minimum is likely to be unwarranted if the respondents are unable to answer the questions with great precision. That is to say, the results of this research would be likely to be invalid if the respondents did not have sufficient knowledge of the business needs within their organisations. Bearing this in mind, it was decided that the questionnaires would be addressed to people at a senior position such as IT manager, human resource director, chief information officer, or a member of the organisation's executive team. This was to ensure the validity of the responses and credibility of data to be collected.

3.3.4 Use of SFIA and Design of Questionnaire

As discussed earlier in Chapter 2 (section 2.5), to achieve consistency, prior to data collection, a framework with an agreed upon list of skills was developed. This has formed the basis of the survey questions. The skills included in this framework are based on SFIA (Skills Framework for the Information Age), which is one of the standard ICT skill frameworks that are

recognized and used by organisations worldwide. In addition, in order to obtain a higher response rate, the questions were designed to ensure minimum time was needed by participants to answer the questions.

Following the feedback from the pilot survey of the expert group, the questionnaire was designed in three parts. Part 1 asks demographic information of the organisation being surveyed. The purpose of this information was to identify the characteristics of respondent organisations such as company size, number of employees in various ICT related positions and the number of vacancies of ICT roles. Part 2 is the main body of the questionnaire. As discussed in the previous chapters, a lack of using a standardised skills classification has made the prior research findings inconsistent and difficult to compare. As a result, it was decided that the skills to be examined in part 2 of the questionnaire would be based on the chosen skills framework SFIA. The first version of the questionnaire in part 2 used the 86 skills grouped into the 6 categories directly from SFIA but with only 3 levels of responsibilities – “entry”, “intermediate” and “advanced”. The intention of this design was that the findings of any future studies using SFIA at the more detailed level could be re-grouped into these 3 levels of responsibility and directly compared with this study.

To rate the level of importance (value) of a certain skill for the organisation, a multiple-choice (4 levels) and single-response scale of answer was designed for respondents to select from. Part 3 was an evaluation of the questionnaire and the use of SFIA for the design of the questions. The intention of this evaluation was again to test the validity of the survey.

As discussed in chapter 2, a temporary need for a particular skill may bias the perception of the demand. By wording the questionnaire to ask for the significance of the skill and rating it with the value to the business an attempt was made to avoid biasing the results with a temporary need. To be able to measure the demand for various ICT skills, the questionnaire was designed for participants to rate the value (importance) of each skill to the business operations and development within their organisations. It is assumed that where a skill is rated as being of “value” to organisations, there will be a “demand” for people who possess that particular skill. In other words, “value” implies “demand”.

3.3.5 Sampling Strategy

A simple random probability sampling strategy was adopted as the survey research method. It was intended that only larger organisations be considered for this study. Based on the definitions of medium to large organisations, the sample population was projected to include companies with 100 or more employees. The justification is that those organisations are more likely to be in a position of risking communication efficiency, business reengineering and growth by improper or inadequate use of ICTs. What's more, excluding small firms can reduce the excessively large sample size to a more optimum level, and at the same time still "fulfil the requirements of efficiency, representativeness, reliability and flexibility" (Kumar, 2008). Apart from the size of the organisations to form the sample population, the strategy for identifying and seeking access to qualified organisations and/or individuals was also taken into account. This is outlined as follows:

Sources for identifying organisations and individuals

Company listings available from various sources were initially considered to be used to establish the population of potential participants. After a number of attempts such as searching online listings (including Statistics NZ website and Yellow Pages) and seeking advice from professional bodies (i.e. Canterbury Development Corporation and New Zealand Computer Society), it was decided to use the Kompass Database that could be accessed via the Massey website. The Kompass Database is a worldwide B to B company search engine.

Identifying organisations that qualify for the survey

As discussed earlier, to ensure the validity and credibility of the data collected, it was decided that the sample population was only to include organisations with 100 or more employees across all industries within New Zealand. More specifically, the sample would include both companies specializing in providing ICT solutions and services directly (e.g. IT companies such as application development, general ICT service support, internet services providers, web

design & development and web hosting & domain registering services) and client organisations (non-ICT providers).

3.4 DISTRIBUTION AND FINE-TUNING OF THE QUESTIONNAIRE

The first version of the questionnaire was distributed to organisations that were listed on the Kompass Database with 20 or more employees, only within the Canterbury region, where the initial intention of the research was to be focused. However, the disruptions by the Christchurch earthquakes shortly after the distribution resulted in a very low response rate, which consequently forced the survey to be postponed. During this time, the questionnaire was reviewed and simplified to facilitate a higher response rate in the next distribution.

To simplify SFIA, first it was decided to remove the 3 levels of responsibility. Second, the 86 skills were condensed into a total number of 45 (i.e. similar skills were grouped together and named after SFIA's subcategories). This allows for any future studies using the full version of SFIA with 86 skills to be re-grouped for comparison with the current study. Then, the 45 skills were categorised into 4 main skill sets, which are "*Solution Design / Development / Release*", "*Operations Management*", "*Strategy and Business Alignment*" and "*Department Management*". In order to study the trends/change in the demand, the questionnaire asks the significance of each skill split between short and longer term.

3.5 OBJECTIVES OF THE DATA ANALYSIS – INTERPRETING DATA

The proposed data analysis was aimed to establish the skills that would be rated as critical to both the current and future growth of New Zealand businesses. More specifically, the outcome of the study was to find out 1) the level of demand for various ICT skills in New Zealand; 2) potential change of demand and trends for skills directly related to technological specialities and non-technological knowledge/skills; and 3) consistency of ICT skills in New Zealand with the chosen framework.

In addition, this study was devised to provide recommendations for educational and training organisations in order to aid the planning of a balanced ICT workforce in New Zealand. These

could also be applied to employers in the planning of their human resource requirements.

3.6 ETHICAL CONSIDERATIONS

As it is believed (Dale et al., 1988, cited in Saunders, Lewis, & Thornbill, 2007) that "ethical problems associated with a questionnaire survey strategy are fewer due to the nature of structured questions that are clearly not designed to explore responses and the avoidance of the in-depth interview situation" (p. 189) the ethical issues in this research were mainly associated with general issues in gaining access, collecting data, data processing and storage. Overall this was a low risk project where ethical issues were concerned.

An information sheet was attached to the questionnaire administered to the participants. The information sheet was prepared according to C*ode of Ethical Conduct for Research, Teaching and Evaluations involving Human Participants* used in Massey University. The cover letter and information sheet provided the purpose of the research, storage and accessibility of the data. Furthermore, the rights of the participants were clearly stated. For example, participants were made aware that their participation was voluntary and they had rights not to answer any or some of the questions in the questionnaire.

As mentioned earlier, the questions in part 1 of the questionnaire were linked to the respondent organisations' demographics. This information needed to be kept safe for both digitally stored (restricted access) and hard copy data within the researchers' department with consideration given to information security, confidentiality and privacy.

Overall, ethical considerations of this research include:

- An approved notification of low risk research/evaluation involving human participants.
- Guaranteeing confidentiality – results must not be linked in any form to individuals and companies.
- Participants to be provided with information of their rights of refusal for participation

and/or being involved.

- Participants to be offered the option of receiving information about the outcome of the research.
- Safe keeping of collected information and data.
- Sensitive demographic data to be kept for no longer than necessary.
- The questionnaire was designed with a low demand on the participants' time avoiding any requirement to supply extensive written answers.
- The results of data analysis would not be selective.

3.7 SUMMARY

Collecting data for this study (primary research) was conducted in phase 3. With the aim of keeping the respondents' answers consistent and therefore comparisons between participants' views could be made, it was decided to conduct the current research using a pre-prescribed questionnaire. A pilot survey of an expert group was carried out to pre-test the proposed research instrument. In addition, the design of the questionnaire adapting SFIA as a standard skills framework was also intended to reinforce the consistency of the findings with peer studies. Having considered the nature of the survey (i.e. the geographics of the sample population), a postal questionnaire survey seemed appropriate and efficient. The organisations with 100 or more employees were considered to form the sample population. What's more, in order to ensure the validity and credibility of the data to be collected, it was decided that the questionnaire would be addressed to people at senior positions with sufficient knowledge of the business needs within their organisations. A simple random probability sampling strategy was chosen to be the survey sampling method. After investigation of various sources to access the sample population, it was decided that the Kompass Database, which can be accessed via Massey's website, would be the main source of the access to the sample population. It appeared that this research was a low risk project when concerning ethic issues. A cover letter providing the purpose of the research and an information sheet explaining the rights of the participants was included along with the

questionnaire. The security, confidentiality and privacy of the data to be collected were also clearly communicated to the potential participants.

Chapter IV

Research Results

4.1 INTRODUCTION

This chapter elaborates on the analysis of outcomes of the survey. The survey contained three sections, which are 1) demographics, 2) rating the significance (value) of ICT skills (the main component of the survey), and 3) general information about the survey and evaluation of the framework of skills used. The results from all three sections are presented in this chapter.

Demographics look at the organisation size, industry distribution, current IT positions and vacancies, and the role of the respondents. The core questions of the survey are grouped in part two. This part examines 45 skills grouped into four categories, split between short term and longer term demand. This has been defined as immediate (within the next 12 months) significance of each skill, and longer term (greater than 12 months) significance of the skill. The respondents were asked to rate each skill from 0 to 3, where 0 was of no value and 3 was highly valuable to the organisation. In part three, respondents were asked to evaluate the questionnaire and framework (SFIA) used for the design of the questions.

Please note that, the analysis and discussion of results consider the following assumptions:

Assumption 1 – as discussed earlier in chapter 2, based on the correlation between value and demand, it is assumed that when a skill is rated as being of “value” to the organisation, there is a “demand” for this particular skill.

Assumption 2 - rating with mean values over “2” means high value (i.e. greater than 2 out of 3). Based on assumption 1, where there is a high valued skill, there is demand for that skill.

4.2 BACKGROUND

The first version of the questionnaire was launched for a survey of the Canterbury region only in late August 2010. A first batch of approximately 150 questionnaires was distributed to companies within the region. Unfortunately, the September 2010 earthquake happened shortly after. This resulted in major disruptions in the region and an extremely low response rate. It was decided to stop the survey until companies were settled and back into their normal business routines. The questionnaire was fine-tuned (based on a small number of responses from the first batch of the questionnaires) and the survey was re-launched in early 2011. Sadly, the 22 February earthquake and the resultant considerable damage to the region made it impossible to complete the second round of the survey.

By April 2011 it became obvious that the project as it was designed (a pilot for the Canterbury region) could no longer be carried out. In consultation with both academic and industry supervisors, a decision was made to broaden the study to be a nationwide investigation.

After securing support from the industry and academic supervisors, it was decided that

a) the research design was to be reviewed to target a nationwide study
b) based on 11 responses received, the framework adopted was to be simplified to secure a better response rate.

As highlighted in research design, random sampling strategy was used for this research. Five hundred and ninety companies (with 100 or more employees) were randomly chosen (using the Kompass Database via Massey's website). The first batch included 500 companies. Four unopened questionnaires were returned due to change of address. After 71 responses were received, the reminder letters were distributed to the 500 companies. In addition, a second batch of 90 companies was launched. This resulted in receiving an additional 19 responses. According to the Kompass Database, there are a total number of 1231 companies with 100 or more employees in New Zealand. The randomly selected sample size of 590 appeared to provide a sufficient coverage of business industries nationwide.

The total of 90 responses achieved a response rate of over 15% (with 16 not being

considered due to the respondents being unable to answer the questions or incomplete questionnaires). Overall, 74 valid answered questionnaires were used in the analysis of the results.

To compare the response rate with previous studies of a similar kind, a 17% response rate was attained in the study of perception gaps between IS academics and IS practitioners by Lee et al. (2002). The response rate for a study by Auckland University Computer Science on software development practices in New Zealand was 15.8% (Kirk & Tempero, 2012).

In brief, even though this study used a complex questionnaire that requires detailed knowledge of the industry in order to be able to respond to it, the response rate seems comparable with other similar studies in the field mentioned above.

4.3 DEMOGRAPHICS

4.3.1 Company Size and Industry

This section presents various demographics as collected from this survey. More than 43% of the organisations in the sample employed over 500, 27% had between 100 and 249 employees, nearly 22% had employees numbering between 250 and 499. Eight percent of respondent companies currently had less than 100 employees. As mentioned earlier, the target population was organisations with 100 or more employees nationwide. It was surprising to see a number of respondent organisations with employees less than 100. This could be a result of company downsizing or re-grouping and the company information was not up to date in the Kompass Database. However, this result still shows that approximately half of the companies in the sample are considered large organisations. It is expected that they represent a fairly wide range of use for various ICT skills within organisations in New Zealand.

The number of employees within ICT departments is also assessed. Approximately a quarter of the sample represented ICT organisations with over 30 people. Once again, it is expected that these large ICT organisations represent a variety of needs for ICT skills. The smaller ICT

teams for larger organisations seem to outsource some of their ICT skills needs. Examining the number of people each organisation employed in their IT departments, about 46% of the sample had up to 10 people, approximately 30% had between 10 and 20 people, less than 7% had between 21 and 30 people and more than 17% had over 30 employed within the IT department.

The sample covered organisations belonging to a wide range of various industries. Fifteen percent of the organisations in the sample were manufacturing firms, 11% were in the "*Transport, Postal and Warehousing*" industry, nearly 10% were from each of the "*Education and Training*" sector, and the "*Health Care and Social Assistance*" sector. The "*Public Administration and Safety*" sector and the "*Professional, Scientific and Technical Services*" sector each made up a further 8% in the sample. The "*Electricity, Gas, Water Industry and Waste Services"* sector, and the "*Financial and Insurance Services*" sector were also equally represented at nearly 7% each. "*Information Media and Telecommunications*" was over 5%. The industry categorization of the remaining respondents was less than 5% in each area. Where the answer is "other", the following industries were specified:

- Third party logistics - stevedore & inventory management
- Local Government - District Council
- Petroleum Refining (Oil & Gas)
- Facilities Services
- Oil and gas production
- Government (Policy)
- Local Government

To be consistent with industry categories standardised by Statistic New Zealand, the above industries are re-grouped into relevant categories, which results in a different distribution of industry profiles as shown in figures 4.1 – 4.4. The table outlining the percentage can be found in Appendix 4 (Table 4.1).

Figure 4.1: Number of employees

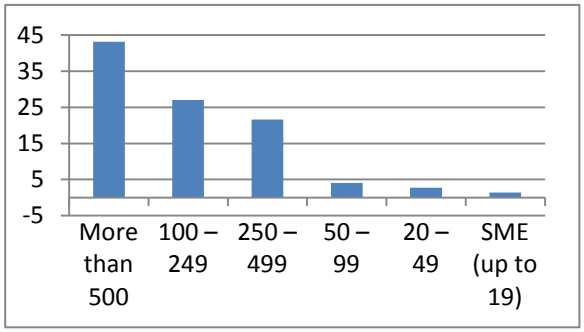


Figure 4.2: Number of ICT employees:

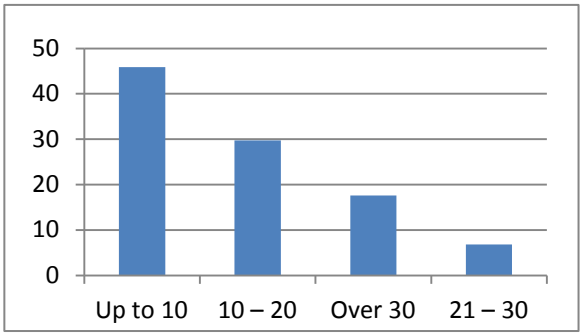


Figure 4.3: Industry Distribution – before re-grouped:

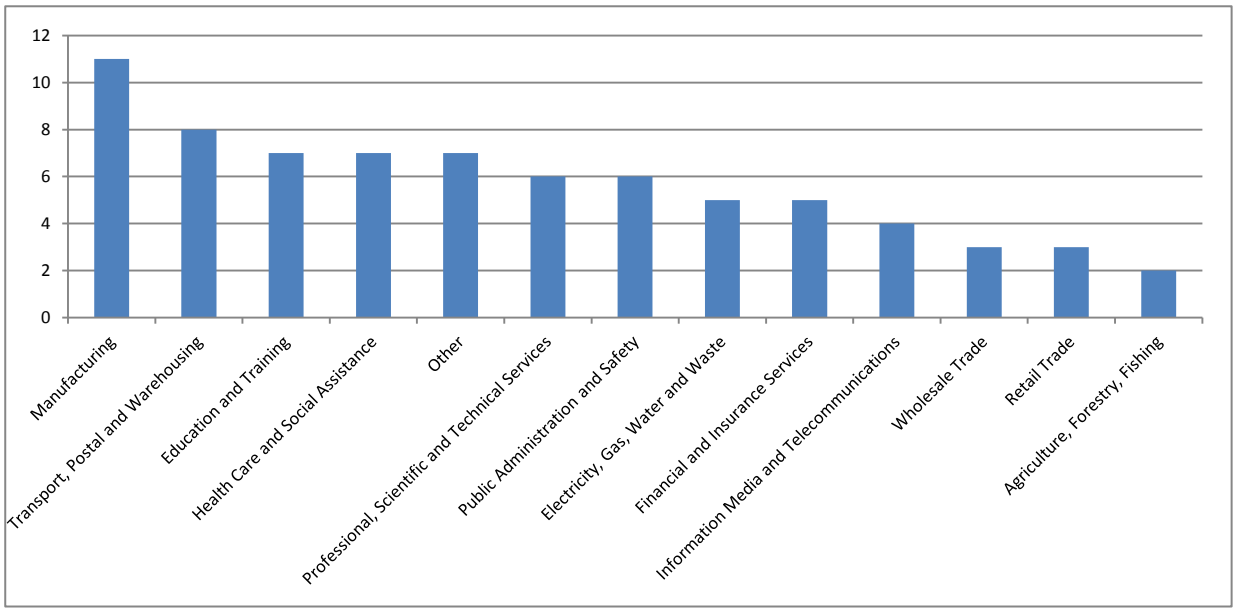
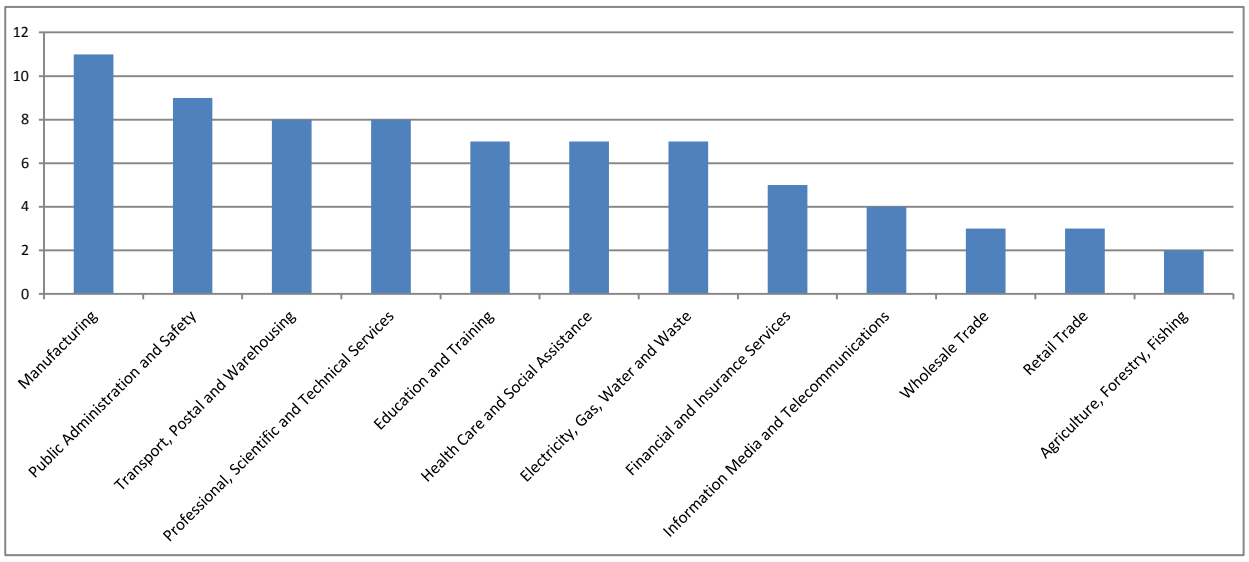
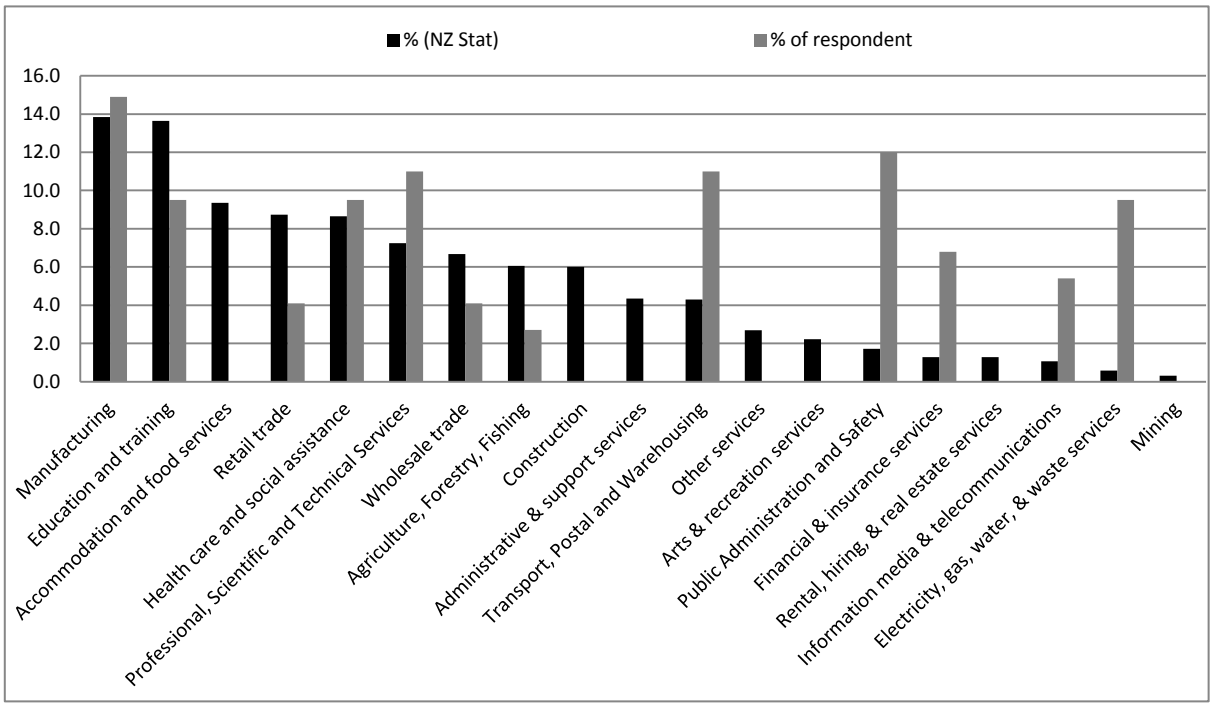


Figure 4.4: Industry Distribution – re-grouped:



To compare the distribution of the respondent organisations with the overall population of organisations within New Zealand, the industry distribution of companies with a number of employees 100 or more as at February 2011 was retrieved from New Zealand Statistics website (Statistics NZ, 2011). As can be seen in Figure 4.5, there are considerable differences of distribution of industry between the respondent organisations and the overall population organisations. The largest industry category as per New Zealand Statistics is "*Manufacturing*" forming almost 14% of the total population. The response rate from this category was 15%, which reflects a reasonably accurate representation of the overall population. Similarly accurate representation also can be observed in "*Health Care and Social Assistance*". A much poorer representation can be seen in industry categories of "*Education and Training*", "*Retail Trade*", "*Wholesale Trade*", and "*Agriculture, Forestry and Fishing*". There were no responses from "*Accommodation and Food Services*", "*Administrative and Support Services*", "*Arts and Recreation Services*", "*Construction*", "*Mining*" and "*Rental, Hiring and Real Estate Services*", which in total constitute 23.5% of the overall population of organisations with 100 or more employees. As a contrast, the category of "*Professional, Scientific and Technical Services*", forming 7.2% of the overall population, is somewhat over represented in the survey responses at 10.8%. The industry categories of "*Transport, Postal and Warehousing*", "*Public Administration and Safety*", "*Financial and Insurance Services*", "*Information Media and Telecommunications*", and "*Electricity, Gas, Water and Waste Services*" collectively add up to 9% of the overall population, but accounted for almost 45% of the total responses. Figure 4.5 demonstrates the comparison of industry distribution to the respondent organisations industry categories. It is not unexpected to see a disproportionally high response rate from "*Information Media and Telecommunications*" industry because of the alignment of the research with this industry.

Figure 4.5: Comparison of Industry Distribution – Overall Population and Respondent Organisations



4.3.2 Respondents' Roles

Of the 74 respondents, 58% were IT managers and/or directors. More than 20% were chief information officers and/or chief technology officers and 8% were members of the organisation's executive team (Table 4.3). The remaining respondents were grouped into category "other", which accounted for 13.5%. Category "Other" includes "*ICT consultants*", "*Chief Financial Officers*", "*Human Resource Managers*", "*Infrastructure Managers*", "*Business Systems Team Leaders*", "*Heads of Schools (Information Technology)*", "*Human Resource Advisors*", "*Business Analysts*", "*System Administrators*", "*Managers to oversee ICT*", "*Advisors to ICT*", "*Corporate Governance Boards*", "*Managing directors*" and *"Advisors to Chief Executives*". This result shows that respondents are highly likely to have been in roles that enable them to have sufficient knowledge of ICT needs organisation-wide.

Table 4.3: percentage of role/position the respondents currently holding

Respondent's Current Role/Position	Frequency	%
IT Manager/Director	43	58.1
Chief Information Officer/Chief Technology Officer	15	20.3
Organisation Executive Team	6	8.1
Other	10	13.5

4.3.3 Current Positions and Current Vacancies

The respondents were then asked the number of employees in the existing positions and number of current vacancies in the organisation. The outcome is summarised in tables 4.4 and 4.5. Where the numbers of current employees is not expressed as an integer, then it means that one person has more than one position.

There were 6 respondents who indicated that there were positions (roles) that were outsourced. There is one response which was not taken into consideration – as the respondent mentioned that certain roles existed but did not indicate numbers.

The questionnaire listed a number of positions which could exist in the respondent's organisation. Some respondents added additional positions without specifying the number of the current employees fulfilling each position but did give a total number. This total was classified into the general category "Other". These included positions such as "*IT Administrator*", "*Managing Licenses*", "*Billing for Services*", "*Systems Engineer*", "*Application Specialist*", "*PMO Coordination*", "*System Architect*", "*Service Delivery Manager*", "*Application Manager*" and "*Test Manager*". In a few cases, when the number of vacancies was reported, the category "Other" was answered with simply "yes/no". Where they replied "yes", but did not further specify the roles or numbers, this reply was excluded in the results.

Table 4.4: Number of employees in the existing positions

Existing position	No. of current employees	Percent
Software Engineer	395	25.7
Help Desk	194.5	12.6
Computer Operators	183	11.9
Business Analyst	147.5	9.6
IT Manager	144.3	9.4
Networking Specialist	114.7	7.5
System Analyst	56.5	3.7
Project Manager	47	3.1
CIO/IT Director	38.3	2.5
System Admin	24.5	1.6
Support Analyst	21	1.4
Purchasing	18	1.2
Testers/Test manager	16	1
Other	16	1
Architect	15	1
DBA	9.5	0.6
Application Support	9	0.6
Training	8.5	0.6
GIS Specialists	8	0.5
Web advisors	7	0.5
Technical analyst	6	0.4
Information Analyst	4	0.3
Procurement	4	0.3
Relationship Manager	4	0.3
System Engineer	4	0.3
Business Reporting	3	0.2
Change Co-ordinators	3	0.2
Infrastructure	3	0.2
System Support	3	0.2
App System Specialist	2	0.1
Application Manager	2	0.1
Asset Manager	2	0.1
Data analyst	2	0.1
Finance	2	0.1
Integration specialist	2	0.1
Planning	2	0.1
Project admin	2	0.1
Security/DR Advisor	2	0.1
Solution architects	2	0.1
Process improvement	1.5	0.1
Admin	1	0.1
Capacity planners	1	0.1
Change Management	1	0.1
Change/release	1	0.1
Data warehouse specialist	1	0.1
Government	1	0.1
Program Analyst	1	0.1
Telecommunication engineer	1	0.1
Web Admin	1	0.1

(Figure 4.6 illustrating this distribution is included in Appendix 4)

Table 4.5: Number of current vacancies

Position	No. of current vacancies	%
Software Engineer	25	25.8
Business Analyst	14	14.4
Help Desk	13	13.4
IT Manager	10	10.3
System Analysis	6	6.2
Others	6	6.2
Networking Specialist	5	5.2
Computer Operators	4	4.1
DBA	3	3.1
Planner	3	3.1
Purchasing	2	2.1
Project Manager	1	1
Computer Operator/System Admin	1	1
Application Manager	1	1
Test Manager	1	1
Application System Specialist	1	1
SharePoint Specialist	1	1
CIO/IT Director	0	0

(Figure 4.7 illustrating this distribution is included in Appendix 4)

Within the 74 respondent organisations, there were 395 (25.7%) "*Software Engineers*", 194.5 (12.6%) were "*Help Desk*" personnel and 183 (11.9%) were "*Computer Operators*". Thus, these three categories constituted over 50% of all IT employees in the surveyed organisations. Table 4.4 shows the number of employees in the existing positions.

Table 4.5 outlines the number of current vacancies in the respondent organisations. As can be seen, 80% of both existing positions and vacancies fall in the top 7 categories. In fact, the percentages of vacancies and of existing positions appear to be largely consistent, except for that "*Computer Operators*" are falling down the top 7 list of vacancies and "*Business Analyst*" seems to be in higher demand.

The position with the highest number of current vacancies (25.8%) as indicated by the respondents was again "*Software Engineer".* However, based on this vacancy number, one cannot simply claim that the position of software engineer is in the highest demand without comparing the nature of the positions with vacancies. This is because the position of software engineer requires a higher number of employees and therefore it is expected that the number of vacancies would be

higher. More specifically, when an organisation has one position for IT manager, it often has more than one position for software engineers. As can be seen in table 4.6, a 10.3% vacancy for "*IT Manager*" does not necessarily mean less demand than the 25.8% vacancy for "*Software Engineer*" or 13.4% for "*Help Desk*" personnel. Therefore, as discussed in previous chapters, this research looks at the value of each skill as rated by the respondents as an indicator of demand rather than simply gathering the number of vacancies for each skill.

Table 4.6 shows the percentages of each vacancy position against the number of employees in the particular role. The average vacancy rate of all positions is 6.3%. When looking at the position of "*Software Engineer*" mentioned above, which had the highest total number of vacancies, the vacancy rate as percentage of existing employees merely matches the average. This supports the discussion regarding the absolute number of vacancies by itself not being indicative of demand.

The positions where the percentage of vacancies deviates significantly from the average, indicates the relative ease or difficulty in filling that role. This has to be examined in the context of the number of overall employees. Where there are a large number of employees the percentage is more accurate. The positions of "*Computer Operators*" and "*Networking Specialist*" with 183 and 115 employees respectively have vacancy rates noticeably under the average rate, indicating they are possibly easier to fill. In contrast, the position of "*Business Analyst*" has vacancy rate of 9.5%, suggesting that it is harder to fill this position than other roles. For the positions with a low number of existing employees the population size of that role is generally too small to give meaningful results. An exception to this could be positions such as "*Planning*" where there were only 2 employees in the category, however the listed vacancies actually exceed the incumbent positions, possibly indicating a difficulty in filling this position.

Once again, these percentages only demonstrate the relative difficulty of filling the positions. It cannot be generalised that those positions that are the most difficult to be filled are in the highest demand.

Table 4.6: Number of vacancies as a percentage of existing employees

Existing position	No. of employees	No. of vacancies	% of vacancies
Software Engineer	395	25	6.3
Help Desk	194.5	13	6.7
Computer Operators	183	4.5	2.5
Business Analyst	147.5	14	9.5
IT Manager	144.3	10	6.9
Networking Specialist	114.7	5	4.4
System Analyst	56.5	6	10.6
Project Manager	47	1	2.1
CIO/IT Director	38.3	0	
System Admin	24.5	0.5	2
Support Analyst	21		
Purchasing	18	2	11.1
Testers/Test manager	16	1	6.3
Other	16	7	43.8
Architect	15		
DBA	9.5	3	31.6
Application Support	9		
Training	8.5		
GIS Specialists	8		
Web advisors	7		
Technical analyst	6		
Information Analyst	4		
Procurement	4		
Relationship Manager	4		
System Engineer	4		
Business Reporting	3		
Change Co-ordinators	3		
Infrastructure	3		
System Support	3		
App System Specialist	2	1	50
Application Manager	2	1	50
Asset Manager	2		
Data analyst	2		
Finance	2		
Integration specialist	2		
Planning	2	3	150
Project admin	2		
Security/DR Advisor	2		
Solution architects	2		
Process improvement	1.5		
Admin	1		
Capacity planners	1		
Change Management	1		
Change/release	1		
Data warehouse specialist	1		
Government	1		
Program Analyst	1		
Telecommunication engineer	1		
Web Admin	1		
Total	**1537.8**	**97**	**6.3**

4.4 VALUE OF ICT SKILLS IN BOTH SHORT TERM AND LONGER TERM BUSINESS NEEDS

The results presented in this section are the perceived values of each skill rated by respondents. These individual skills are distinct from the job categories discussed in the previous section. More specifically, a position or job category may comprise multiple skills, thus each of the skills does not necessarily represent each of the positions. The total 45 skills are classified into 4 categories based on SFIA. Each skill is firstly presented and analysed within their categories by short and longer term perceived value as rated by the respondents. Then the four main skill sets are compared and discussed. This is followed by the analysis of all skills regardless of category, combined short and longer term ratings, and finally, the discussion of technological speciality skills versus non-technological knowledge/skills.

4.4.1 Solution Design, Development and Release

Based on the mean values of variables (ratings) established in this survey, each skill in this category is ranked (in descending order) – table 4.7. As can be seen, there is consistency in the ranking for short term and longer term needs. More specifically, of the 15 skills investigated, 11 seem to be ranked exactly the same in short and longer term ratings. The two skills rated as the most valuable are "*data/information analysis and database design*" and "*program and project management – including risk management, change management, quality management and assurance*". The least valued skill is "*solution safety design and safety assessment*", followed by "*systems ergonomics and human factors integration*". Some skills are rated differently in short and longer term ratings. For instance, "*systems and applications testing*" is ranked as the 6th valued skill in the longer term but is in the 8th place in the short term. The results of statistical significance suggest that only three skills were found to be significantly different in ratings for short and longer term – they are "*program and project management*" and "*systems and application testing*" and "*sustainability assessment and engineering*". That is to say, with a higher value projected by the respondents, these three skills are seen as being more important in the longer term to the organisations than they are in the short term.

As discussed in the introduction (section 4.1), for this study, it is assumed that ratings above "2"

represent skills in high demand. Therefore, in this category the following skills need to be seriously considered in the longer term planning for ICT skills development:

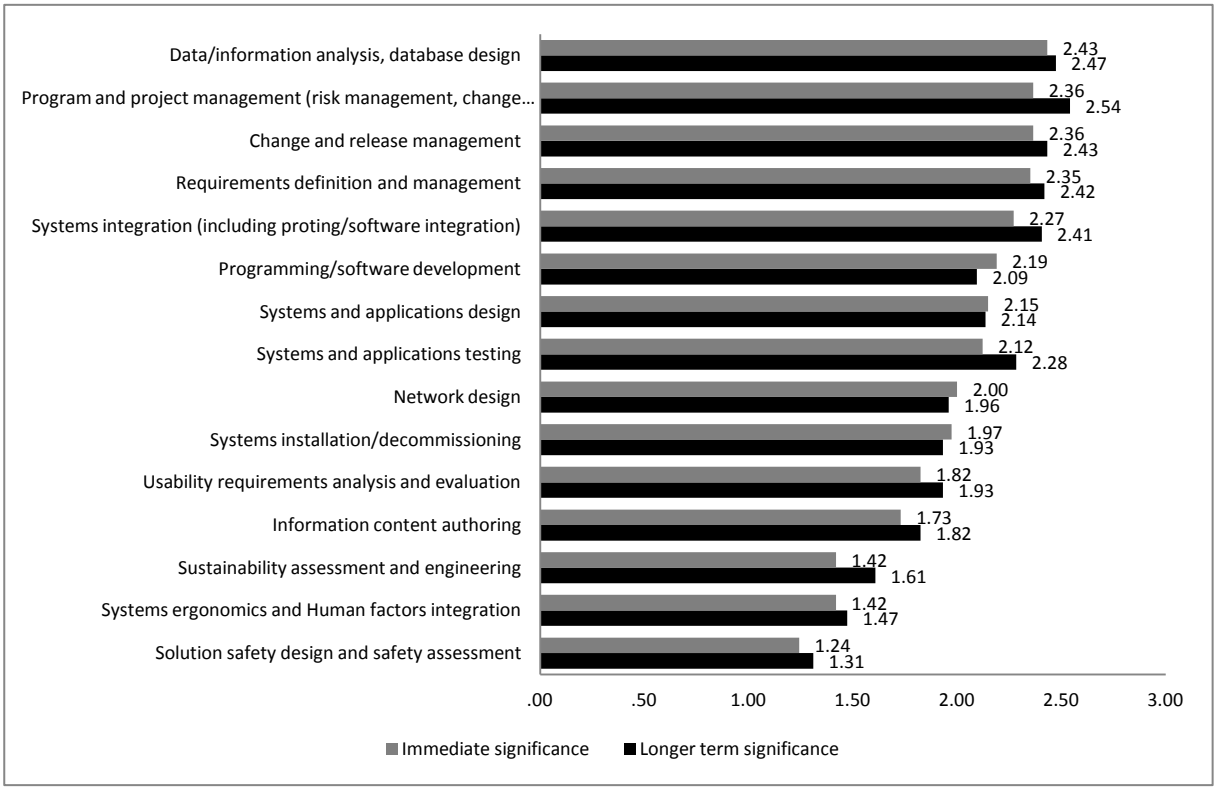
- *Data/information analysis, database design*
- *Program and project management (risk management, change management, quality management and assurance)*
- *Change and release management*
- *Requirements definition and management*
- *Systems integration (including porting/software integration)*
- *Programming/software development*
- *Systems and applications design*
- *Systems and applications testing*

Table 4.7: Value and rankings of immediate and longer term significance of solution design / development / release skills

	Immediate			Longer term					
Variables (significance of the skill)	Mean	Rank	Std. Deviation	Mean	Rank	Std. Deviation	Min	Max	Range
Measure 1: Solution Design / Development / Release									
Data/information analysis, database design	2.43	1	0.812	2.47	2	0.707	0	3	3
Program and project management (risk management, change management, quality management and assurance)	2.36	2	0.821	2.54*	1	0.645	0	3	3
Change and release management	2.36	3	0.694	2.43	3	0.684	0	3	3
Requirements definition and management	2.35	4	0.766	2.42	4	0.641	0	3	3
Systems integration (including porting/software integration)	2.27	5	0.833	2.41	5	0.81	0	3	3
Programming/software development	2.19	6	0.886	2.09	8	0.968	0	3	3
Systems and applications design	2.15	7	0.886	2.14	7	0.833	0	3	3
Systems and applications testing	2.12	8	0.891	2.28*	6	0.803	0	3	3
Network design	2	9	0.936	1.96	9	0.913	0	3	3
Systems installation/decommissioning	1.97	10	0.74	1.93	10	0.8	0	3	3
Usability requirements analysis and evaluation	1.82	11	0.927	1.93	11	0.912	0	3	3
Information content authoring	1.73	12	0.88	1.82	12	0.97	0	3	3
Sustainability assessment and engineering	1.42	13	0.922	1.61**	13	0.963	0	3	3
Systems ergonomics and Human factors integration	1.42	14	0.936	1.47	14	0.954	0	3	3
Solution safety design and safety assessment	1.24	15	0.934	1.31	15	1.006	0	3	3

* Significant at P < .05 ** Significant at P < .01 *** Significant at P < 0.001

Figure 4.7: Value and rankings of immediate and longer term significance of solution design / development / release skills



4.4.2 Operations Management Skills

Table 4.8 demonstrates the rankings of short and longer term significance of the second category of skills - "O*perations Management Skills*". Unlike the first category, the ranking of skills for short/immediate and longer term value shows considerable variance. The top 2 most valued skills in both immediate and longer term significance measures are "*application support and IT operations*" and "*network operation and network support*". However, while the skill of "*management of capacity and availability of IT services (hardware, software and networks)*" is ranked as the 3rd most valuable skill in the immediate significance (short term), it is ranked as the second least valuable skill in the longer term. The skill of "*problem management including service desk and incident management*" is ranked as the 4th most valuable in the short term, but ranked as the 3rd least valuable in the longer term business needs.

Considering the statistical significance, in total, of the 12 skills in this group, 4 are rated as being more valuable in the longer term. They are "*service level management*", "*consultancy, guidance and advice*", "*client services management*", and finally "*learning resources creation, learning*

delivery (including training and professional development)". At the same time, 4 skills are rated as being less valuable in the longer term – "*management of capacity and availability of IT services (including hardware, software and networks)*", "*problem management including service desk and incident management*", "*security administration of IT facilities*", and "*database administration*". These results show a much higher level of statistical significance ($P < 0.001$) in the difference between short and longer term business needs. Unlike the first category (where all the 3 skills with significant difference between short and longer term are valued more in the future), of the 8 skills in this group that are rated with statistical significance, 4 are valued less in the future and the other 4 skills are valued more. The respondents perceive considerable changing of value in this category of skills between short and longer term business needs.

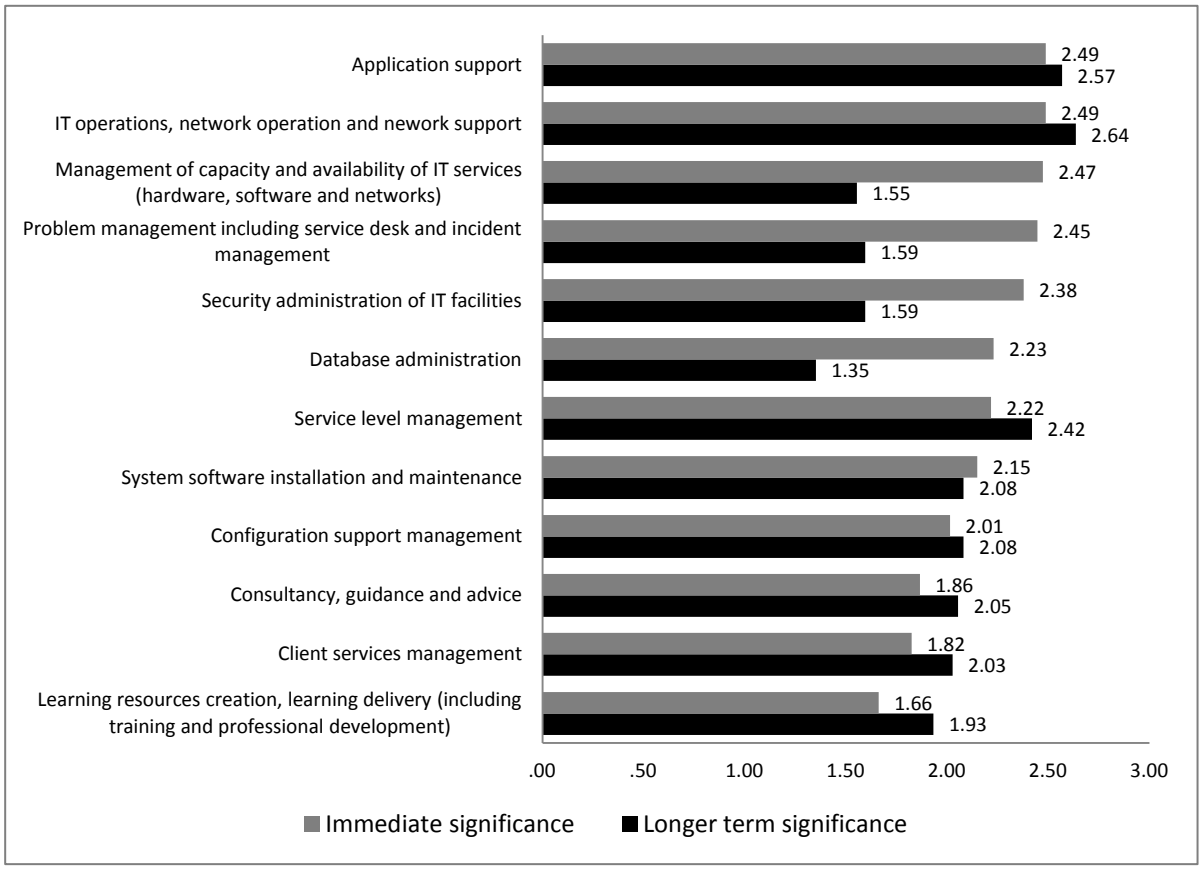
A majority of the skills (7 of 12) in this group are rated over "2" for the longer term significance. They are "*application support*", "*IT operations, network operation and network support*", "*service level management*", "*client services management*", "*configuration support* management", "*consultancy, guidance and advice*", and "s*ystem software installation and maintenance*". As mentioned in the previous section, these represent the skills in higher demand in the longer term.

Table 4.8: Rankings of immediate and longer term significance of operations management skills

	Immediate			Longer term					
Variables (significance of the skill)	Mean	Rank	Std. Deviation	Mean	Rank	Std. Deviation	Min	Max	Range
Measure 2: Operations Management									
Application support	2.49	1	0.646	2.57	2	0.664	0	3	3
IT operations, network operation and network support	2.49	2	0.781	2.64*	1	0.632	0	3	3
Management of capacity and availability of IT services (hardware, software and networks)	2.47	3	0.707	1.55***	11	0.622	0	3	3
Problem management including service desk and incident management	2.45	4	0.724	1.59***	10	0.595	0	3	3
Security administration of IT facilities	2.38	5	0.676	1.59***	9	0.547	0	3	3
Database administration	2.23	6	0.786	1.35***	12	0.671	0	3	3
Service level management	2.22	7	0.781	2.42**	3	0.641	0	3	3
System software installation and maintenance	2.15	8	0.715	2.08	4	0.736	0	3	3
Configuration support management	2.01	9	0.692	2.08	5	0.636	0	3	3
Consultancy, guidance and advice	1.86	10	0.816	2.05*	6	0.757	0	3	3
Client services management	1.82	11	0.897	2.03**	7	0.875	0	3	3
Learning resources creation, learning delivery (including training and professional development)	1.66	12	0.832	1.93**	8	0.833	0	3	3

* Significant at $P < .05$ ** Significant at $P < .01$ *** Significant at $P < 0.001$

Figure 4.8: Rankings of immediate and longer term significance of operations management skills



4.4.3 Strategy and Business Alignment Skills

In this section the rating for skills in the third category ("*Strategy and Business Alignment"*) is discussed. The order of ranking for importance of each skill in each group for both immediate and longer term is fairly consistent – as also seen in the first category.The top 3 most valued skills are *"information security and assurance strategies*", "*corporate governance of IT*", and "*solution strategy and architecture*". On the other hand, the least valued skills are "*emerging technology monitorin*" and "*sustainability strategy and management for IT*".

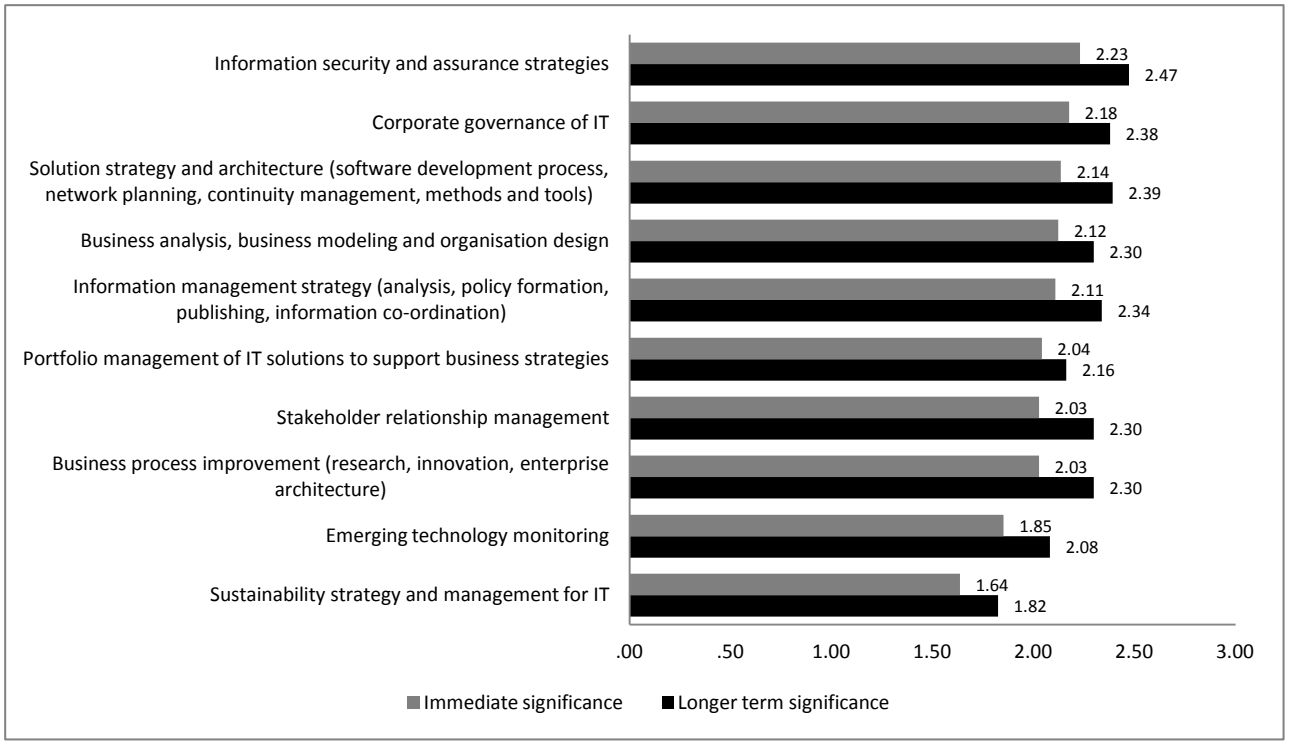
It must be noted that, based on *P* value, the 10 skills in this category are all rated as being more valuable in the longer term. This shows that the respondents perceive this category of skills as being of increasing importance in the longer term. Furthermore, 9 out of the 10 skills in this category were rated as being of high value to the business, which implies high demand (i.e. the mean values are greater than "*2"*) in the longer term. That is to say, these 9 skills need to be taken into serious consideration when planning future ICT skills development.

Table 4.9: Rankings of immediate and longer term significance of strategy and business alignment skills

	Immediate			Longer term					
Variables (significance of the skill)	Mean	Rank	Std. Deviation	Mean	Rank	Std. Deviation	Min	Max	Range
Measure 3: Strategy and Business Alignment									
Information security and assurance strategies	2.23	1	0.803	2.47***	1	0.667	0	3	3
Corporate governance of IT	2.18	2	0.85	2.38**	3	0.789	0	3	3
Solution strategy and architecture (software development process, network planning, continuity management, methods and tools)	2.14	3	0.816	2.39**	2	0.773	0	3	3
Business analysis, business modelling and organisation design	2.12	4	0.827	2.30**	6	0.789	0	3	3
Information management strategy (analysis, policy formation, publishing, information co-ordination)	2.11	5	0.786	2.34**	4	0.708	0	3	3
Portfolio management of IT solutions to support business strategies	2.04	6	0.835	2.16*	8	0.828	0	3	3
Stakeholder relationship management	2.03	7	0.936	2.30***	5	0.84	0	3	3
Business process improvement (research, innovation, enterprise architecture)	2.03	8	0.875	2.30**	7	0.806	0	3	3
Emerging technology monitoring	1.85	9	0.806	2.08***	9	0.79	0	3	3
Sustainability strategy and management for IT	1.64	10	0.915	1.82**	10	0.912	0	3	3

* Significant at P < .05 ** Significant at P < .01 *** Significant at P < 0.001

Figure 4.9: Rankings of immediate and longer term significance of strategy and business alignment skills



4.4.4 Department Management Skills

The last group of skills included in the survey was "*Department Management Skills"*. The ratings for this category are presented in table 4.10. As can be seen, most of the eight skills in this group ranked in the same order for both long and short term value – all but "*supplier relationship management"* and "*asset management*". These two skills are ranked as 4th and 5th in immediate significance, and 5th and 4th in the longer term significance.

All of the 8 skills in this group are rated as being more valuable in the longer term, but 4 of them are rated as being significantly higher when comparing with short term importance. Once again, the respondents perceive a growing value of this skill set, especially for the longer term business needs.

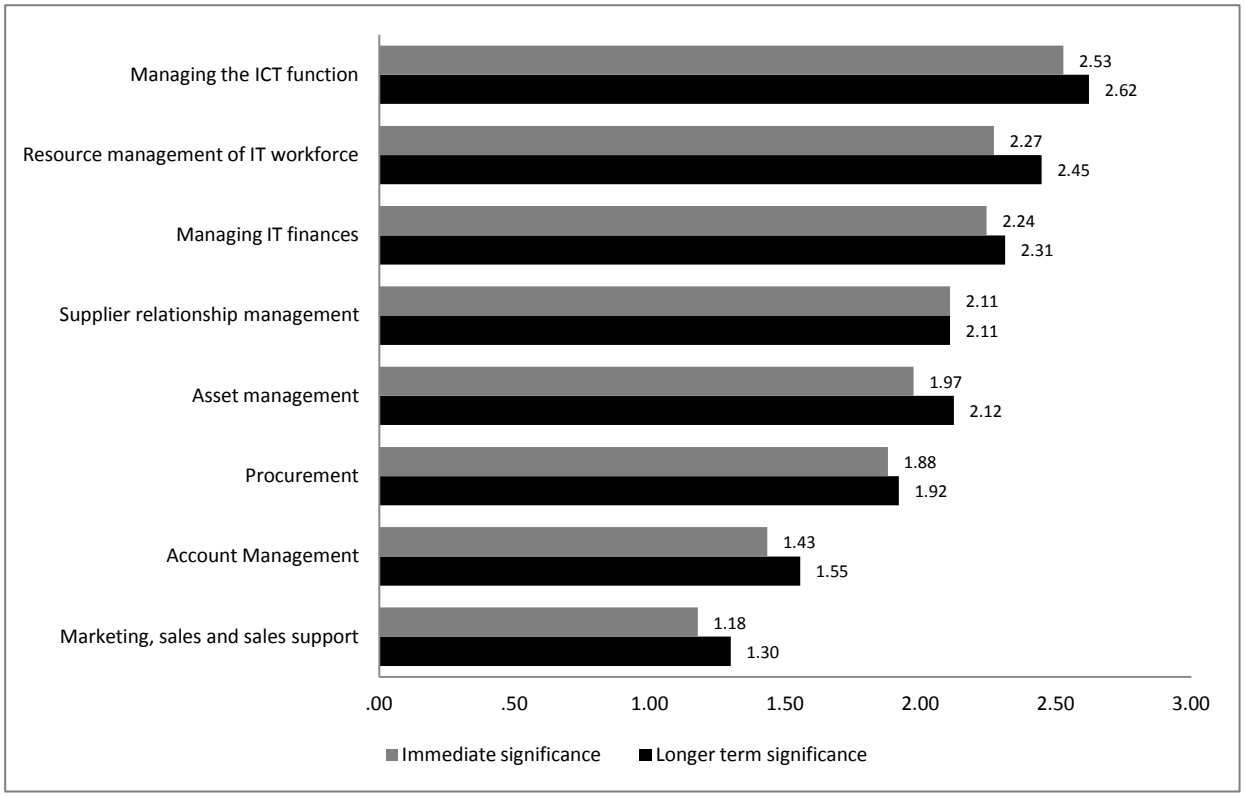
In this category, the skills with mean values above "*2"* are "*managing the ICT function*", "*resource management of IT workforce*", "*managing IT finances*", "*supplier relationship management*", and finally "*asset management*". In other words, these 5 skills will play more important roles in the future business development, and therefore, need to be focused on for longer term planning of ICT skills development.

Table 4.10: Rankings of immediate and longer term significance of department management skills

	Immediate			Longer term					
Variables (significance of the skill)	Mean	Rank	Std. Deviation	Mean	Rank	Std. Deviation	Min	Max	Range
Measure 4: Department Management									
Managing the ICT function	2.53	1	0.687	2.62	1	0.656	0	3	3
Resource management of IT workforce	2.27	2	0.849	2.45**	2	0.685	0	3	3
Managing IT finances	2.24	3	0.808	2.31	3	0.793	0	3	3
Supplier relationship management	2.11	4	0.713	2.11	5	0.694	0	3	3
Asset management	1.97	5	0.758	2.12*	4	0.776	0	3	3
Procurement	1.88	6	0.721	1.92	6	0.657	0	3	3
Account Management	1.43	7	0.923	1.55**	7	1.022	0	3	3
Marketing, sales and sales support	1.18	8	0.998	1.30*	8	1.056	0	3	3

* Significant at P < .05 ** Significant at P < .01 *** Significant at P < 0.001

Figure 4.10: Rankings of immediate and longer term significance of department management skills



4.4.5 Comparison of the Four Main Sets of Skills

This section discusses the comparison of the four main categories of skills – as shown in table 4.11. In the short term, "*Operations Management Skills"* are rated as the most valued set of skills of the four categories examined. However, this category is rated as least valued in the longer term. The remaining 3 skill sets are fairly consistent in the ratings of the mean values for immediate and longer term needs. As can be seen in table 4.11, "*Strategy and Business Alignment Skills"*, "*Solution Design/Development/Release Skills"* and "D*epartment Management Skills"* are rated as being the first, second and third valued for longer term needs. On the other hand, they are rated as being the second, third and least valuable skills for the immediate needs.

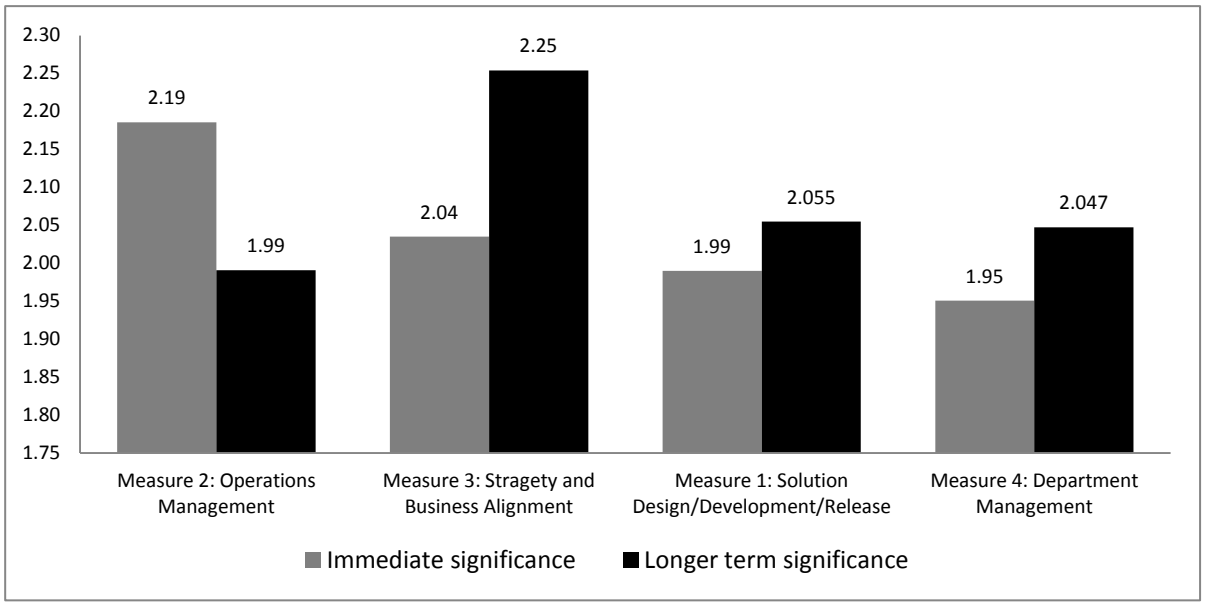
As the "*Operations Management Skill"* set is of a more technological nature, it shows that for the immediate business needs, technological skills are seen as being more important. However, the importance of this skill set is expected to decline in the future and become the least valuable amongst the 4 skill categories. In contrast, the importance of the skill set of "*Strategy and Business Alignment"* will increase to be the most valuable in the longer term. Overall, 3 out of 4 categories of skills will become more critical for the longer term business development. This may

sugggest a change of focus for future planning of operations management skills development should be considered.

Table 4.11: Rating of immediate and longer term significance of 4 categories of skills

	Immediate		Longer term	
	Average		Average	
Variable (Immediate significance of skill category)	Mean	Rank	Mean	Rank
Measure 2: Operations Management	2.19	1	1.99	4
Measure 3: Strategy and Business Alignment	2.04	2	2.25	1
Measure 1: Solution Design/Development/Release	1.99	3	2.055	2
Measure 4: Department Management	1.95	4	2.047	3

Figure 4.11: Rating of immediate and longer term significance of 4 categories of skills



4.4.6 All Skills Regardless of Category

In order to present an overview of the importance of all skills regardless of categoery, tables 4.12 and 4.13 show the rating for each of the 45 skills altogether for the short term and longer term percieved value respectively. As can be seen in the short term table (table 4.12), the top five rated skills are "*managing the ICT funtion*", "*application support*", "*IT operations, network operation and network support*", "*management of capacity and availability of IT services (hardware, software and networks)*", and "*problem management including service desk and incident management*". The top 3 skills in the longer term are also the top 3 in the short term but in a different order. However, the

skill rated as in the 4th highest place in the short term ("*management of capacity & availability of IT services (hardware, software & network*)") has dropped to 40th place in the longer term. The 4th highest place in the longer term ("*program and project management – including risk management, change management, quality management and assurance*") has risen from 8th place in the short term. The skill rated as in the 5th highest place in the short term ("*problem management including service desk & incident management*") has dropped to 39th place in the longer term. The 5th highest place in the longer term ("*data/information analysis, database design*") has moved up one place from 6th in the short term. These two skills with significant drops in rating from short term to longer term value are both grouped in the "O*perations Management Skill"* category, which is the only category with an overall decreased value in the future.

The 5 skills that are rated as being the least valued in the short term are mostly consistent with longer term value. Four of the 5 skills that appear last in both short term and longer term tables are "*account management*", "*systems ergonomics and human factors integration*", "*solution safety design and safety assessment*", and "*marketing, sales and sales support*". The skill of "*sustainability assessment & engineering*" shows only a slightly higher rating in the longer term, removed from being in the bottom 5 in the longer term. The skill of "*database administration*" has dropped from 14th place in short term to 43rd place in the longer term value.

Table 4.12: Ranking of immediate significance of all 45 skills

Immediate (next 12 months) significance of the skill	Range	Min	Max	Statistic Mean	Std. Deviation	Rank
Managing the ICT function	3	0	3	2.53	0.6869	1
Application support	3	0	3	2.49	0.6462	2
IT operations, netw ork operation & netw ork support	3	0	3	2.49	0.7806	3
softw are & netw orks)	3	0	3	2.47	0.7066	4
Problem management including service desk & incident management	3	0	3	2.45	0.7242	5
Data/information analysis, database design	3	0	3	2.43	0.8123	6
Security administration of IT facilities	3	0	3	2.38	0.6765	7
management, quality management & assurance)	3	0	3	2.36	0.8205	8
Change and release management	3	0	3	2.36	0.6939	9
Requirements definition & management	3	0	3	2.35	0.7663	10
Resource management of IT w orkforce	3	0	3	2.27	0.8488	11
Systems integration (including porting/softw are integration)	3	0	3	2.27	0.8325	12
Managing IT finances	3	0	3	2.24	0.8077	13
Database administration	3	0	3	2.23	0.786	14
Information security & assurance strategies	3	0	3	2.23	0.8032	15
Service level management	3	0	3	2.22	0.7811	16
Programming/softw are development	3	0	3	2.19	0.8864	17
Corporate governance of IT	3	0	3	2.18	0.8498	18
System softw are installation & maintenance	3	0	3	2.15	0.7154	19
System & application design	3	0	3	2.15	0.8865	20
netw ork planning, continuity management, methods & tools)	3	0	3	2.14	0.8163	21
Business analysis, business modelling & organisation design	3	0	3	2.12	0.8268	22
Systems & application testing	3	0	3	2.12	0.8906	23
Supplier relationship management	3	0	3	2.11	0.7132	24
publishing, information co-ordination)	3	0	3	2.11	0.7863	25
Portfolio management of IT solutions to support business strategies	3	0	3	2.04	0.8348	26
Stakeholder relationship management	3	0	3	2.03	0.9359	27
architecture)	3	0	3	2.03	0.8754	28
Configuration support management	3	0	3	2.01	0.6923	29
Netw ork design	3	0	3	2	0.9363	30
Systems installation/decommissioning	3	0	3	1.97	0.7397	31
Asset management	3	0	3	1.97	0.758	32
Procurement	3	0	3	1.88	0.7206	33
Consultancy, guidance & advice	3	0	3	1.86	0.8163	34
Emerging technology monitoring	3	0	3	1.85	0.8055	35
Usability requirements analysis & evaluation	3	0	3	1.82	0.9269	36
Client services management	3	0	3	1.82	0.8968	37
Information content authoring	3	0	3	1.73	0.8805	38
professional development)	3	0	3	1.66	0.8322	39
Sustainability strategy & management for IT	3	0	3	1.64	0.9152	40
Account management	3	0	3	1.43	0.9228	41
Sustainability assessment & engineering	3	0	3	1.42	0.9217	42
Systems ergonomics & Human factors integration	3	0	3	1.42	0.9364	43
Solution safety design & safety assessment	3	0	3	1.24	0.9336	44
Marketing, sales and sales support	3	0	3	1.18	0.9981	45

Table 4.13: Ranking of immediate significance of all 45 skills

Longer term significance of the skill	Range	Min	Max	Statistic Mean	Std. Deviation	Rank
IT operations, netw ork operation & netw ork support	3	0	3	2.64	0.6319	1
Managing the ICT function	3	0	3	2.62	0.6559	2
Application support	3	0	3	2.57	0.6638	3
management, quality management & assurance)	3	0	3	2.54	0.6451	4
Data/information analysis, database design	3	0	3	2.47	0.7066	5
Information security & assurance strategies	3	0	3	2.47	0.6667	6
Resource management of IT w orkforce	3	0	3	2.45	0.6853	7
Change and release management	3	0	3	2.43	0.6841	8
Service level management	3	0	3	2.42	0.6412	9
Requirements definition & management	3	0	3	2.42	0.6412	10
Systems integration (including porting/softw are integration)	3	0	3	2.41	0.8095	11
netw ork planning, continuity management, methods & tools)	3	0	3	2.39	0.7731	12
Corporate governance of IT	3	0	3	2.38	0.7887	13
publishing, information co-ordination)	3	0	3	2.34	0.7076	14
Managing IT finances	3	0	3	2.31	0.7925	15
Stakeholder relationship management	3	0	3	2.3	0.8396	16
architecture)	3	0	3	2.3	0.8063	17
Business analysis, business modelling & organisation design	3	0	3	2.3	0.7891	18
Systems & application testing	3	0	3	2.28	0.8027	19
Portfolio management of IT solutions to support business strategies	3	0	3	2.16	0.8281	20
System & application design	3	0	3	2.14	0.833	21
Asset management	3	0	3	2.12	0.7755	22
Supplier relationship management	3	0	3	2.11	0.6938	23
Programming/softw are development	3	0	3	2.09	0.9675	24
Emerging technology monitoring	3	0	3	2.08	0.7896	25
System softw are installation & maintenance	3	0	3	2.08	0.7357	26
Configuration support management	3	0	3	2.08	0.6358	27
Consultancy, guidance & advice	3	0	3	2.05	0.7566	28
Client services management	3	0	3	2.03	0.8754	29
Netw ork design	3	0	3	1.96	0.9132	30
Systems installation/decommissioning	3	0	3	1.93	0.7995	31
Usability requirements analysis & evaluation	3	0	3	1.93	0.9116	32
professional development)	3	0	3	1.93	0.8331	33
Procurement	3	0	3	1.92	0.657	34
Information content authoring	3	0	3	1.82	0.9702	35
Sustainability strategy & management for IT	3	0	3	1.82	0.912	36
Sustainability assessment & engineering	3	0	3	1.61	0.9626	37
Security administration of IT facilities	2	0	2	1.59	0.5469	38
Problem management including service desk & incident management	2	0	2	1.59	0.5949	39
softw are & netw orks)	2	0	2	1.55	0.6225	40
Account management	3	0	3	1.55	1.0222	41
Systems ergonomics & Human factors integration	3	0	3	1.47	0.9541	42
Database administration	2	0	2	1.35	0.671	43
Solution safety design & safety assessment	3	0	3	1.31	1.0058	44
Marketing, sales and sales support	3	0	3	1.3	1.0564	45

Of the total number of 45 skills, 30 (67%) are rated with a mean value above "*2"* in the short term and 29 (64%) in the longer term value. That is to say, approximately 2 third of 45 skills examined are rated as being considerably important to the business regardless of short or longer term. More specifically, the fact that more than half of the total number of skills are rated as being above moderately valued, may suggest that overall there is a demand for ICT skills (short and long term) in the organisations that were being surveyed.

4.4.7 Combined short and longer term value ratings

In the last step of the analysis, each skill's score of immediate and longer term significance were added together to draw an overall ranking of all 45 skills combined over both immediate and longer term – table 4.14:

- a maximum score of 6, indicates both immediate and longer term significance being highly valuable (3+3);
- a score of 0 (minimum) indicates both immediate and longer term significance being not at all valuable (0+0);
- a score of 1 indicates either immediate being little valuable and longer term significance being not at all valuable, or longer term being little valuable and immediate being not at all valuable;
- a score of 2 could be achieved from 3 possible mixes; a score of 3 could be 4 possibilities, a score of 4 could be 3 possible mixes, and a score of 5 could be from 2 possibilities.

This analysis generalises an overall significance of the skills that have been examined in the survey. The skills of "*managing the ICT function*", "*IT operations, network operation and network support*", "*application support*", "*program and project management*" and "*data/information analysis, database design*" are seen as being valued the most. This result is consistent with the top 5 skills in the longer term demand analysis.

In contrast, the skills of "*marketing, sales and sales support*", "*solution safety design and safety assessment*", "*systems ergonomics and human factors integration*", "*account management*", and "*sustainability assessment and engineering*" are rated as being least valued. This is consistent with the bottom 5 skills in the short term demand analysis.

Table 4.14: Ranking of mixed immediate and longer term significance of all 45 skills

Significance of the skill	Range	Min	Max	Statistic Mean	Std. Deviation	Rank
Managing the ICT function	6	0	6	5.15	1.2014	1
IT operations, netw ork operation and netw ork support	6	0	6	5.12	1.3028	2
Application support	4	2	6	5.05	1.1213	3
management, quality management and assurance)	6	0	6	4.91	1.3566	4
Data/information analysis, database design	6	0	6	4.91	1.3464	5
Change and release management	5	1	6	4.8	1.2604	6
Requirements definition and management	6	0	6	4.77	1.2985	7
Resource management of IT w orkforce	6	0	6	4.72	1.4573	8
Information security and assurance strategies	6	0	6	4.7	1.3622	9
Systems integration (including porting/softw are integration)	6	0	6	4.68	1.4907	10
Service level management	6	0	6	4.64	1.2776	11
Corporate governance of IT	6	0	6	4.55	1.5451	12
Managing IT finances	6	0	6	4.55	1.5273	13
netw ork planning, continuity management, methods and tools)	6	0	6	4.53	1.4639	14
publishing, information co-ordination)	6	0	6	4.45	1.3763	15
Business analysis, business modelling and organisation design	6	0	6	4.42	1.5171	16
Systems and applications testing	6	0	6	4.41	1.5955	17
Stakeholder relationship management	6	0	6	4.32	1.697	18
architecture)	6	0	6	4.32	1.5359	19
Systems and applications design	6	0	6	4.28	1.6177	20
Programming/softw are development	6	0	6	4.28	1.7944	21
System softw are installation and maintenance	6	0	6	4.23	1.3704	22
Supplier relationship management	6	0	6	4.22	1.3166	23
Portfolio management of IT solutions to support business strategies	6	0	6	4.2	1.5788	24
Configuration support management	6	0	6	4.09	1.1955	25
Asset management	6	0	6	4.09	1.4061	26
Problem management including service desk and incident management	4	1	5	4.04	1.1638	27
softw are and netw orks)	5	0	5	4.03	1.216	28
Security administration of IT facilities	4	1	5	3.97	1.1223	29
Netw ork design	6	0	6	3.96	1.7473	30
Emerging technology monitoring	6	0	6	3.93	1.511	31
Consultancy, guidance and advice	6	0	6	3.92	1.4501	32
Systems installation/decommissioning	6	0	6	3.91	1.4446	33
Client services management	6	0	6	3.85	1.6526	34
Procurement	6	0	6	3.8	1.2712	35
Usability requirements analysis and evaluation	6	0	6	3.76	1.7502	36
professional development)	6	0	6	3.59	1.4981	37
Database administration	5	0	5	3.58	1.365	38
Information content authoring	6	0	6	3.55	1.7684	39
Sustainability strategy and management for IT	6	0	6	3.46	1.7687	40
Sustainability assessment and engineering	6	0	6	3.03	1.8205	41
Account Management	6	0	6	2.99	1.9196	42
Systems ergonomics and Human factors integration	6	0	6	2.89	1.8325	43
Solution safety design and safety assessment	6	0	6	2.55	1.9027	44
Marketing, sales and sales support	6	0	6	2.47	2.0152	45

4.4.8 Technological skills vs. Non-technological skills

The result of a comparison between technological speciality skills and non-technological knowledge/skills is presented in this section. Technological speciality skills are considered to be the specialized knowledge and abilities needed to accomplish specific tasks which do not require a great deal of business knowledge or management capabilities. In this category, only direct and purely technological skills are included. In contrast, non-technological knowledge/skills include not only managerial abilities but also knowledge and capabilities such as investigating, analysing, assessing, consulting, problem solving and so on. The description of each skill in SFIA was reviewed and discussed with the industry supervisor and an agreed upon categorisation of each skill as either technological or non-technological was reached. Where a particular skill did not clearly fall into the technological category, it was considered to be a non-technological skill.

In order to examine hypothesis 2 that technological skills are in higher demand than non-technological skills, the 45 skills are re-grouped as follows:

Table 4.15: Technological and Non-TechnologicalSkills

Technological Skills	Non-Technological Skills
1. Data/information analysis, database design	1. Requirements definition and management
2. Systems and application design	2. Systems ergonomics and Human factors integration
3. Network design	3. Usability requirements analysis and evaluation
4. Programming/software development	4. Change and release management
5. Solution safety design and safety assessment	5. Program and project management (risk management, change management, quality management and assurance)
6. Systems and application testing	6. Sustainability assessment and engineering
7. Systems integration (including porting/software integration)	7. Management of capacity and availability of IT services (hardware, software and networks)
8. Systems installation/decommissioning	8. Service level management
9. Information content authoring	9. Consultancy, guidance and advice
10. Configuration support management	10. Client services management
11. System software installation and maintenance	11. Learning resources creation, learning delivery (including training and professional development)
12. Application support	12. Information security and assurance strategies
13. IT operations, network operation and network support	13. Corporate governance of IT
14. Problem management including service desk and incident management	14. Business analysis, business modelling and organisation design
15. Database administration	15. Information management strategy (analysis, policy formation, publishing, information co-ordination)
16. Security administration of IT facilities	16. Portfolio management of IT solutions to support business strategies
17. Solution strategy and architecture (software development process, network planning, continuity management, methods and tools)	17. Stakeholder relationship management
	18. Business process improvement (research, innovation, enterprise architecture)
	19. Emerging technology monitoring
	20. Sustainability strategy and management for IT
	21. Managing the ICT function
	22. Resource management of IT workforce
	23. Managing IT finances
	24. Supplier relationship management
	25. Asset management
	26. Procurement
	27. Account Management
	28. Marketing, sales and sales support

By conducting paired sample *t*-tests, the difference in mean values between technological and non-technological skills for both immediate and longer term needs is shown as statistically significant – as can be seen in tables 4.16 and 4.17 (i.e. the *t*-test significance of the mean value

difference between technological and non-technological skills for the short term demand is less than .0001; this significance for longer term is less than .05). The technological skills are rated as being more valuable than the non-technological skills in the short term demand. In contrast, the non-technological knowledge/skills are seen as being more important than the technological skills in the longer term. In conclusion, the hypothesis of technological skills in higher demand than non-technological skills is accepted for the short term business perspective; however, it is rejected for the longer term ICT skills needs.

Table 4.16: Mean values of technological skills and non-technological skills

		Mean	Std. Deviation	Std. Error Mean
Short term	Tech	2.14	.857	.024
	Non -Tech	1.99	.894	.020
Longer term	Tech	2.04	.869	.024
	Non-Tech	2.10	.863	.019

Table 4.17: Independent sample test for variance of means between technological and non-technological skills

		Levene's Test for Equality of Variances		t-test for Equality of Means						
									95% Confidence Interval of the Difference	
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
Short term	Equal variances assumed	.716	.398	4.994	3328	.000	.157	.031	.095	.219
	Equal variances not assumed			5.047	2741.3	.000	.157	.031	.096	.218
Longer term	Equal variances assumed	1.323	.250	-2.009	3328	.045	-.062	.031	-.123	-.001
	Equal variances not assumed			-2.006	2638.7	.045	-.062	.031	-.123	-.001

4.5 EVALUATION OF THE QUESTIONNAIRE AND FRAMEWORK

In part 3 of the questionnaire, respondents were asked to evaluate the questionnaire in general and the framework (SFIA) that was adopted for conducting this study. The results are shown in

table 4.18 and figure 4.12. A 5-level Likert scale was used to assess the following questions:

Q1: I find the structure of this survey easy to comprehend and follow;

Q2: ICT skills used in this survey are compatible with skills as seen and practiced by New Zealand ICT sector and organisations;

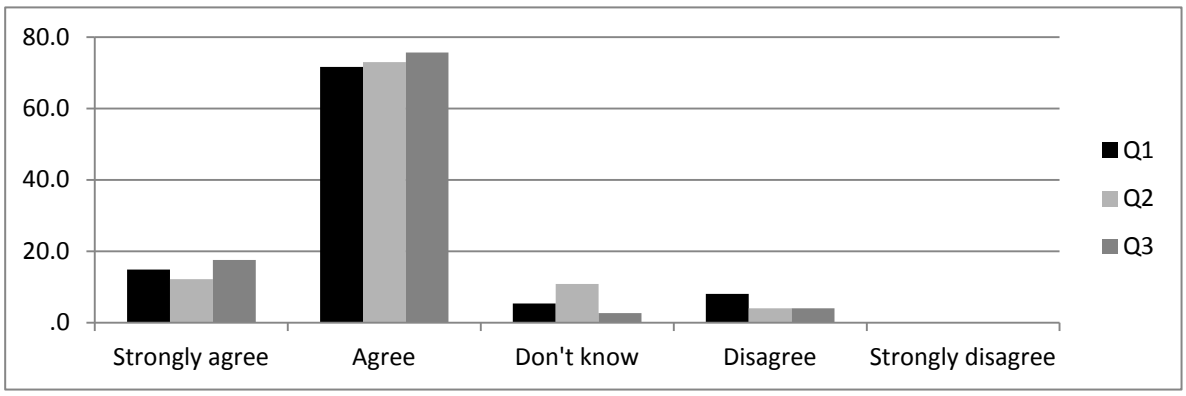
Q3: I find the set of ICT skills used in this survey easy to comprehend and follow.

The majority of responses fell into the “agree” category for all 3 questions. None of the respondents chose “strongly disagree” for any of the questions mentioned above. This can be considered as the questionnaire being fairly usable and respondents did not have major difficulties in understanding and responding to questions. In addition, 73% answered “agree” to question two – use of SFIA as a framework being compatible with skills seen and practiced in New Zealand. This may indicate that although SFIA may not have been adopted by some organisations within New Zealand, it is largely understood by the New Zealand ICT sector.

Table 4.18: Evaluation of questionnaire and relevance of SFIA

	Q1		Q2		Q3	
	Frequency	Percent	Frequency	Percent	Frequency	Percent
Strongly agree	11	14.9	9	12.2	13	17.6
Agree	53	71.6	54	73.0	56	75.7
Don't know	4	5.4	8	10.8	2	2.7
Disagree	6	8.1	3	4.1	3	4.1
Strongly disagree	0	.0	0	.0	0	.0

Figure 4.12: Evaluation of questionnaire and relevance of SFIA



Among the responses that disagreed with or answered as “Don’t know” to the use of SFIA, some provided comments as follows:

“SFIA is a fairly complex tool and its relevance to the average NZ business needs questioned.”

“It was not clear to me what you were seeking for this survey as standard descriptions/terminology was not utilized. […] I did not see the link to SFIA.”

“Difficult to rank value of some skills as they might be particularly important in some areas, but not others.”

“[…] it is difficult to compare staff positions especially in smaller shops like us as one person may fill several roles.”

4.6 CONCLUSION

Based on two assumptions: 1) skills with high value imply high demand for the skill; 2) skills with mean values above “2” are highly valued skills, this chapter discusses the analysis of the survey results in three main sections - demographics, ratings of the value of ICT skills (the main component of the survey) and evaluation of the questionnaire and the relevance of SFIA as a framework used for this research.

The demographic results suggest that the respondents were in the relevant positions for this survey. That is to say, it is highly likely that the respondents have sufficient knowledge in this field and thus have been able to correctly answer the questions. “*Software Engineer”* is the position that was occupied by the highest number of employees in the sample organisations, and was also the position with the highest number of vacancies. However, this is not used to claim that the skill of software development is in the highest demand in the current research. More specifically, without comparing the nature of each skill, the number of vacancies cannot adequately indicate the demand for a certain role. This research looks at the value of each skill as an indicator of demand rather than simply gathering the number of vacancies for each skill.

The comparison of the 4 categories of skills between short and longer term demand suggest that a majority of skills will become more critical for the longer term business needs (3 out of 4).

However, the skills grouped under the "*Operations Management*" category were rated as the most valuable skill set for the short term demand, but are expected to become the least important in the future. Approximately 2 thirds of the 45 total skills were rated as being considerably important to the business regardless of short or longer term (mean values above "2"). Based on assumptions that highly valued skills are in higher demand, this result suggests that overall there is a demand for ICT skills (short and long term) in the organisations that were being surveyed.

The comparison of technological speciality skills and non-technological knowledge/skills using paired sample *t*-tests supports the hypothesis that technological skills are in higher demand than non-technological skills for the short term business perspective. However, this hypothesis is rejected when examining the longer term skill needs.

The results of the evaluation of the questionnaire and use of SFIA as a base conducting the survey appear to be positive. This can be considered as the questionnaire being fairly usable and the respondents did not have major difficulties in understanding and responding to questions. Furthermore, the result that over 85% responses were "agree" or "strongly agree" to the use of SFIA as being compatible with skills seen and practiced within New Zealand indicates that although SFIA may not have been adopted by some organisations, it is largely understood by the New Zealand ICT sector.

Chapter 5

Discussion and Reflection of Research Findings

5.1 INTRODUCTION

This chapter summarises the outcome of the current study on the demand for ICT skills in both short and longer term needs by businesses within New Zealand. Following the review of literature, two research hypotheses were established. In order to test the hypotheses, a questionnaire survey was conducted nationwide based on SFIA as a standard skills framework to achieve consistency. The results from the survey were discussed in detail in Chapter 4. This chapter outlines an overview of the key findings and reflection on what has been learned throughout this study.

The outcome of this research can add value to the body of knowledge that exists regarding demand for ICT skills in planning and personnel development processes. Both the education sector and industry training organisations can potentially benefit from the findings of this research. The benefits of the findings can even extend to New Zealand Immigration Service and other similar planning and development organisations involved in assessing and resolving the need for various skills within New Zealand.

As the skills considered in this study were examined based on a standard skills framework, the findings can be compared with peer studies that also use the same standard classification of ICT skills. More specifically, the findings of any future studies using SFIA to define and analyse skills can be directly compared with the results of this study. For instance, a study focusing on supply of ICT skills classified according to SFIA can examine if the supply meets demand by comparing the results with the current study.

5.2 AN OVERVIEW OF THE RESEARCH OUTCOME

The research findings comprise three main sections. The first section, demographics of the 74 respondent organisations, presents a wide range of industry sectors, including both private

business and public sector. There are noticeable discrepancies of industry distribution between the overall population (organisations with 100 or more employees within New Zealand) and the respondent organisations. Two of the industries ("*Manufacturing*" and "*Health Care and Social Assistance*") were well represented with a reasonably accurate proportion of responses, 6 industry categories were disproportionally over represented and 9 under represented, including 5 categories which had no responses. This could be a reflection of the industries' interest in the area of this particular research and the nature of the business. More specifically, some industries (i.e. "*Information Media and Telecommunications*") were more responsive possibly because of the alignment of the outcome of this research with their industry, while others may have seen it irrelevant and therefore had little motivation to respond. In addition, as the questionnaires were sent to randomly selected companies, the distribution may not exactly reflect the distribution of the overall population.

The information regarding the positions/roles of the respondents shows that they are in the relevant positions with sufficient knowledge of ICT needs organisation-wide to be qualified to answer the survey questions. The results of current vacancies within the sample organisations reveal that the role of "*Software Engineer*" had the highest number of current vacancies. However, this is not used to claim that the skill of software development is in higher demand than other skills including managerial positions such as "*IT Manager*", which had the 4th highest number of vacancies. This is because "*Software Engineer*" in the respondent organisations also had the highest number of existing employees. The vacancy rate for this role as percentage of the number of existing employees in this position was no more than the average for all positions. That is to say, the absolute number of vacancies by itself is not indicative of demand. Without evaluating the nature of each position, the number of vacancies cannot be used to generalise the demand for a certain role. The current research assesses the value of each skill to indicate the demand rather than simply collecting the number of vacancies. Furthermore, from the labour supply perspective, as there is often a larger volume of a supply of skills such as software development than that of managerial skills such as IT function management, the difficulties of accessing the skill of software development may not be experienced as much as when filling a vacancy for IT manager. "Demand" is a different concept from "shortage" – which is the difference between supply and demand.

Therefore, it can only be claimed that there is a shortage of software engineers if this demand cannot be met.

The second section presents the value of (demand for) ICT skills in short and longer terms rated by the 74 organisations. The results were analysed and presented in 5 areas. The 45 skills are firstly analysed within 4 categories, which are "S*olution Design / Development / Release*", "*Operations Management*", "S*trategy and Business Alignment*" and "*Department Management*". The skills in categories 2 and 3 have the greater variances of ratings between short and longer term demand. The comparison of the 4 categories was then completed to show the trend of the skill needs between short and longer term. The result reveals that there is a significant drop in values of (demand for) the skills in the category of "*Operations Management*". Of the 12 skills in this category, 3 out of the 4 skills that were rated less valued (with statistical significance) in the future are the skills directly related to technological specialities. On the other hand, 3 out of the 4 skills that were rated more valuable (also with statistical significance) in the future are non-technological related skills. The higher rating for the skill of "*learning resources creation, learning delivery (including training and professional development)*" in the longer term may indicate that organisations are increasingly aware of the importance of customised learning activities in incorporating relevant business needs, which will help the transfer of business and technological skills and knowledge. What's more, organisations realise the benefits of aligning employees' professional development with their business needs. The skill of "*service level management*" being rated higher in the longer term may suggest that organisations are focusing more resources on meeting customer business requirements. In order to provide the agreed levels of service, organisations need to continually and proactively improve their service delivery and sustainability targets.

In contrast, the lower ratings of the technological skills in the longer term can be interpreted as a decreasing demand for direct technological related skills in the future business needs. As discussed later in this chapter, this could be a result of the respondents being at senior position that oversee the organisational development needs at a higher level. For instance, the skills of "*database administration*" and "*security administration of IT facilities*" may be seen as necessary for "commodity work" that can be accomplished outside the organisation via outsourcing.

As a contrast to the overall decreased value of skills in the future in this category, all the other 3 categories of skills are valued more in the longer term. This may sugggest a need for a change of focus for future planning of ICT skills development within organisations. The analysis of all 45 skills regardless of category shows somewhat consistency between short and longer term demand. For instance, the 3 most valued skills in the short term are also the top 3 in the longer term. What's more, 4 of the 5 least valued skills are shown in both short and longer term needs, with the 5th showing only a slightly higher rating in the longer term. The analysis of combined short and longer term value ratings was also provided to help readers establish an overall impression of demand for the 45 skills irrespective of current or future business needs. The paired sample *t*-tests were conducted to examine the difference of the demand for technological and non-technological related skills in both short and longer term. The results verify that only in the short term, there is a higher demand for direct technological related skills.

In the last section of the results analysis, the evaluation of the survey was discussed. The outcome shows that respondents did not have major difficulties in understanding and responding to the questions. In addition, the use of SFIA as a framework is appropriate and largely accepted by the respondents. This can imply that the questionnaire survey conducted to investigate demand for ICT skills within New Zealand is relevant and valid.

5.3 A COMPARISON OF FINDINGS VERSUS PRIOR STUDIES – VALIDATING HYPOTHESES

In chapters 1 and 2, after considering the outcome of the literature review two hypotheses were established. The first hypothesis stated that "*there is high demand worldwide for ICT skills. New Zealand is part of the global economy; therefore there must be high demand for ICT skills in New Zealand consistent with international trends."*

Based on the assumptions discussed in chapter 4, it was decided that skills with mean values over "2" indicate that there is a high demand. Tables 4.12 and 4.13 in chapter 4 outline the overall rating for all skills both in the short and longer terms. Considering the results presented in chapter 4, it can be seen that of all the ICT skills examined (total of 45), 30 (67%) are rated with a mean value above "2" in the category of "immediate need". This signifies that two thirds of the skills are rated

to be in high demand where short term needs are concerned. Furthermore, if we view a rating of 1.5 to 2 to be an indication of medium demand for skills, then except for 5 skills, the rest (40 out of 45, 89%) are in either the medium or high demand categories. Therefore, the first theory is validated – for the short term demand.

Where longer term demand is concerned, 29 (64%) skills are rated above "2". Once again if we view a rating of 1.5 to 2 to be an indication of medium demand for skills, then from table 4.13 in chapter 4, only 4 skills are rated below 1.5. That is to say, 41 out of 45 skills (91%) are rated as being in moderate or high demand in the longer term. This validates the first hypothesis for the skills in the longer term. Therefore, the first hypothesis is validated for both short and longer term needs.

Comparing this result with various industry reports (e.g. JVM Report, 2007; IT Job Vacancies Index Report, DoLNZ, 2012), it is fair to say that New Zealand ICT industry is experiencing a growing demand for ICT skills.

Hypothesis 2 stated that "*In the New Zealand ICT industry, the areas in higher demand are those that are directly associated with technological specialties.*" Section 4.4.8 in chapter 4 presented a classification of ICT skills into two different groups – technological and non-technological.

Tables 4.16 and 4.17 in chapter 4 outline the paired sample *t*-test for average ratings as they related to the two categories discussed above. The test was implemented to show statistical significance of the two mean values (overall ratings of demand for skills in both categories – technological and non-technological) before any conclusions are drawn so as to prove or disprove the second hypothesis. The results of the tests show that for both short and longer term demand, the difference between technical and non-technical skills ratings are of significance (statistically).

Based on the discussion above, technological skills are rated as being of more value (higher demand) in the short term – compared with non-technological skills. This is in agreement with a study of demand for ICT skills in New Zealand (Asgarkhani & Wan; 2008a), which reveals that technological skills are the most required by the industry. In contrast, the results of the current study show that non-technological related skills are seen as being more important than the

technological skills in the longer term. This is consistent with a number of previous academic studies and industry reports (Abraham et al. 2006; Thibodeau, 2006; Zwieg et al. 2006; Bullen et al. 2009; Diversiti, 2008; Goles et al. 2008) predicting a declining need for technological skills in the industry as discussed in chapter 2 – literature review.

In conclusion, the hypothesis of direct technological related skills being in higher demand than non-technological skills is accepted for the short term business perspective; however, it is rejected for the longer term ICT skills needs. This could be a reflection of the positions of the respondents, who are senior managers and executives. They oversee the businesses at a higher level. More specifically, the respondents may view direct technological related skills as less critical than those skills that can lead their organisations to a competitive advantage. This is because technological skills for "commodity" work can be obtained via various ways, such as outsourcing. However, the skills that differentiate one company from another often require a higher level knowledge of the business within the organisation, therefore in general, not desirable to be outsourced.

5.4 FINAL REFLECTION

5.4.1 Implications of Findings

The findings of this research suggest that firstly ICT related skills are in demand. However, the shape and form of those skills may not necessarily be traditional skills (mostly concentrated on direct technological aspects). More specifically, ICT solutions are seen as tools for enabling business. As suggested by the findings, there is moderate to high demand for the majority of skills considered in this study. This has implications on a) education and training organisations, b) ICT service providers and users, c) employers, and d) government and other development agencies (e.g. NZIS, CDC and DoL NZ).

Educational and training organisations need to connect their educational programs to the needs in the industry – in this case, ICT skills in demand. The scope of this study does not cover assessing the relationship between the outcome of this study and what students (applicants) are trained for in reality. It is recommended that the findings of the current study to be communicated to the education sector for reviewing their programs and fine-tuning if seen necessary.

There are similar implications on the industry. That is to say, organisations should project their human resource needs and plan for addressing those needs. It may be beneficial for organisations to take notice of findings of this study – and align their projection of skills needs with the findings presented here if applicable. The benefits of the findings can even extend to New Zealand Immigration Service, Department of Labour New Zealand, or any similar planning and development organisation (such as local economic development boards or agencies). New Zealand Immigration Service has policies to allow skilled migration into New Zealand to solve projected shortage of skills. The findings of this study can be of value to this organisation – as it highlights demand for certain ICT skills.

Furthermore, New Zealand is a small economy (compared with other ICT enabled countries) and is made of much smaller ICT organisations (on average) when compared with other countries. It is expected that ICT organisations may not be able to clearly separate direct technological skills from those of non-technological knowledge and abilities. That is to say, providers of ICT education in New Zealand may need to plan to cater for more than just developing students' technological skills for the local employment market. This could have been reflected in the longer term value of technological versus non-technological skills – based on the discussion above regarding testing the hypothesis.

ICTs form a significant component of organisations' budgets. There seems to be a need for managing and reviewing the validity of the use of technology and assessing returns on an on-going basis. This may have been reflected in this study – by seeing a higher demand in the longer term for non-technological related skills including those that relate to project management and project monitoring. The skills declining in importance (less valued) in the future may even reflect a change of technology. In other words, obsolete technology will out date the associated technical skills.

5.4.2 Limitations of the Research and Recommendations for Future Studies

When considering the results of this study, there are a number of limitations that need to be addressed. First, the respondent organisations did not proportionally represent the overall population. While some industry categories were over represented with higher response rates

others were under represented and some even had no responses at all. Although to some extent this is inevitable as a result of the alignment of the research and the nature of the business, it may be able to be managed better by increasing the number of randomly selected companies and the use of telephone interviews. As a consequence of the disproportion of the industry representation, the findings may not be used for generalisation. That is to say, at this point, this study should be considered preliminary.

The second limitation concerns the skills used in the questionnaire. As one of the research objectives is the consistency of the measure of the skills that can enable the comparison with peer studies, this research adapted SFIA as a standard skills framework. However, each skills category had a different number of skills. In addition, a number of skills may have been seen as obscure to some respondents. This may have resulted in some dilemma when comparing the ratings of each skill set.

The third limitation is the lack of defining the level of skills being classified. SFIA is a complex model and in order to achieve a higher response rate this study has modified SFIA and removed the level of responsibility of skills within organisations. Without measuring the level of responsibility, the demand for certain skills may not be as accurately reflected by the rating of the value.

One of the issues discussed in this study was that of the difference between demand and shortage. Shortage is a complex concept and can be looked at in many different ways. In general, shortage is the difference between demand and supply. This study did not address the supply of ICT skills. More specifically, the scope of this study did not extend to assessing what skills educational organisations train their students for. The shortage can only be substantiated when supply is also measured against the demand. Furthermore, as discussed in chapter 2, there are a number of factors that can impact on the perception of skills shortage. Fill rate of vacancies, time taken to fill a vacancy for a particular position, employers' expectations and the nature of the vacancy positions need to be taken into consideration when assessing the demand for and supply of each skill.

The findings of this research establish the level of demand for various skills based on an adapted version of SFIA. It is recommended that a study on supply of the same skills (using SFIA) will be beneficial – in that it identifies the areas of shortage that should be planned for in the longer term. Considering the lack of classification of the level of responsibility for each skill, it is believed that further studies applying the more complex model can paint a more accurate picture of demand including the level of responsibility and authority.

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Appendix 1: Questionnaire

Questionnaire

(Significance and Value ICT Skills)

Today, organisations increasingly rely on ICT solutions to not only operate efficiently but to survive within an increasingly competitive environment. In this questionnaire the term "value" refers to significance of a particular ICT skill to survival of the organisation within the market place.

Part I – Demographic Information of Organisation

1. How many people are employed within the organisation?
   - ☐ SME (up to 19)
   - ☐ 20 – 49
   - ☐ 50 – 99
   - ☐ 100 – 249
   - ☐ 250 – 499
   - ☐ More than 500

2. How many people are employed within the IT department?
   - ☐ Up to 10
   - ☐ 10 – 20
   - ☐ 21 – 30
   - ☐ Over 30

3. What industry best describes the organisation?

- ☐ Agriculture, Forestry, Fishing
- ☐ Mining
- ☐ Manufacturing
- ☐ Electricity, Gas, Water and Waste Services
- ☐ Construction
- ☐ Wholesale Trade
- ☐ Retail Trade
- ☐ Accommodation and Food Services
- ☐ Transport, Postal and Warehousing
- ☐ Information Media and Telecommunications
- ☐ Financial and Insurance Services
- ☐ Rental, Hiring and Real Estate Services
- ☐ Professional, Scientific and Technical Services
- ☐ Administrative and Support Services
- ☐ Public Administration and Safety
- ☐ Education and Training
- ☐ Health Care and Social Assistance
- ☐ Arts and Recreation Services
- ☐ Other (please specify)

4. What is your current position/role in the organisation?
   - ☐ ICT consultant
   - ☐ IT manager/director
   - ☐ Chief Information Officer/Chief Technology Officer
   - ☐ ICT planner
   - ☐ Organisation executive team (please specify)

     _____

   - ☐ Organisational planner
   - ☐ Others (please specify)

     _____

5. Which of the following position exists in your ICT organisation? Please use the blank rows to specify positions not included in the list.

Position	Number of current employees	Number of current vacancies
CIO/IT Director		
IT manager		
Business Analyst		
Help Desk personnel		
Networking Specialist		
Software Engineer/Programmer		
Computer Operators		
Others (please describe below)		
Purchasing		
System Analysis		

Part II – ICT Professional Skills

The level of importance of a certain skill for an organisation is rated from zero to three – as follows:

0: not at all valuable

1: little valuable

2: moderately valuable

3: highly valuable

1. Solution Design/Development/Release

	Skill Description	Immediate (next 12 months) significance of the skill	Longer term significance of the skill
		please rate from 0-3 where the skill is of value to business operations and business development within the organisation	please rate from 0-3 where the skill is of value to business operations and business development within the organisation
1	Data/information analysis, database design	0 1 2 3	0 1 2 3
2	Requirements definition and management	0 1 2 3	0 1 2 3
3	Systems and applications design	0 1 2 3	0 1 2 3
4	Network design	0 1 2 3	0 1 2 3
5	Programming/software development	0 1 2 3	0 1 2 3
6	Solution safety design and safety assessment	0 1 2 3	0 1 2 3
7	Systems and applications testing	0 1 2 3	0 1 2 3
8	Systems ergonomics and Human factors integration	0 1 2 3	0 1 2 3
9	Usability requirements analysis and evaluation	0 1 2 3	0 1 2 3
10	Systems integration (including porting/software integration)	0 1 2 3	0 1 2 3
11	Systems installation / decommissioning	0 1 2 3	0 1 2 3
12	Change and release management	0 1 2 3	0 1 2 3
13	Program and Project management (risk management, change management, quality management and assurance)	0 1 2 3	0 1 2 3
14	Sustainability assessment and engineering	0 1 2 3	0 1 2 3
15	Information content authoring	0 1 2 3	0 1 2 3
16	Others (Please specify)	0 1 2 3	0 1 2 3

The level of importance of a certain skill for an organisation is rated from zero to three – as follows:

0: not at all valuable

1: little valuable

2: moderately valuable

3: highly valuable

2. Operations Management

	Skill Description	Immediate (next 12 months) significance of the skill	Longer term significance of the skill
		please rate from 0-3 where the skill is of value to business operations and business development within the organisation	please rate from 0-3 where the skill is of value to business operations and business development within the organisation
1	Management of capacity and availability of IT services (hardware, software and networks)	0 1 2 3	0 1 2 3
2	Service level management	0 1 2 3	0 1 2 3
3	Configuration support management	0 1 2 3	0 1 2 3
4	System software installation and maintenance	0 1 2 3	0 1 2 3
5	Application support	0 1 2 3	0 1 2 3
6	IT operations, network operation and network support	0 1 2 3	0 1 2 3
7	Problem management including service desk and incident management	0 1 2 3	0 1 2 3
8	Database administration	0 1 2 3	0 1 2 3
9	Consultancy, guidance and advice	0 1 2 3	0 1 2 3
10	Client services management	0 1 2 3	0 1 2 3
11	learning resources creation, learning delivery (including training and professional development)	0 1 2 3	0 1 2 3
12	Security administration of IT facilities	0 1 2 3	0 1 2 3
13	Others (Please specify)	0 1 2 3	0 1 2 3

The level of importance of a certain skill for an organisation is rated from zero to three – as follows:

0: not at all valuable

1: little valuable

2: moderately valuable

3: highly valuable

3. Strategy and Business Alignment

	Skill Description	Immediate (next 12 months) significance of the skill	Longer term significance of the skill
		please rate from 0-3 where the skill is of value to business operations and business development within the organisation	please rate from 0-3 where the skill is of value to business operations and business development within the organisation
1	Corporate governance of IT	0 1 2 3	0 1 2 3
2	Information management strategy (analysis, policy formation, publishing, information co-ordination)	0 1 2 3	0 1 2 3
3	Information security and assurance strategies	0 1 2 3	0 1 2 3
4	Portfolio management of IT solutions to support business strategies	0 1 2 3	0 1 2 3
5	Business analysis, business modelling and organisation design	0 1 2 3	0 1 2 3
6	Stakeholder relationship management	0 1 2 3	0 1 2 3
7	Solution strategy and architecture (software development process, network planning, Continuity management, methods and tools)	0 1 2 3	0 1 2 3
8	Business process improvement (research, innovation, Enterprise architecture)	0 1 2 3	0 1 2 3
9	Emerging technology monitoring	0 1 2 3	0 1 2 3
10	Sustainability strategy and management for IT	0 1 2 3	0 1 2 3
11	Others (Please specify)	0 1 2 3	0 1 2 3

The level of importance of a certain skill for an organisation is rated from zero to three – as follows:

0: not at all valuable

1: little valuable

2: moderately valuable

3: highly valuable

4. Department Management

	Skill Description	Immediate (next 12 months) significance of the skill	Longer term significance of the skill
		please rate from 0-3 where the skill is of value to business operations and business development within the organisation	please rate from 0-3 where the skill is of value to business operations and business development within the organisation
1	Managing IT finances	0 1 2 3	0 1 2 3
2	Managing the ICT function	0 1 2 3	0 1 2 3
3	Procurement	0 1 2 3	0 1 2 3
4	Supplier Relationship management	0 1 2 3	0 1 2 3
5	Asset management	0 1 2 3	0 1 2 3
6	Resource management of IT workforce	0 1 2 3	0 1 2 3
7	Marketing, sales and sales support	0 1 2 3	0 1 2 3
8	Account management	0 1 2 3	0 1 2 3
9	Others (Please specify)	0 1 2 3	0 1 2 3

Part III – Evaluation of Questionnaire and Framework

1. I find the structure of this survey easy to comprehend and follow.
   - ☐ Strongly agree
   - ☐ Agree
   - ☐ Don’t know
   - ☐ Disagree
   - ☐ Strongly disagree

2. ICT skills used in this survey are compatible with skills as seen and practiced by New Zealand ICT sector and organisations.
   - ☐ Strongly agree
   - ☐ Agree
   - ☐ Don’t know
   - ☐ Disagree
   - ☐ Strongly disagree

3. I find the set of ICT skills used in this survey easy to comprehend and follow.
   - ☐ Strongly agree
   - ☐ Agree
   - ☐ Don’t know
   - ☐ Disagree
   - ☐ Strongly disagree

4. Please add any additional comments which you would like to make in the space below:

5. Would you be willing to be involved in a follow-up study? Please give your contact information if you were willing to be interviewed in the follow-up study.

Thank you for taking the time to complete this questionnaire!!

Appendix 2: Cover Letter

Dear Respondent,

I am inviting you to participate in a research project to study the future demand for various Information and Communications Technology (ICT) related roles and skills within New Zealand.

The questionnaire attached is designed to assess the level of need for various ICT roles/skills within organisations. I would appreciate it if you could kindly allocate time to participate in this study and respond to this questionnaire.

By participating in this study, you play a major role in identifying the future needs for ICT skills. The outcome of this study will be used to determine how tertiary educational and training institutions align their education and training programs so as to develop a suitably skilled workforce for the ICT sector. Furthermore, the results of this study will be of benefit to both local and national economic development agencies.

This study is the first to use the Skills for Information Age (SFIA) as a framework. This framework is likely to play a major role in the future of New Zealand ICT industry. It has been adopted by the New Zealand Computer Society (NZCS) as the basis for granting certification to IT professionals (ITCP program). It may play a major role in standardizing ICT qualifications in New Zealand.

I am confident that the results of the survey will be useful for not only economic development and educational/training agencies but also for participating organisations.

Thank you in advance

Jun Wan (Lead Researcher)

Mehdi Asgarkhani (Industry Sponsor)

Appendix 3: Information Sheet

A Study on Demand for ICT Roles and Skills within New Zealand

INFORMATION SHEET

This study is conducted to fulfil the requirements of completing a thesis for of a Master of Business and Administration qualification (majoring in Information Systems) at Massey University.

There is no risk involved if you choose to participate in this study and answer survey questions.

The method of selecting participants for this study involved firstly identifying companies within Canterbury which use ICT tools fairly extensively to support business functions. If you feel there are other employees in your organisations who are more likely to be in a better position to respond to this questionnaire please feel free to forward the questionnaire to them.

Data collected from this survey will be used to identify the critical demand for ICT roles and skills within New Zealand. Data will be stored electronically within secure environment and accessible by the researcher and supervisors only. Your participation in this study will be kept confidential. Data collected will not be stored in a way to be connected to and identify participants and their organisations. A summary of findings can be made available to participants – if participants make their contact details available. Data collected will be kept securely for a period of three years to help with further studies – should it be required.

Your participation is voluntary. You have the right to:

a) Decline to participate.
b) Decline to answer certain questions.
c) Contact researcher or supervisors if you have any queries.
d) be provided with summary of findings should you choose to provide your name and contact details

Please note that completion and return of the questionnaire implies consent.

Project Contacts

Researcher (student):

Jun Wan
Email: *WanJ@CPIT.ac.nz*

Supervisors:

Dick Whiddett
Email: R.J.Whiddett@massey.ac.nz

Keri Logan
Email: *K.A.Logan@massey.ac.nz*

Mehdi Asgarkhani
Email: *AsgarkhaniM@CPIT.ac.nz*

This project has been evaluated by peer review and judged to be low risk. Consequently, it has not been reviewed by one of the University's Human Ethics Committees. The researcher and supervisors named above are responsible for the ethical conduct of this research.

If you have any concerns about the conduct of this research that you wish to raise with someone other than the researcher(s), please contact Professor John O'Neill, Director, Research Ethics, telephone 06 350 5249, email humanethics@massey.ac.nz".

Appendix 4: Tables and Figures

Table 4.1: Industry Distribution of Respondent Organisations

	%
Number of Employees	
SME (up to 19)	1.4
20 – 49	2.7
50 – 99	4.1
100 – 249	27
250 – 499	21.6
More than 500	43.2
Number of IT employees	
Up to 10	45.9
10 – 20	29.7
21 – 30	6.8
Over 30	17.6
Industry Category *(before re-grouped)*	
Agriculture, Forestry, Fishing	2.7
Education and Training	9.5
Electricity, Gas, Water and Waste	6.8
Financial and Insurance Services	6.8
Health Care and Social Assistance	9.5
Information Media and Telecommunications	5.4
Manufacturing	14.9
Professional, Scientific and Technical Services	8.1
Public Administration and Safety	8.1
Retail Trade	4.1
Transport, Postal and Warehousing	10.8
Wholesale Trade	4.1
Other	9.5
Industry Category *(re-grouped)*	
Agriculture, Forestry, Fishing	2.7
Education and Training	9.5
Electricity, Gas, Water and Waste	9.5
Financial and Insurance Services	6.8
Health Care and Social Assistance	9.5
Information Media and Telecommunications	5.4
Manufacturing	14.9
Professional, Scientific and Technical Services	10.8
Public Administration and Safety	12.2
Retail Trade	4.1
Transport, Postal and Warehousing	10.8
Wholesale Trade	4.1

Table 4.2: Industry Distribution of Overall Population (organisations with 100 or more employees within NZ)

Industry Category	%
Accommodation & food services	9.4
Administrative & support services	4.4
Agriculture, forestry, & fishing	6.1
Arts & recreation services	2.2
Construction	6.0
Education & training	13.6
Electricity, gas, water, & waste services	0.6
Financial & insurance services	1.3
Health care & social assistance	8.6
Information media & telecommunications	1.1
Manufacturing	13.8
Mining	0.3
Other services	2.7
Professional, scientific, & technical services	7.2
Public administration & safety	1.7
Rental, hiring, & real estate services	1.3
Retail trade	8.7
Transport, postal, & warehousing	4.3
Wholesale trade	6.7

Figure 4.6 Percentage of employees in the existing positions

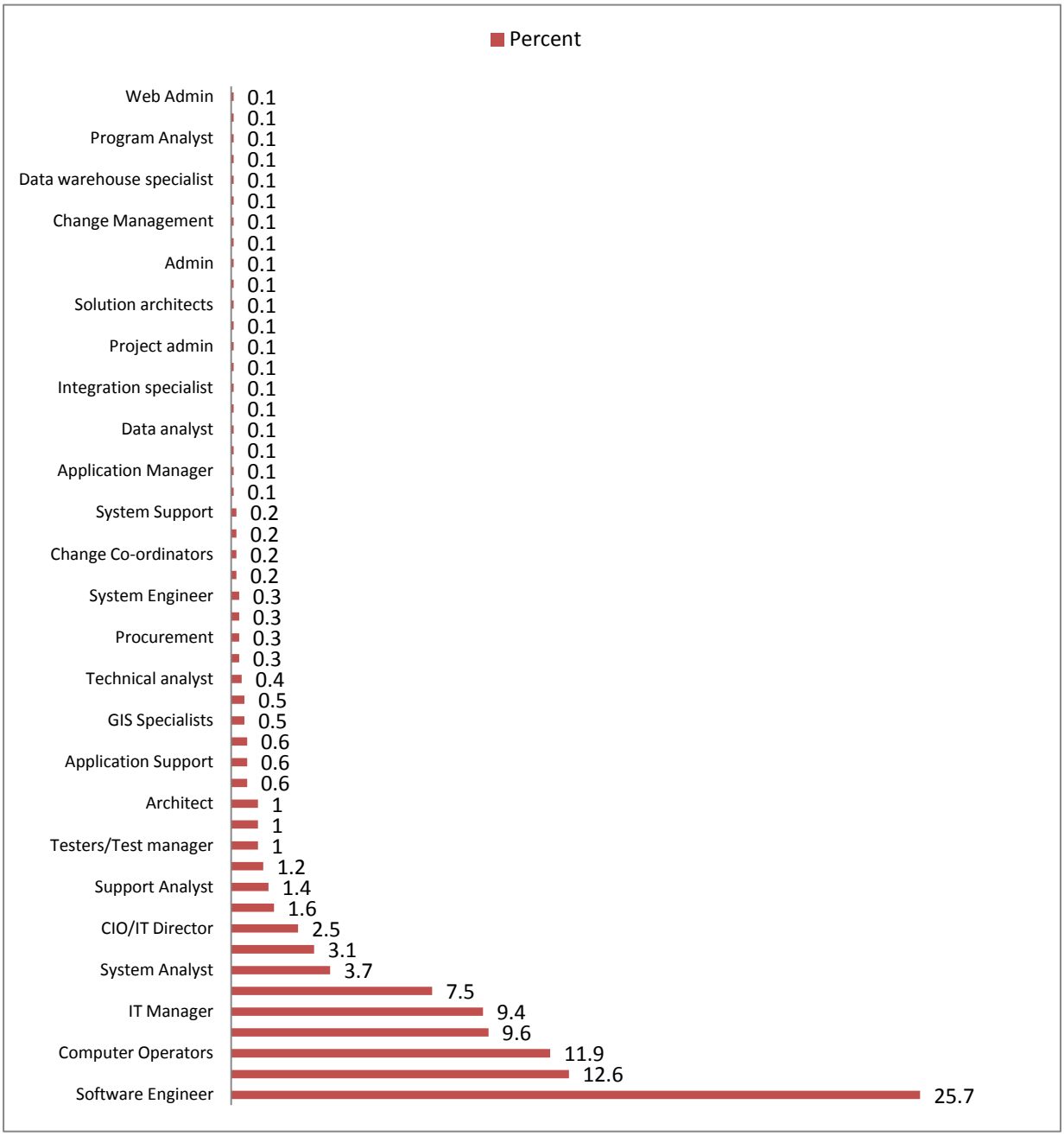
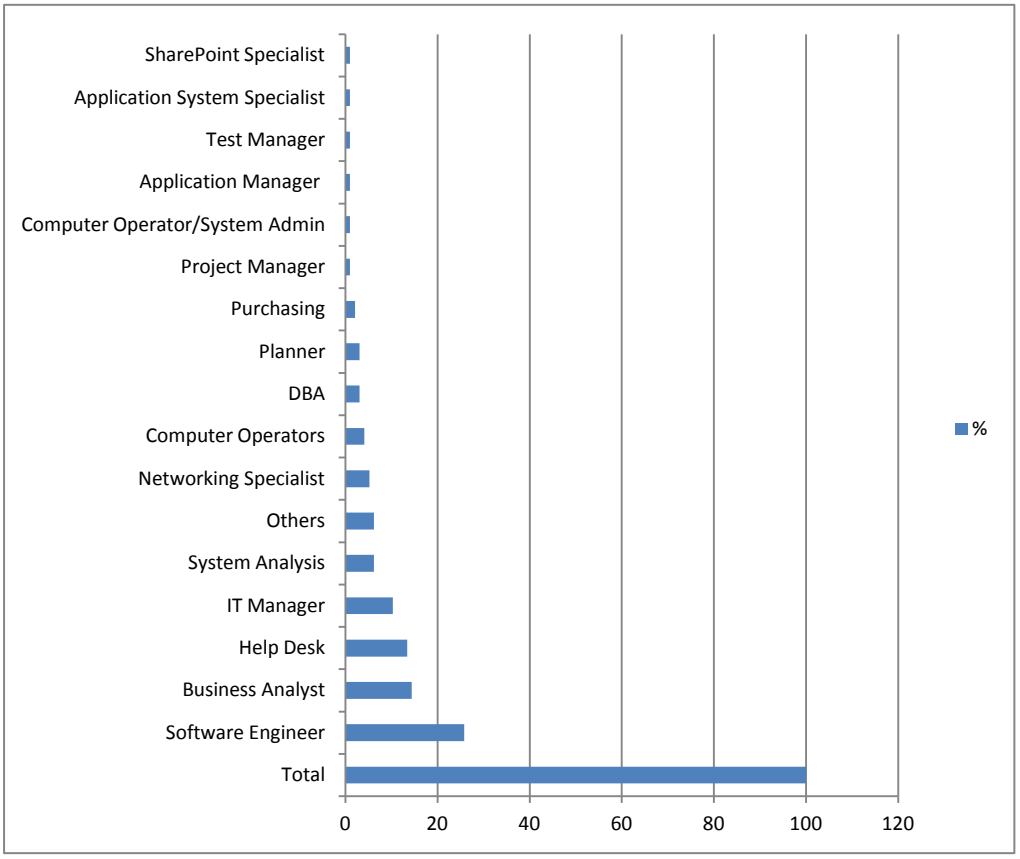


Figure 4.6 Percentage of current vacancies



Appendix 5: Quality Assurance Plan

QUALITY ASSURANCE

The quality of this research is managed through three key criteria - as outlined in table 1.

Quality	Tool
Consistency and validity of data	▪ Skills Framework (Benchmark) ▪ Suitable sampling technique ▪ Provision of possible answers to survey questions for participants to choose from
Statistical accuracy of findings Ability to generalize application of results	▪ Adequate sample size – considering confidence level and margin of error ▪ Application of results fit tests – e.g. t test. ▪ Elimination of bias ▪ Employing techniques for increased response rate for surveys
Research process	▪ Research proposal ▪ Standardised reporting procedures ▪ Application of industry standards where applicable

Appendix 6: Potential Risk Plan

POTENTIAL PROBLEMS AND RISKS

Some of the potential risks for this project are as follows:

- Possible communication delays which can cause delays in progressing with clarifying concepts and seeking approval – as I am studying extramurally.
- Potential difficulty to accurately establishing the population that guides sampling design for this project.
- Limited access to sources of collecting data (companies and experts).
- Low response rate that may impact on accuracy of outcomes.
- Potential difficulty in aligning some of ICT skills frameworks with local roles and skills that have been traditionally considered in New Zealand.
- Potential challenge in transitioning the methodology from theory to practice.
- Possible challenge in aligning industry interest with academic requirements.
- A questionnaire based on a comprehensive framework can be long and may be perceived as being time consuming to respond to. This can potentially cause difficulties in achieving a high response rate. Participants' guide sent alongside questionnaire will be considered as a strategy to manage this risk.

A risk management plan will be in place to monitor these risks on an ongoing basis. Potential issues that may cause difficulties in progressing will be reported to supervisors in advance.

Appendix 7: Research Management and Budget

RESEARCH MANAGEMENT AND BUDGET

Project Management

A research project (similar to any other project) needs to be managed effectively so as to facilitate the delivery of agreed upon outcomes. Management of a research project involves:

- Ensuring objectives and outcomes are clearly set and agreed upon
- Effective communication and people management
- Clear steps and phases of research
- Clear definitions of tools and methodologies
- Clear understanding of quality
- Identifying, understanding and managing risks.
- Identifying potential problems and seeking resolution
- Understanding boundaries of commercial values and academic ethics and values.
- Managing time for timely delivery of outcomes
- Monitoring progress and reporting achieved outcomes through progress reports.

The research proposal, as a key tool, plays a major role in achieving most of the outcomes (actions) specified above.

Broad project plan (draft – subject to review)

- Finalize proposal
- Finalize approval and determine roles and responsibilities (e.g. support from CDC and local research bodies and industry).
- Complete literature review, document and submit for comments and feedback from

supervisor(s).

- Develop benchmark for skills and roles analysis – with reference to ICT skills frameworks.
- Develop study (survey, interviews) method and questions. Submit for approval.
- Obtain ethics approval.
- Conduct a test phase (focus group) of the study and fine tune questions and methods if needed.
- Complete the study – data collection.
- Finalize analysis, submit for comments and review.
- Assess importance of research findings and prepare report to industry.
- Finalize all documentations of the thesis for review by supervisor(s).
- Submit reviewed and approved theses.