A case study on ICT skills shortage and skills gap in Ireland through Training Networks Programme

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Declaration

I declare that the work described in this dissertation is, except where otherwise stated, entirely my own work, and has not been submitted as an exercise for a degree at this or any other university. I further declare that this research has been carried out in full compliance with the ethical research requirements of the School of Computer Science and Statistics.

Signed:

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Joanna Piechota

30th September 2016

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Joanna Piechota

30th September 2016

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Abstract

The aim of this research project was to conduct a case study designed to examine ICT skills shortage and the skills gap in Ireland, through the Training Networks Programme. The Training Networks Programme (TNP) is one of the main programmes that supports training across a wide range of industry sectors and geographical regions. It is managed by Skillnets and funded from the National Training Fund (NTF) through the Department of Education and Skills (DES). An in-depth review of the literature available was conducted, focusing on the skills shortage and skills gap in the ICT sector in Ireland but also in Europe and further afield. Primary research was conducted by using qualitative and quantitative research methods. Qualitative interviews together with an observation were carried out with Network Managers who manage training networks in the ICT sector. An online questionnaire was also carried out with companies who are members of those networks. The findings were analysed to develop emerging themes to assess whether an ICT skills shortage and skills gap exists in Ireland. In conclusion, this research has shown that the ICT skills shortage and skills gap exists in Ireland.

Table of Contents

List of Figures

List of Tables

List of Abbreviations

ASTD – American Society for Training and Development

ACS – Australian Computer Society

CIO – Chief Information Officer

CSO – Central Statistics Office

DES – Department of Education and Skills

ERT – European Round Table of Industrialists

EU – European Union

EC – European Commission

ECA – Europe and Central Asia

ESF – European Social Fund

FDI – Foreign Direct Investment

IADT – Dun Laoghaire Institute of Art and Design

IBEC – Irish Business and Employers Confederation

ICT – Information and Communication Technology

IOT – Internet of Things

IT – Information Technology

ISIC – International Standard Industrial Classification of All Economic Activities

MBIE – the New Zealand Ministry of Business, Innovation and Employment

MINEDU – Ministry of Education and Culture Finland

NTF – National Training Fund

OECD – Organisation for Economic Co-operation and Development

OSS – OECD Skills Strategy

PCAST – President Obama's Council of Advisors on Science and Technology

STEM – Science, Technology, Engineering and Mathematics

TNA – Training Needs Analysis

TNP – Training Networks Programme

US – United States

UX – User Experience

Chapter 1: Introduction and Background

1.1 Introduction

This research project is a case study on the Information and Communication Technology (ICT) skills shortage and skills gap in Ireland through Training Networks Programme (TNP). It looks to investigate whether the skills gap and skills shortage exist and why are employers encountered with a challenge in recruitment of workforce with ICT skills.

This chapter sets out the background to the research. It starts with a brief overview of the ICT industry along with the skills and employment challenge. The scope and justification of the research undertaken is discussed in relation to ICT skills shortage and skills gaps in the Irish context. The structure of the thesis is presented in order to provide guidance and direction for the reader.

1.2 An Overview of the ICT sector in Ireland

1.2.1 ICT definition

In 2007, member countries of Organisation for Economic Co-operation and Development (OECD) agreed to define the ICT sector as a combination of manufacturing and services industries that capture, transmit and display data and information electronically. This definition, based on an International Standard Classification of Activities (ISIC Rev. 4, 2008), was considered to be an initial measurement of ICT sector core indicators. The definition of this sector provides a statistical basis for the measurement, in an internationally comparable way, of that part of economic activity that is generated by the production of ICT goods and services. The following general principle (definition) as per ISIS Rev. 4 (2008) is used to identify ICT economic activities (industries):

> *"The production (goods and services) of a candidate industry must primarily be intended to fulfil or enable the function of information processing and communication by electronic means, including transmission and display".*

The activities (industries) in the ICT sector can be grouped into ICT manufacturing industries, ICT trade industries and ICT services industries. The ISIC, Rev.4 industries that comply with the above definition are provided in Table 1.1.

Table 1.1: ICT sector group

ICT manufacturing industries	
2610	Manufacture of electronic components and boards
2620	Manufacture of computers and peripheral equipment
2630	Manufacture of communication equipment
2640	Manufacture of consumer electronics
2680	Manufacture of magnetic and optical media
ICT trade industries	
4651	Wholesale of computers, computer peripheral equipment and software
4652	Wholesale of electronic and telecommunications equipment and parts
ICT services industries	
5820	Software publishing
61	**Telecommunications**
6110	Wired telecommunications activities
6120	Wireless telecommunications activities
6130	Satellite telecommunications activities
6190	Other telecommunications activities
62	**Computer programming, consultancy and related activities**
6201	Computer programming activities
6202	Computer consultancy and computer facilities management activities
6209	Other information technology and computer service activities
631	**Data processing, hosting and related activities; web portals**
6311	Data processing, hosting and related activities
6312	Web portals
951	**Repair of computers and communication equipment**
9511	Repair of computers and peripheral equipment
9512	Repair of communication equipment

1.2.2 ICT Sector Profile

The software industry has been central to the Celtic Tiger (Clancy, 2016). In the 1980s, Ireland became the base for many United States (US) computer companies exporting to the European market. Building on this success, the country then attracted a new generation of US software companies. By the mid-1990s, Ireland was the world's second largest software exporter and produced more than 50 per cent of all software packages sold in Europe for personal computers (O'Gorman, O'Malley, and Mooney, 1997).

Despite the recession, the ICT sector is thriving, with exports and employment in both indigenous and multinational technology firms continuing to grow. Ireland is emerging as a global technology hub. In the last three years over 17,500 jobs have been announced by technology companies and the sector is responsible for €72 billion in exports, some 40% of our national exports, annually (American Chamber of Commerce Ireland, 2016). This success has made Ireland even more dependent than before on foreign direct investment (FDI) (Wickham, 2015). According to Enterprise Ireland (2015) website, Ireland is the second largest exporter of computer and IT services in the world and has successfully attracted eight of the top ten global information technology companies such as Intel, HP, Apple, Facebook, LinkedIn, Amazon, PayPal, eBay and Twitter. Their arrival has firmly positioned Ireland as the internet capital of Europe. Ireland is also the European data centre location of choice for world leaders including IBM, Microsoft, Google, Yahoo, MSN and Adobe and is now poised to become a global cloud centre of excellence. Ireland's worldwide reputation for creativity and communication is also fuelling the interest of games companies, with Big Fish, EA, Havok, DemonWare, PopCap, Zynga, Riot Games and Jolt (Enterprise Ireland, 2015).

Ireland's ICT sector covers a wide range of technology and activities such as:

- Developing hardware and devices

- Operating systems and software

- Digital Content creation

- Providing consultancy and services

- Systems Integration

- Outsourcing

- Data Supply

- Storage

- IT security

- Cloud computing

- Telecoms, and technical support services (Labour Market Review, 2016)

1.2.3 Employment in the ICT Sector

As of 2005, total employment in the software industry was estimated at 24,000 (Table 1.2), almost equally divided between the foreign and indigenous sectors, but with firm size much larger in the foreign sector (Wickham & Vecchi, 2008).

Table 1.2: **The Irish software sector 2005**

	Foreign	Indigenous	Total
Companies (number)	140	750	890
Employment	12,900	11,100	24,000
Average company size	92,1	14,9	27

Source: Adapted from National Software Directorate (in Wickham & Vecchi 2008:699)

It is one of the fastest growing sectors of the Irish economy, with employment up 40% since 2010. As can be seen from Table 1.3, in 2012, there were over 72,000 ICT professionals working within the ICT sector while in 2014 the number exceeded 82,000 (CSO, 2016).

Table 1.3: **Number of people employed in the ICT sector 2008-2013**

	2008	2009	2010	2011	2012	2013	2014
Information and communication	7,3289	66,811	67,683	69,290	72,684	77,060	82,010

Source: CSO (2016)

According to Forfás (2013) studies, Ireland is likely to face an average increase in demand for high-level ICT skills of around 5 per cent a year out to 2018 with the employment of ICT professionals anticipated to rise to just over 91,000. This prediction has been already exceeded. The ICT sector in Ireland directly employs over 105,000 people, with 75 per cent employed in multinational companies and the remainder in the indigenous technology sector (CSO, 2016).

Employment in the technology sector in Ireland
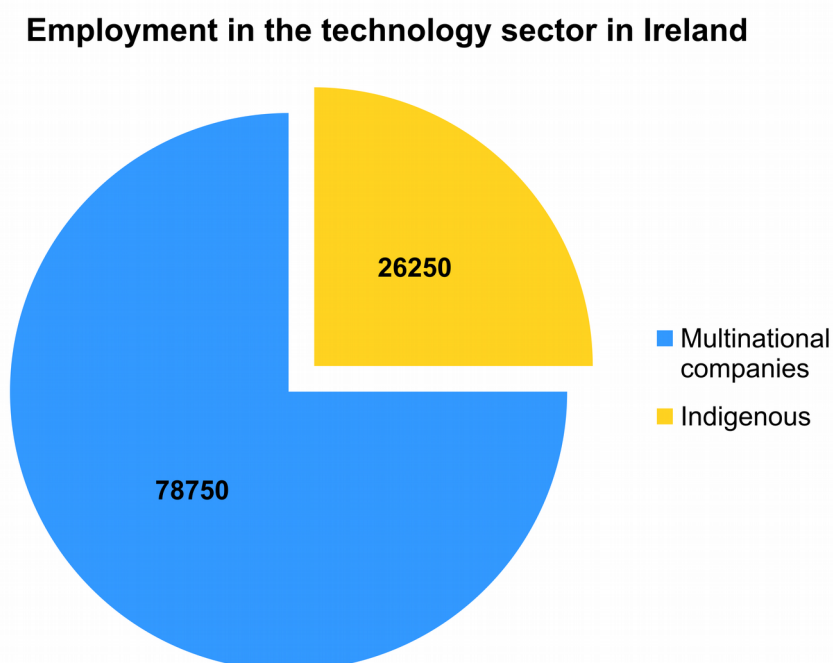
Figure 1.1: Employment in the technology sector in Ireland

Source: CSO (2016)

1.2.4 The Skills Challenge

Classic economic theories suggest that during recession time when jobs are scarce, there is usually an excess of labour supply over demand, making it an employers' market when it comes to recruiting. Ireland did not see an example of this theory. Evidence from two Irish newspapers (Irish Independent 5/4/12, Cork Independent 25/8/11) reported recruitment difficulties and skills shortages being experienced in 'knowledge industry' sectors such as ICT. The report "Action Plan for Jobs' issued by the Department for Jobs, Enterprise and Innovation (DJEI, February 2012) under the heading Aligning Skills with Enterprise Needs (p 30), recognises that skills shortages continue to persist despite the recession. Employers are having difficulty in finding suitably qualified and experienced people in the areas of ICT, Engineering, Science, Finance, Health and Sales. Skills shortages in the Science, Technology, Engineering and Mathematics (STEM) disciplines are particularly acute.

Skills shortage seems to be one of the most significant factors limiting the growth of this industry, especially for the smaller, Irish owned companies. Despite the growing number of graduates in this sector, it is being argued that individuals are often more attracted by the multinational companies who are able to offer better conditions and career opportunities

(Fitzgerald et al., 2014). According to the National Skills Bulletin (2015) produced by Solas for the Expert Group on Future Skills Needs, there were problems in getting qualified workers in industries from the ICT sector to transport and logistics. The group's chair, Una Halligan, said the need for IT abilities was being felt in almost all industries, with experience in fields like data analysis and online security in demand everywhere from retailers to shipping companies.

ICT sector seems very much a candidate driven market and employers are routinely struggling to fill vacancies across IT disciplines, in particular Analytics, Software Development, Mobile Development, Cyber Security and Development Operations. The main reason why there are fewer IT professionals available is that the sector has reached almost 100% employment, start-ups are arriving into the sector on a regular basis, inward investment and the number of companies looking to set-up operations in Ireland is increasing and major companies continue to expand their Irish operations.

But Ireland is not the only country where the ICT skills shortage is visible. The European Commission estimates that Europe could face an 800,000 person ICT skills shortage by 2020. The shortage of talent in ICT is a global problem. This is due to unprecedented growth and innovation in the sector. What matters most is what the government is doing to grow the supply of tech talent for the industry in Ireland.

1.3 Background and Context to the Research

Skillnets is a state funded, enterprise-led support body dedicated to the promotion and facilitation of training and up-skilling as key elements in sustaining Ireland's national competitiveness.

Skillnets support and fund networks of enterprises to engage in training under the Training Networks Programme (TNP). These networks, now referred to as 'Skillnets', are led and managed by the enterprises themselves to design, manage and deliver specific training programmes across a broad range of industry and service sectors nationwide.

Since 1999, Skillnets has facilitated over 50,000 Irish enterprises, in over 300 networks to improve the range, scope and quality of training and allowed over 240,000 employees to upskill and meet their work related training needs.

Since 2010 Skillnets networks are also providing training to job-seekers in the Training Networks Programme (TNP), who are training with those in employment. By training with those in employment, job-seekers can access networking opportunities and keep up to date with their sector while participating in relevant industry-specific training programmes.

Whilst many of Skillnets networks deliver technology related training there are six networks dedicated to high tech training. These are ICT Ireland Skillnet, ISA Software Skillnet, ITAG Skillnet, IT@Cork Skillnet, Tech NorthWest Skillnet and Animation Skillnet. These training networks engage with Irish employers to combat skills gaps in order to meet their current business objectives.

1.4 Research Aim and Objectives

The aim of this research project is to conduct a case study designed to examine ICT skill shortage and skills gap in Ireland through Training Networks Programme.

This research explores a number of issues in relation to ICT skills shortage and skills gap in Ireland. The objectives of this research are:

- to examine the views of enterprises to see if ICT skills shortage and skills gap exists in Ireland

- to examine the views of other key stakeholders in relation to the ICT sector

- to find out how Irish enterprises identify skills gap and if the process is adequate;

1.5 Research Importance and Beneficiaries of the Study

As mentioned earlier, the topic of ICT skills shortage and skills gap is highlighted in a number of reports. However, this research hopes to gain a greater insight into the issue of skills shortage and skills gap in the ICT sector from the point of view of enterprises in the ICT sector.

The target population of this research project are member companies of Skillnets networks in ICT sector across Ireland. These training networks actively up-skill employees of the companies, mainly in the ICT sector but also in sectors where the technology is used, i.e. manufacturing, animation, services etc.

The research findings would be of particular interest to any decision makers, employers, recruiters as well as academic institutions. Decision makers may be interested in this research as a loose means of gauging the area of skills shortage and skills gap from the point of view of enterprises, possibly with a view of creating policies and making decisions that will help to tackle these gaps and shortages. Finally, academics involved in researching ICT sector in Ireland may find this study informative.

1.6 Scope and Boundaries

This single case study research is applicable to the companies in the ICT sector. Since it is practically impossible to sample all companies in Ireland, a convenience sampling is selected. The convenience sample selected for this study are selected member companies of six Skillnets training networks as indicated in the section 1.3 of this chapter. These networks are based in the Republic of Ireland.

1.7 Structure of the Dissertation

The dissertation is divided into five chapters and is structured as follows:

Chapter 1 – Introduction:

The first chapter provides an overview of the research topic, the relevant background information, the research aim and objectives, its importance and the target audience as well as the structure of the dissertation.

Chapter 2 – Literature Review:

The literature surrounding ICT skills shortage and skills gap in the Irish, European and worldwide context, training needs analysis and government initiatives is reviewed in this chapter, setting the framework for the research questions.

Chapter 3 – Research Methodology:

The chosen research philosophy and methodology is explained in this chapter. It provides details on the chosen data gathering technique, the sampled population, the questionnaire content and points of consideration. The limitations and strengths of the research project are also discussed.

Chapter 4 – Findings and Analysis:

In this chapter the qualitative and quantitative data gathered from the observation, online questionnaire and interviews are analysed. It provides the framework used in the interpretation of the data and a justification of the results.

Chapter 5 – Conclusions and Recommendations

The last chapter presents the answer to the research question and objectives. The opportunities for further research based on these findings will be considered.

Chapter 2: Literature Review

2.1 Introduction

An analytical reading of the literature is an essential prerequisite for all research (Hart, 2001). This chapter focuses on analysing and synthesising the literature that is of particular relevance to the research topic as outlined in the conceptual framework.

This chapter explores what research has determined skills gap and skills shortage to be, reviewing literature on ICT skills shortage in Europe as well as other countries. It reviews literature on ICT skills needs in Ireland and skills myth across different countries. The review also looks at training needs analysis and how governments address skills shortage. The chapter begins by reviewing some of the theoretical literature on skills shortage.

2.2 ICT Skills Shortage and Skills Gap

Demographic shifts in the workforce, globalisation of human capital, educational attainment and the impact that the global recession has had on organisations, bring senior managers number of challenges. Some of them, such as managing and filling the skills gap and dealing with skills shortage seem an ever-present reality for many organisations (Kapoor, 2011).

According to the report published by Network for Policy Research, Review and Advice on Education and Training (NORRAG, 2011), the term "skills gap" and "skills shortage" is often incorrectly used in the literature, that is why it is important to ensure that there is conceptual clarity and distinction between those two phenomena.

2.3 Defining Skills Shortage

It is necessary to point out at the beginning that there is some debate in the literature about the exact definition of skills shortage by occupation (Bosworth and Warren, 1992; Muysken, 1994). One of the main points is the term "shortage" is imprecise. In a discussion of skills shortages one needs to consider skills as encompassing economic and institutional factors as well as innate abilities and personal characteristics. A long-standing definition that appeals to economists is that by Arrow and Capron (1959). A shortage is "a situation in which there are unfilled vacancies in positions where salaries are the same as those currently being paid to others of the same type and quality". Francis Green (2013) describes skills shortage as the situation where a job vacancy is hard to fill because of a lack of applicants with the needed skills. This definition excludes

vacancies that cannot be filled because of unattractive wages or working conditions, but it is not confined to technical skills: shortages can also occur, because of a lack of applicants with "suitable" attitudes and commitment (Green, 2013).

Richardson (2007) has proposed the following system for defining skill shortages:

- level 1 shortage: there is a shortage of individuals with the relevant technical skills who are not already using them and it takes a long training time to develop these skills;

- level 2 shortage: there are few people who have sufficient skills and are not already using them, but such skills can be developed relatively quickly.

UK Commission's Employer Skills Survey (2013) define a skills shortage as an expressed difficulty in recruiting individuals from the external labour market under current market conditions with a particular skill set due a low number of applicants caused by at least one of the following reasons: lack of required skills; lack of work experience a company demands; or lack of qualifications a company demands.

2.4 Defining Skills Gap

According to American Society for Training and Development (ASTD, 2006) a skills gap is a significant gap between an organisation's skill needs and the current capabilities of its workforce. It is the point at which an organisation can no longer grow and/or remain competitive in its industry because its employees do not have the right skills to help drive business results and support the organisation's strategies and goals.

A skills gap occurs where an employee's competence to do the job is called into question (typically by his or her manager). This phenomenon is relatively uncommon in cases where employers are free either to train or to dismiss incompetent workers (Francis Green, 2013). The term "skills gap" is often incorrectly used as a comprehensive term describing both quantitative shortages in external labour markets as well as qualitative skills deficiencies internal to the firm (Schwalje, 2011). Skills gaps apply internally to the company's existing workforce (Shah and Burke, 2008). Skill gaps occur where existing employees do not have the required qualifications, experience and/or specialised skills to meet the firm's skill needs for an occupation. Workers may not be adequately trained or qualified to perform tasks, or may not have up-skilled to emerging skill requirements (Department of Employment and Workplace Relations quoted in Department of Education, Science and Training 2000, p.4).

2.5 General Skills Shortage

Throughout the world there has been an increase in the demand for skilled labour in what is now a global knowledge economy (Sondergaard et al., 2011). As Europe struggles to exit from a protracted and costly economic crisis, four in ten businesses in the European Union (EU) report difficulties finding staff with the right skills. This situation and skill shortages have adverse consequences for the productivity and competitiveness of European enterprises (Cedefop, 2015). Workers in today's economies are increasingly required to solve complex and unexpected tasks in their jobs, which involve fewer and fewer simple, predictable activities. In addition, workers must be able to master changing technologies and make sense of large amounts of information (Sondergaard et al., 2011)

2.6 ICT Skills Shortage in Europe and Worldwide

The OECD (2007) defines "ICT specialists" as those who have the ability to develop, operate and maintain ICT systems and for whom ICTs constitute the main part of their job. This is a narrow measure, comprising specialists whose jobs focus is on ICTs, such as software engineers. However, there is a second category, defined as "Advanced users" which are competent users of advanced, and often sector-specific, software tools. This is a broader measure and concerns employees who use ICTs regularly as part of their jobs, but whose jobs do not focus on ICTs. This would include professions in the front lines of media, as teachers in classrooms, as medical staff, or in the financial sector (OECD, 2012b).

A skills shortage in the technology industry is looming, not only in Europe but worldwide, with the number of predicted job vacancies growing and concern mounting over whether there will be enough qualified workers to fill them (The Irish Times, 2015). In many countries, the predicted shortfall of Science, Technology, Engineering and Mathematics (STEM) workers is supposed to number in the hundreds of thousands or even the millions. For example, in 2012, President Obama's Council of Advisors on Science and Technology (PCAST) assembled a Working Group of experts in post-secondary STEM teaching, learning-science research, curriculum development, higher-education administration, faculty training and educational technology. PCAST (2012) report stated that over the next decade, 1 million additional STEM graduates will be needed. The report was based on several analyses such as STEM enrolment, economic analysis STEM Workforce Need, Evidence of the Mathematics Preparation Gap etc. The report was strengthened by input from additional experts in post-secondary STEM education, STEM practitioners, professional societies, private companies, educators, and Federal education

officials. EC (2016) has been predicted a growing shortage of ICT professionals and experts, with an estimated shortfall of as many as 900 000 professionals by 2020, and in the United States, there will be a projected 1.4 million unfilled computer science-related jobs by 2020 and only 400,000 computer science graduates with the skills to apply for them (EC, 2012).

A set of recommendations to increase employability and tackle youth employment in ICT and STEM have been released by the European Round Table of Industrialists (ERT,2015). According to the report Europe will face a shortage of 820,000 ICT professionals by 2020. The recommendations have been made for European governments, schools, universities and businesses to work together to close the ICT and STEM skills shortage. The ERT (2015) report suggests a number of measures to boost hard and soft skills. ERT recommends the modernisation of EU Member State's education systems and that a more positive image of ICT and STEM should be promoted particularly towards females.

2.7 Skills Shortage Myth or Reality

The last decade has seen considerable concern regarding a shortage of STEM workers to meet the demands of the labour market, not only in Ireland but around the World (Labour Market Review, 2016).

The demand for IT specialists is increasing in Europe, USA and many other developed countries. In the mid-1990s, the use of the Internet and e-commerce increased, and many companies started to use IT-enabled services. This development created a widespread demand for IT specialists, but local labour supplies were not sufficient to fill high-level IT positions. In addition, the number of students in IT and computer science has declined in developed countries in the past decade (OECD, 2010). The resulting labour shortages have sparked a global movement of IT specialists (Xiang, 2001). The global standardisation of IT products and services makes IT skills highly portable across national borders (Iredale, 2001). As businesses across the board are becoming increasingly digitised, technology and high-tech companies alike have been complaining over the shortage of available ICT skills (IStart, 2014).

Australia

Digital Pulse report (2015) carried out by the Australian Computer Society (ACS), forecast of 100,000 new jobs created over the next five years raises questions about filling the gap. However, there seem to be different opinions in relation to the skills gap. According to

some Chief Information Officers (CIOs) of the most successful technology companies in Australia the biggest barrier to their growth is the lack of a local skilled workforce. The CIOs are also reporting challenges hiring skilled staff. Others on the other hand do not agree with this and called it "nonsense" and "a myth" (IStart, 2014). The Australian Department of Employment, states in the *Labour Market Research report on ICT Professions* (2015) that there is no shortage in ICT business analysts, systems analysts, analysts and developer programmers or computer network and systems engineers. It does allow that "employers recruiting for workers with appropriate government security clearances face some difficulties", a fact that is particularly evident for software engineers.

New Zealand

The research and engagement with the sector undertaken by the New Zealand Ministry of Business, Innovation and Employment (MBIE) suggests that the issues firms face in finding the ICT skills they need go beyond insufficient supply of skills, and relate to the quality of the skills available, and the ability of employers to retain and effectively use the skills that are available. Andy Jackson, manager of skills and employment policy at the MBIE says:

> *"Over the past 10 years, the employment of highly-skilled ICT professionals has been increasing in particular – specifically software engineers and ICT system test engineers – with a slight decline in the employment of lower skilled technical occupations" (IStart, 2014).*

USA

The study carried out by the United States Bureau of Statistics revealed significant heterogeneity in the STEM labour market: the academic sector is generally oversupplied, while the government sector and private industry have shortages in specific areas.

According to the National Centre for Education Statistics (2013), colleges created far more programmers and engineers than the job market was absorbing. Roughly twice as many American undergraduates earned degrees in science, technology, engineering, and maths disciplines than went on to work in those fields. As shown in the graph below, in 2009 less than two thirds of employed computer science graduates were working in the IT sector a year after graduation.

The Economic Policy Institute argues that two important figures prove there is no tech talent shortage:

- There is a surplus of American graduates with STEM degrees

- Wages for STEM careers are stagnant; if there was a dearth of applicants, wages would rise to attract more workers

Both of these claims are true. Roughly half of STEM graduates never take a job in the field, and fifty two per cent of those who abandon a technology career do so for reasons related to pay, promotion, and working conditions. For STEM graduates, the supply exceeds the number hired each year by nearly two to one (NCES, 2013).
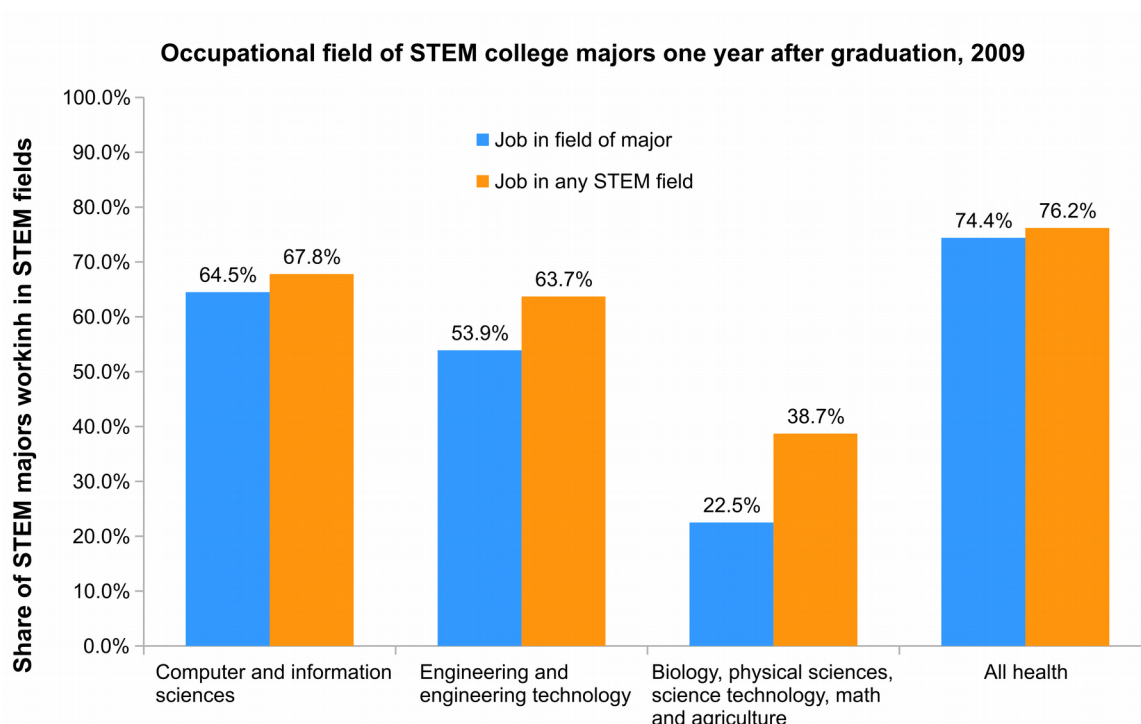
Figure 2.1: Occupational field of STEM college majors one year after graduation, 2009

Source: Author's analysis of National Center for Education Statistics (2013)

Another study conducted by Michael Finn (2012), senior economist at the Oak Ridge Institute for Science and Education, showing that nearly two-thirds of the most highly educated foreign graduates from U.S. universities in science and engineering had remained in the United States ten years after graduation. According to Costa (2012) the nation would be better served if Microsoft filled its 3,400 job openings for researchers, developers and engineers by hiring and retraining some of the 141,000 unemployed workers in computer occupations who are actively looking for work around the country.

However, Naget et al (2015) in the latest paper summarises that the American economy lacks the labour force they need to compete on a global scale. This contradicts the literature and statistics from the National Center for Education Statistics as illustrated in

Figure 2.1 above The solution for this problem is twofold. In the short run America needs to expand high-skilled immigration, including for H-1B visas. For the longer term the government needs to boost STEM education, particularly in high school and college. In addition, stronger oversight to make sure that all companies pay fair, prevailing wages and to shut down degree mills producing H-1B candidates with spurious credentials is needed. Furthermore, provisions should grant H-1B guest workers the ability to more easily change jobs. Whatever the problems of the H-1B program, debate around it should focus on optimizing the effectiveness of the United States' high-skilled immigration programme, not on dismantling it.

Canada

Two years ago Canada also announced skills shortage however the skills myth has been exposed in this case. The federal government was using unreliable statistics to support its claim that Canada had plenty of jobs but no workers with the skills to fill them. In response to the exaggerated skills shortage, Ottawa has allowed hundreds of thousands of temporary foreign workers into the country. There is now substantial evidence they are taking jobs from Canadians and driving up the unemployment rate in some parts of the country (Toronto Star, 2014).

Despite complaints about a shortage of skilled workers, studies show corporate spending on training has been in steady decline for the past two decades (Macleans, 2014). Canada is also near the bottom of the pack when it comes to adult participation in non-formal job-related training (resulting in no degree, diploma or certificate), well behind several European countries and the United States.

**Adult Paticipation in Non-Formal Job-Related Education,
2009 or Most Recent Year**
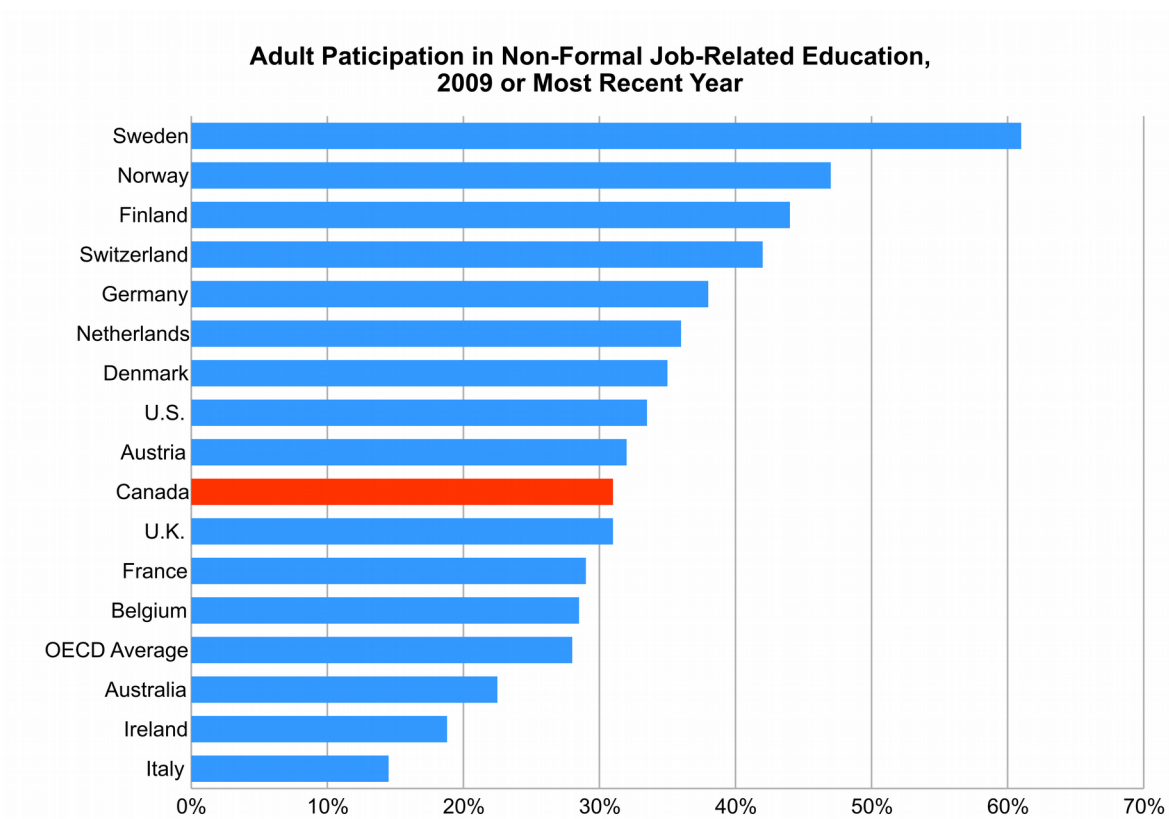
Source: OECD, Education at a Glance 2011 (Indicator C5)

This phenomenon contributes to Canada's abnormally low productivity rates (In 2011, Canada's level of labour productivity was US$42, much lower than that of the United States, at US$52), since well-trained workers tend to do their jobs more efficiently. Macleans' (2014) report highlights that the problem seems not in the skills shortages (number of Canadians went to university and then one college and another college) but there is a huge disconnect between employers and students. A bigger employer commitment to training, co-op programs and paid internships would go a long way toward alleviating the problem (Immigration.Ca, 2014).

Europe

It has been questioned whether there is a European STEM skills shortage in the first place. It is true that the number of STEM enrolments and graduates has increased in the EU over the past decade in absolute terms from 630,400 in 1999 to 916,100 in 2008 (Business Europe, 2011). The reason is the increase in the number of births from 1980 in some of the European countries. For example, Sweden experienced a baby boom after 1985. Also, the number of births recorded in Ireland reached a twentieth century peak of

74,000 in 1980 (CSO, 2000). This follows as a consequence of the larger number of people continuing to tertiary education overall (Business Europe, 2011). Although millions of Europeans are currently without a job, companies operating in Europe claim they are facing a massive skills ICT shortage. As a result, there could be up to 825,000 unfilled vacancies for ICT professionals by 2020 (European Commission, 2013).

Andrus Ansip, European Commission (EC, 2016) Digital Single Market chief, issued the warning during a speech at Digital Single Market Conference in Warsaw (Poland), where he outlined the scale of the skills gap facing Europe. He emphasized that despite rapid growth in the ICT sector, creating some 120,000 new jobs a year, Europe could face a shortage of more than 800,000 skilled ICT workers by 2020. Ansip described this as an alarming state of affairs, especially as the benefits of new IT trends such as big data can be truly realised only with tech-savvy workers.

IT has a crucial role to play in the **UK**'s future prosperity (The Royal Academy of Engineering, 2009). However, there are serious concerns over the IT skills shortage in the UK. According to EU Skills Panorama Analytical Highlight (2012), the demand for science and technology professionals in the UK will grow by 18% by 2014 compared with 4% growth for all other occupations. This translates into 775,000 new roles that will require high-level STEM skills by 2014. The UK expansion and replacement demand taken together will by then result in a total of 2.4 million positions requiring high-level STEM skills (Business Europe, 2011). A Tech City Futures Report (2013) from the market research company GfK, found that 77% of the businesses operating in the London tech sector cited the lack of skilled workers as restricting their growth. In fact, 44 % of companies state that finding skilled workers is the single biggest challenge their business face. It is estimated that the demand for new IT staff in UK is between 156,000 and 179,000 people per year, yet we face an estimated annual shortfall of around 40,000 scientists, engineers and technicians. Many companies are being forced to either seek out highly-trained international recruits to plug holes in their workforce, or to constrain the pace at which they can grow. A survey by the CBI (2013) showed that 39 per cent of firms are already struggling to recruit workers with the advanced technical STEM (science, technology, engineering and maths) skills they need, and 41 per cent of firms believe that the shortage will persist over the next three years. Another body, the Royal Academy of Engineering (2012) reported that the nation will have to graduate 100 000 STEM majors every year until 2020 to stay even with employers' demand.

In **Germany** the shortage of STEM-skilled workers is not a cyclical problem but a structural one. In 2008, which was a boom year for business activity, over 114,000 people with such skills were missing. Obviously, this figure decreased during the economic and financial crisis, but is now already picking up again and reached 117,000 in February 2011 (Business Europe, 2011). It is estimated that in the next few years, Germany will have a shortage of about 210,000 workers in what is known there as the MINT disciplines—mathematics, computer science, natural sciences, and technology (Cedefop, 2012).

In **Austria**, it was clear that business suffered from STEM skills shortages also before the recession. After a moderate ease during the economic and financial crisis, shortages are now increasing again and, in 2010, 77% of Austrian companies reported difficulties in recruiting talents in the field of technology and production (Business Europe, 2011).

In **Belgium**, the shortage of engineers is particularly important in spite of 2,000 engineers graduating each year. In 2009, the number of unfilled vacancies for engineering professions reached 2,500 (Business Europe, 2011). On the contrary, a survey by USG Innotiv Enginnering, an employment service provider, reveals that three quarters of human resource managers interviewed expect the situation to become worse in the upcoming years. Consequently, 28% of the companies in the survey envisage making concessions on the diplomas of job seekers to fill the vacancies (Expatica, 2013).

After the recent sharp global recession, **Ireland**'s employment levels have recovered from unemployment high of 15% at the end of 2011 to less than 9% today (Department of Education and Skills, 2016).

The Oireachtas Committee on Jobs, Enterprise and Innovation (2012), in a review of the Information Communication Technology (ICT) skills demand in Ireland, identified a significant gap between the ICT skills which are taught in schools and third-level colleges and those required to take up job opportunities in the technology sector. Part of the problem is the time lag between curriculum development and the arrival of qualified graduates in the marketplace. According to the report, education clearly has a role to play and, in the case of Ireland, ICT is just one aspect of the skills gap that education could address. The Irish Software Landscape (2014) study conducted by Lero – the Irish Software Engineering Research Centre suggest, that the Irish software industry has the potential to be one of the core engines of Irish economic growth, high income employment and exports but a number of issues needs to be addressed, skills shortage in particular. National Skills Bulletin (2015) confirms that shortages were observed in a greater number

of occupations and sectors compared to recent years and ICT sector is one of them. Table 2.1 presents areas where shortages of ICT skills have been identified.

Table 2.1: Areas of ICT Skills

Areas of ICT Skills
Programming and software development: programming languages (Java, J2EE, JavaScript, C++, Summit, .net, C#, JSP, JQuery, AJAX, Python, PHP); mobile applications development (iOS and Android); web development (CSS, HTML)
Cloud computing: Software as a Service (SaaS) and virtualisation technologies
Web design (niche areas only): particularly web related applications focusing on enhancing users' online experience (UX) and supporting user interaction (UI)
IT project management
Networking and infrastructure: IP (internet protocol) networking and specialist roles such as software quality assurance engineers
IT business analysis: business intelligence and search engine optimisation
Databases, big data analytics and data warehousing: Oracle, SQL, MySQL, Hadoop and noSQL.
Testing, quality assurance and troubleshooting
Technical support: user support with foreign language skills (German, French)

Source: Student own work, based on the data from National Skills Bulletin (2015)

2.8 Identifying Skills Gap and Training Needs

The importance of analysing training needs prior to conducting training has been emphasized by many writers such as Burke and Day (1986), Goldstein (1986) and Wexley (1984). In their seminal contribution to the literature on training needs analysis, McGehee and Thayer (1961) suggested that assessment of training needs involves three types of analysis: organisation, operational (task) and person analysis. For the past thirty years, theoretical and empirical perspectives on the identification of training needs within organisations have been based upon this tripartite framework.

Organisation analysis was initially conceptualized by McGehee and Thayer (1961) as focusing on where in the organisation training could be utilized, based on the organisation's goals, climate and efficiency indices. This has been expanded by Goldstein (1986) to incorporate the identification of system-wide issues, the climate for training within the organisation, the availability of training resources and external pressures (including economic, legal, political and social factors). Operations or task analysis entails

setting performance standards or criteria, describing tasks to be completed, deriving optimal procedures for performing those tasks and specifying the requisite knowledge and skills for task performance.

Finally, person analysis serves to identify personnel who need training, via performance appraisals, proficiency testing and other methods of measuring job performance (Goldstein, 1986; Herbert and Doverspike, 1990). Self-assessment of training needs by managers has also been recommended by some authors (e.g. Ford and Noe, 1987).

In general, the identifying training needs step is recognised as one of the most important steps in training. This first step in training process is primarily conducted to determine where training is needed, what needs to be taught, and who needs to be trained. Thus, without this step, there can be no solid prognosis to diagnose if the whole training process was correctly designed (Anderson, 1994).

2.9 Training Needs Analysis (TNA)

Organizations that develop and implement training without first conducting a needs assessment may end up over training, under training, or just misinterpret the need (Brown, 2002).

Overall definitions of TNA offered by many authors indicate clearly that TNA is done so that training developed by organizations will enable them to achieve their strategic objectives. The definition by Ferdinand (1988) states that TNA is a "rational process by which an organization determines how to develop or acquire the human skills it needs in order to achieve its business objectives". Another author, Brown (2002) defined training needs assessment as "an ongoing process of gathering data to determine what training needs exist so that training can be developed to help the organization accomplish its objectives". A TNA is a review of learning and development needs within an organisation. It considers the skills, knowledge and behaviours that people need, and how to develop them effectively (Lundberg, 2010). A TNA is considered to be the foundation of all training activities. In order to deliver appropriate and effective training which meets the needs of individuals and the organisation and represents value for money, a TNA is essential (Reed and Vakola 2006, Barrington and Holland 1999, Boydell and Leary 1996). There is general agreement in the literature that a training needs analysis is a best practice first step in the systematic approach to training. This systematic approach to training is the predominant model found in the literature (Reid and Barrington 1999, Wills 1998, Bartram and Gibson, 2000). It is described slightly differently, with varying stages and elements, but there are a

number of core features to the approach. The systematic approach is one which involves considering the linkages between the parts of the training process (Altschuld and Lepicki 2009).

There is an assumption that training must be planned in a cyclical manner and that this approach will lead to high quality, planned training (Iqbal and Khan 2011). Bartram and Gibson (2000) state that a systematic approach to identifying training needs ensures that people are offered opportunities to learn which are efficient and effective. All of the systematic approaches in the literature outline a number of steps in the process and cover similar basic elements. These are as follows:

- determining the training need

- designing (choosing) the appropriate methods to address the identified need

- planning (developing) the training courses/programs

- implementing

- evaluating

The benefit of this approach, as outlined in the literature, is that nothing is left out and there is a planned and professional approach to training development and delivery. It also provides data necessary to justify or explain to senior management and key stakeholders what training is required, what budgets are needed, the relative spending breakdowns and how it will impact the organisation (Wills, 1998).

While the structure of the systematic approach has a certain appeal in that there is a structured and logical step by step process to follow, there is a danger that all energy could be focused on the system and the relationship of the various elements within it to the detriment of the original purpose, namely to provide the necessary training to the organisations employees to enable them to work in the most optimal manner (CLMS M2 U6, Wills 1998).

The term training need as out-lined in the various texts inevitably comes back to the assumption that there is a set of knowledge, skills and attitudes required for a job and that training needs analysis should identify what they are, assess the current level of knowledge, skills and attitudes and that the resulting gap is therefore the training need.

2.10 Addressing Skills Shortage: Government Initiatives

There is no question that good education lies at the heart of economic growth and development. Finland is a perfect example. By investing in knowledge and skills, Finland evolved into a modern information society. Today, Finland uses its policies in education, science and technology sustainably to boost creativity and competencies (Ministry of Education and Culture Finland, 2016). At the same time, improving the quality and relevance of education is enormously difficult not least because there is no one single policy measure that will do so effectively.

Skill shortages can be costly to the economy. If there is unmet demand for skilled workers then there are foregone opportunities for the creation of high-wage jobs. In addition, imbalances between the skills demanded by employers and the skills supplied by workers lead to skill mismatch in the economy, which can have adverse macroeconomic consequences – raising the rate of unemployment the economy can sustain without causing inflation (Neumark, Johnson, and Mejia, 2013).

Governments have attempted to alleviate skills shortages by supporting educational institutions in domestic industries that lack talent. They also sponsor vocational programmes that train and retrain workers (Craig et al., 2011).

Grant schemes play an important role in many countries. Governments in many OECD countries use public financing both to promote more private investment in training and to overcome market failures. Two incentive for firms found in many OECD countries are tax deductions for training costs and payroll training levies. Some of the Europe and Central Asia (ECA) countries have also begun experimenting with these tools (Sondergaard, 2012).

European Union (EU) member states have access to grants from the European Social Fund (ESF). The chart below shows ESF fund allocation by country between years 2007-2013 (ESF, 2013). They use these grants to support lifelong learning programmes in line with the EU Lisbon Jobs and Growth Strategy and its successor, the Europe 2020 Strategy (European Commision, 2015). Others have used demand-side financing, such as vouchers, to target individual workers to participate in training (Sondergaard, 2012).
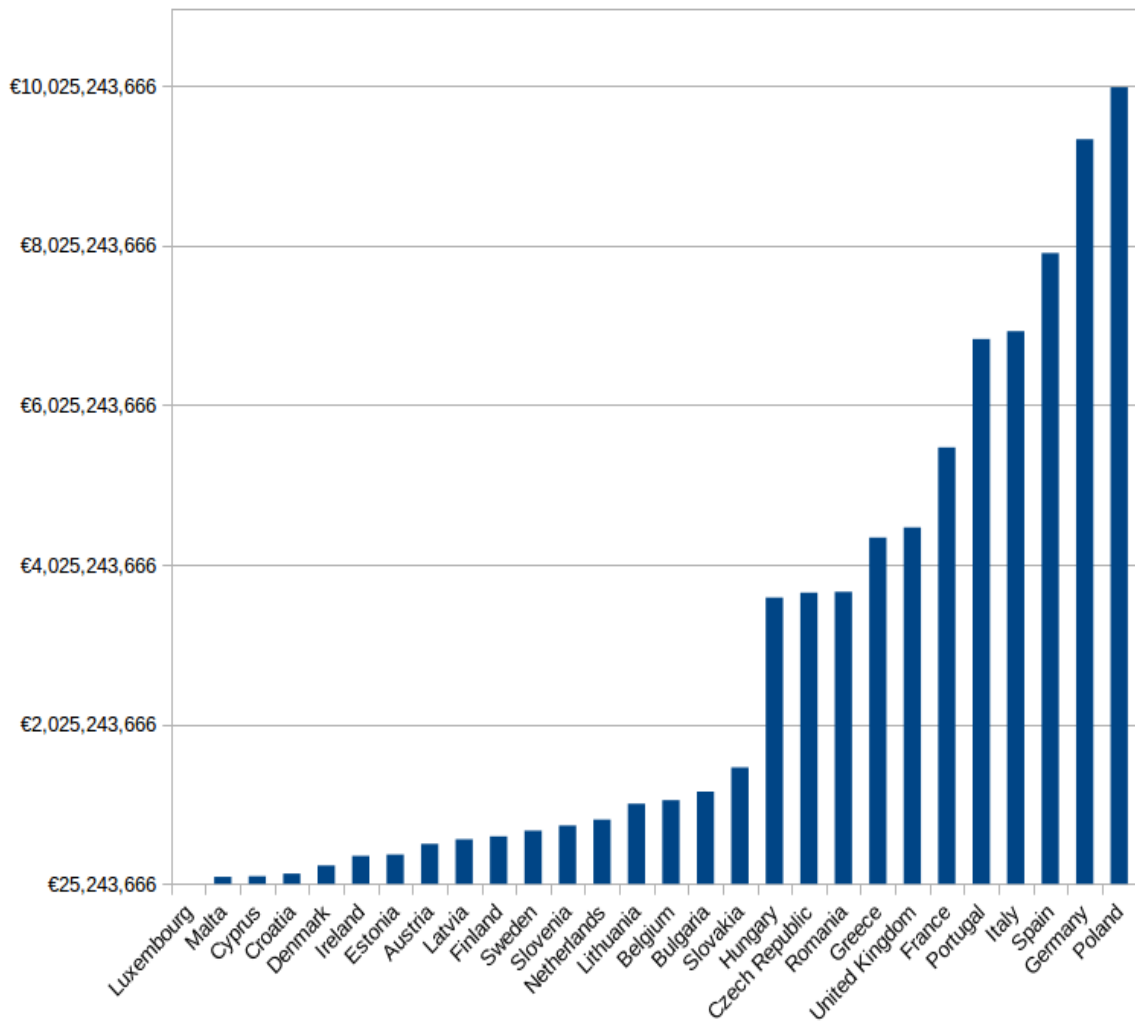
Source: Student own work, chart created based on stats from ESF (2013)

However, these investments in education do not always have the intended result. For example, while the United States grants more than half of its engineering and computer science doctorates to foreign students, many of these students return to their country of origin after graduation (Craig et al., 2011). Germany and its apprenticeship programmes present another instance of business-education-government interaction. Though the focus on skilled tradesmen and enrolment in vocational and technical programs continues to decline, the German government has maintained its strong tradition of support for these practical programs. (Todd, 2013)

According to CRN (2004), The Federal Government in Australia has set up an initiative which aims to pinpoint what are the emerging areas of ICT skills shortages. This includes developing a formal process which involves the industry and will look at both new

challenges facing the ICT sector, and emerging areas of skills shortages. According to Daryl Williams, Minister for Communications, IT and the Arts, this process will provide an analysis of emerging ICT skills requirements that could be used to design university courses and on-the-job training programs. In addition, the Federal Government has also set up a working party made up of industry representatives and experts in accreditation, that will look at the challenges facing Australian software developers trying to compete internationally (CRN, 2004). In Ireland, the Skillnets model enables networks of employers in regions or sectors to come together to determine their common skill needs and procure training for employees. This model has proved to be flexible and effective for companies of various sizes to meet their short and medium term skill needs (DES, 2016).

Retraining and education programmes for the unemployed are largely publicly funded and represent a significant share of government spending on active labour market programmes. The record on effectiveness of such training is mixed, but there is evidence that they can have a positive impact on employment if well designed, especially over the medium term (Betcherman, Olivas, and Dar 2004; Card, Kluve and Weber 2010).

Another aspect that plays important part to reduce skills shortage is policy around skills. Skills policies are acquiring increasing centrality in the post-2015 debates and international organizations are presenting their views on the global situation of skills and the policies that should be implemented. One of the examples is the OECD Skills Strategy (OSS) that provides a policy framework that guides countries on how to invest in skills for creating jobs and boosting economic growth. The main objective of these national strategies is to transform countries into internationally competitive high skills economies (Valiente, 2014). In the policy framework of the OECD, education and training policies should contribute to these strategies by:

- developing the relevant skills for the knowledge economy;

- incentivizing the participation of inactive individuals in the labour market through retraining and up-skilling; and

- fostering entrepreneurship and supporting employers in the creation of highly skilled jobs.

From the perspective of the OECD, education and training policies should be better coordinated with social and economic policies under national interdepartmental skills strategies. These skills strategies should not only focus on improving the supply of skills through education and training systems, but also on stimulating the demand for high skills

in the market and their utilization in the workplace (OECD, 2015). National governments cannot just limit their skills policies to the education and training of individuals; they also need to find ways to incorporate the expanding numbers of higher education graduates into highly skilled jobs. The capacity of national governments to intervene in the market and shape the demand for skills will depend on the model of capitalism that they have adopted and how they organize the production and distribution of welfare (Green, 2013).

The OSS clearly recognizes that education and training systems cannot aspire to improve the opportunities or welfare of individuals in an economic environment characterized by high unemployment rates and low-paid jobs. For the OSS, "investing in skills is just the first step; successful skills policies also need to ensure that available skills are used effectively so that no investment is wasted. Developing skills and making them available to the labour market will not have the desired impact on the economy and society if those skills are not used effectively" (OECD, 2012).

2.11 Female participation in ICT sector

Hayes (2013) report has shown that, while women now equal or surpass men in terms of number in most areas of our economy, they continue to be underrepresented in ICT sector. Yet, they are a vital untapped resource in meeting the current and future demands of the tech sector (Hayes, 2013). According to "Women active in the ICT sector" report prepared by EC (2013), despite strong evidence regarding the importance of fully incorporating women into the Information and Communication Technologies (ICT) sector, a gender ICT gap still remains in Europe. European females do not take ICT courses. Moreover, women are underrepresented in the sector, particularly in technical and decision-making positions (EC, 2013). Women represent around 33% of total graduates in science and technology and around 32% of employees of the ICT sector (Eurostat, 2012) . According to European Position Paper (EPP) Women Draft Resolution 'Women and the Digital Agenda" (2015), women account for 60 % of new graduates, but are under-represented in certain fields of education, in particular in ICT (see Figure 2.2). Only 29 out of every 1000 female graduates has a computing or related degree compared to 95 males, Furthermore, only 4 of the population go on to work in ICT directly (Eurostat, 2012).

Female participation in the ICT sector Europe
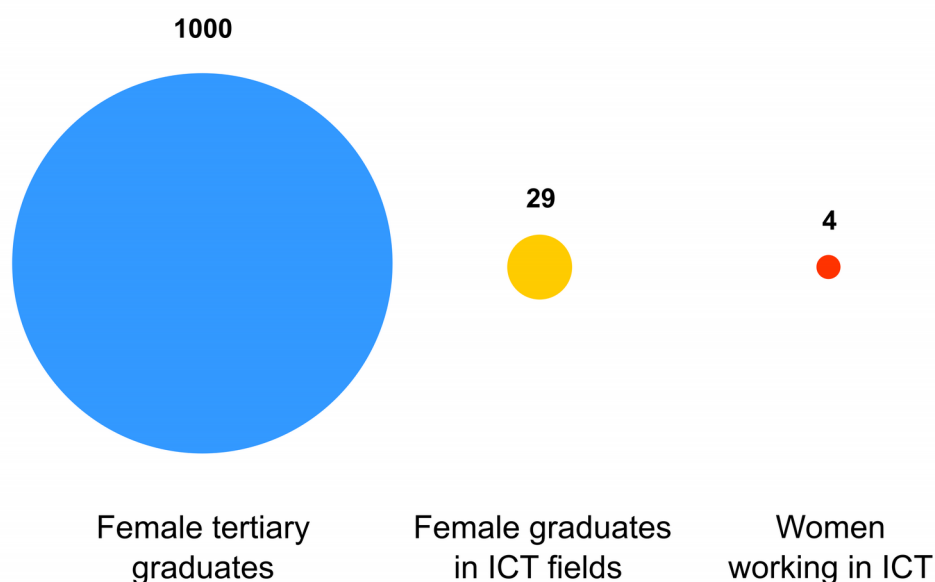
Figure 2.2: Female participation in the ICT sector in Europe

Source: prepared based on European Position Paper (EPP) Women Draft Resolution 'Women and the Digital Agenda" (2015)

In Ireland, female participation in certain fields such as maths and engineering are lower than male participation (DES, 2016). With regards the lack of women studying technology, according to Prof Myers (iStart, 2014), decision makers and countries' representatives need to change the mindset surrounding technology and promote it as people helping people.

2.12 Conclusions

The review of the literature identified ICT skills shortage and skills gap in Ireland. Other countries across Europe and overseas were also explored for the purpose of this study. The literature review began by exploring what research has determined skills gap and skills shortage to be and highlighted ICT skills needs in Ireland. Furthermore, the review looked at training needs analysis and how governments address skills shortage. In addition, the concept of ICT skills myth was introduced. Finally the literature review investigated the issue of female participation in the ICT sector. The chosen methodology for undertaking this study will be discussed in Chapter three.

Chapter 3: Research Methodology

3.1 Introduction

In this chapter the most appropriate methodology for answering the research questions posed in chapter two is presented. Myers and Avison (2002) define a research methodology as a "strategy of enquiry which moves from the underlying philosophical assumptions to research design and data collection". This chapter examines the justification for choosing the case study as the methodology for this research. The design of the case study methodology is outlined including the elements of case study design and data collection methods, including semi-structured interviews, an online questionnaire and observation. The population of the study and the sampling methods will also be discussed, along with issues of validity and reliability. Finally, the last section of this chapter addresses ethical issues that have been taken into consideration for this study.

3.2 Selection of an Appropriate Theoretical Paradigm for the Study

Prior to selecting an appropriate paradigm for a study, Falconer and Mackay (1999) state that it is essential that the researcher is clear about the underlying philosophical assumptions for the phenomena under investigation.

A paradigm can be defined as the "basic belief system or world view that guides the investigation" (Guba & Lincoln, 1994). Positivism and naturalism stand at the two extremes of research methodology (Bassiouni, 1999) and whether one or the other is chosen is irrelevant, once the chosen methodology focuses on the information requirements of the particular research topic (Gill and Johnson, 1997). The concept of positivism and naturalism is explored below.

3.2.1 Positivism and Naturalism

Research philosophies differ on the goals of the research and the way to achieve these goals. Positivism maintains that there is an objective reality, although we may not be able to directly observe all aspects of that reality. Because not all scientific knowledge derives from direct experience, positivism acknowledges that individual beliefs or biases can influence the work of individual researches and lead them to perceive the world differently than it really is and draw incorrect conclusions about it (Whitley, Kite and Adams, 2013).

Naturalism is an old tradition in qualitative research (Babbie, 2010). As a model of qualitative research, naturalism focuses on the factual characteristics of the object under study. Naturalism's strength is its representational simplicity (Silverman, 2013). The

naturalistic approach recognises the intimate relationship which exists between the researcher and the subject matter (Gill and Johnson, 1997). Moreover, the naturalistic approach to research emphasises the importance of the subjective experience of individuals, with a focus on qualitative analysis (Burns, 2000).

As this research explores the views of different stakeholders in relations to skills gap and skills shortage in ICT sector, the naturalism is the chosen methodology for this study as it is more flexible and adaptable than positivism which concentrates on quantitative research methods and is inherently 'scientific' (Gill and Johnson, 1997).

3.3 Methodology Considerations

The research method is a strategy of enquiry, which moves from the underlying assumptions to research design, and data collection (Myers, 2013). A various research methodologies were considered and analysed for suitability with regard to this particular study. Within these different approaches each have their strengths and weaknesses and the method chosen is a function of its suitability for the context in which it is to be used. Below section discuss the key characteristics of these study methodologies to the research in particular to the research undertaken in this study.

3.3.1 Qualitative versus Quantitative Research

Quantitative research, as the term suggests, is concerned with the collection and analysis of data in numeric form. It tends to emphasize relatively large-scale and representative sets of data (Blaxter, Hughes and Tight, 2001). Quantitative research is rooted in the positivist tradition where the research is concern "with understanding and describing the study in terms of observable physical phenomena, with a focus on quantitative measurement of these phenomena" (Draper, 2004). The alternative approach is qualitative research and is concerned with collecting and analysing information in as many forms, chiefly non-numeric, as possible. It tends to focus on exploring, in as much detail as possible, smaller numbers of instances or examples which are seen as being interesting or illuminating, and aims to achieve `depth' rather than `breadth' (Blaxter, Hughes and Tight, 2001). Qualitative research aims to explore and to discover issues about the problem on hand, because very little is known about the problem (Domegan and Fleming, 2007), According to Myers (2013), qualitative research is designed to help researchers understand people, and the social and cultural contexts within which they live.

For above reasons, qualitative research is appropriate for this study as it will allow the researcher to gain a deeper insight into the perceptions, beliefs and motivations of

organisations, head of departments etc. and explore the causes of skills gap and shortage in ICT sector in Ireland. Examples of qualitative methods are action research, ethnography and case study research (Myers 2013) and the latter method has been chosen for conducting this study.

3.3.2 The Case Study Research Method

As mentioned above, the case study method has been chosen for conducting the qualitative research for this study. The case study research is consistent with the naturalistic research paradigm and qualitative data collection methods (Woodside, 2010). Creswell (2003) defines a case study as a bounded system in time and place where the case being studied can be a programme, an event, an activity, or individuals. The case study is considered by Benbasat and Zmud (1999) to be viable for three reasons:

- It is necessary to study the phenomenon in its natural setting;

- The researcher can ask "how" and "why" questions, so as to understand the nature and complexity of the processes taking place;

- Research is being conducted in an area where few, if any, previous studies have been undertaken.

Case studies do not claim to be representative, but the emphasis is on what can be learned from a single case (Tellis, 1997). The underlying philosophy of single case study is "not to prove but to improve" (Stufflebeam, Madaus and Kellaghan, 2000). Indeed, this study seeks to improve the knowledge of the current state in relation to skill gaps and skill shortages in Ireland and find out what needs to be done to reduce them or remove them completely. Given the interpretive position adopted in this research and the nature of the research question, the researcher believes that the case study approach is the most appropriate research strategy for this study because of its advantages in revealing in detail the unique perceptions and concerns of different stakeholders in relation to skill gaps and skill shortages in ICT sector, which would have been lost in quantitative strategies. Moreover, the case study methodology is the most appropriate vehicle in examining this particular issue, as it involves the study of a particular groups and their interaction with ICT sector.

3.4 The Data Collection Methods and Research Instruments

Data collection method are the means by which data is gathered for a research project, e.g. observation, interviews, focus groups, questionnaires (Quinlan, 2011).

This section provides further detail of the primary research instruments used in the study. The questionnaire was the dominant research instrument, while interviews and observation added depth to the research and validated the data.

3.4.1 On-line Questionnaire (Survey)

A questionnaire is a self-report data collection instrument that each research participant fills out as part of a research study. Questionnaires can be used to collect quantitative, qualitative, and mixed data.(Johnson and Christensen, 2014). This was the case with this study, the survey was designed to generate both qualitative and quantitative data. The survey was designed according to Alreck and Settle (2004), where self-administered questionnaires usually contain three parts: an introduction, a body, and a conclusion. The survey itself consisted of three main sections. The section four was added to allow for participants to add any additional comments. "Qualtrics" engine was used to design, host and distribute the survey. The reasoning for this option was for both ease of distribution and collection of data for analysing. Self-completion methods, whether paper based or electronic, can benefit from the complete absence of an interviewer from the process. This removes a major source of potential bias in the responses, and makes it easier for respondents to be honest about sensitive subjects (Brace, 2008). Questionnaire responses were analysed and are presented in the following chapter, in the form of tables and figures.

3.4.2 Semi-structured Interviews

An interview is a purposeful discussion between two or more people (Kahn and Cannell,1957). Interviews in research, involve the collection from individuals, of detailed information, on thoughts, feelings and behaviours (Knight and Ruddock, 2008). A semi-structured interviews are designed to have a number of interviewer questions prepared in advance but such prepared questions are designed to be sufficiently open that the subsequent questions of the interviewer cannot be planned in advance but must be improvised in a careful and theorised way (Wengraf, 2001).

Interviews of a conversational, face-to-face nature, with semi-structured unstructured questions, were conducted to establish network managers' perceptions towards ICT skills shortage and skills gap in Ireland. Interviews took place at a time and location convenient to interviewees. As a hybrid method, the semi-structured interview can be structured into segments, moving from fully open-ended questions toward more theoretically driven questions as the interview progresses (Galletta and Cross, 2013). Semi-structured

interview allows the researcher to get a deeper and richer understanding of the subject being researched (Patton, 1990).

3.4.3 Observation

Observation has been characterised as 'the fundamental base of all research methods' in the social science and behavioural sciences (Adler & Adler, 1994). Observation is a method frequently used as a means of increasing our knowledge about a phenomenon (Cargan, 2007). Research by observation is used in a widely ranging areas as the study of animals, correlation studies, studies of different cultural groups and case studies (Cargan, 2007). Observation differs from interviewing as it aims to examine subjects' behaviour in their natural environment (Jacobsen, 2005). According to Adler and Adler (1994), observation is the most likely method to be used in conjunction with other methods. For that reason the decision was made to complement to information obtained by other data-gathering techniques in this study. The purpose of this stage of the study was to help the researcher develop an insider's view of skills gap and skills shortage from different stakeholders (potential participants, representatives of companies in the sector, HR/Training managers etc.). For this reason, the researcher participated in the launch of a new programme designed by one of the Skillnets' network in order to reduce one of the ICT skills gap. Participant observation does not exclude direct interviewing of participants and may make extensive use of interviewing as a means for data collection (Cargan, 2007). The researcher had an opportunity to talk during the launch to participants as well as managers of companies interested in participating in the programme.

3.5 Population and Sampling Method

Sampling is the purposeful selection of an element of the whole population to gain knowledge and information. The study population consists of the individuals to whom the researcher can gain access and who have the appropriate knowledge and experience (Holloway and Wheeler, 2010). According to Saunders, Lewis and Thornhill (2007), the sampling techniques can be divided into two types:

- probability or representative sampling

- non-probability or judgemental sampling.

With probability samples the chance, or probability, of each case being selected from the population is known and is usually equal for all cases. This means that it is possible to answer research questions and to achieve objectives that require to estimate statistically the characteristics of the population from the sample. Consequently, probability sampling

is often associated with survey and experimental research strategies (Saunders, Lewis and Thornhill, 2007). In a non-probability sample, units are deliberately selected to reflect particular features of, or groups within, the sampled population. The sample is not intended to be statistically representative: the chance of selection for each member of the population is unknown but, instead, the characteristics of the population are used as the basis of selection (Ritchie and Lewis, 2003). It is still possible to generalise from non-probability samples about the population, but not on statistical grounds. For this reason, non-probability sampling (other than quota sampling) is more frequently used when adopting a case study strategy (Saunders, Lewis and Thornhill, 2007). The latter method was selected for this study. Purposive or judgemental sampling enables researcher to use his/her judgement to select cases that will best enable to answer his/her research question(s) and to meet the objectives (Neuman, 2000).

With regards to the population of the study, this case study draws on multiple sources of data (Yin, 2003) and the study uses two different populations. The first population is a population of network managers of selected Skillnets' networks involved in the development and delivery of the programmes in ICT sector. The second population in this study is a population of representatives of member companies (e.g. HR Managers, heads of departments, sole traders or business owners) engaged and/or responsible in/for training programmes.

3.6 Triangulation

The term 'triangulation' is used to refer to the observation of the research issue from (at least) two different points (Flick, 2014). The concept of triangulation was taken up by Denzin in the 1970s. The best-known discussion of triangulation is Denzin's (1988), in which he proposes four types: the use of multiple methods, multiple sources of data, multiple investigators, or multiple theories to confirm emerging findings. In triangulating the research, the researcher can use as many data gathering methods as feasible and necessary to gather data in order to have different perspectives on the phenomenon under investigation (Quinlan, 2011).

With regards to the use of multiple methods of data collection, for example, what someone tells you in an interview can be checked against what you observe on site or what you read about in documents relevant to the phenomenon of interest (Merriam and Tisdell, 2015). In this study the researcher employed triangulation by using two methods of data collection – interviews and observation. Triangulation using multiple sources of data means comparing and cross-checking data collected through observation at different

times or in different places, or interview data collected from people with different perspectives (Merriam and Tisdell, 2015). The latter was used in this study to increase credibility and quality of the research. Denscombe (2010) suggest that mixed methods research can improve the validity of the research by comparing similar data gathered using both methods. This study involved collecting two types of data, qualitative and quantitative. Adopting this approach will provide a fuller picture of the ICT skills gap and skills shortage in Ireland case study.

3.7 Reliability and Validity

Analyses of structure are relevant when the researcher questions the underlying structure of an instrument or is interested in reducing the total number of independent variables. Such analyses of structure can be performed to examine or enhance the reliability or validity of a study (Andrew, Pedersen and McEvoy, 2011). Therefore, the reliability and validity are important components in qualitative research.

Fundamentally, reliability concerns the extent to which an experiment, test, or any measuring procedure yields the same results on repeated trials (Carmines and Zeller, 2016). Golafshani (2003) sees reliability as the potential to replicate results, while Wiersma (1995), asserts that reliability is concerned with both procedures and findings. In other words, if another researcher conducted the same research at a later date, using the same instruments, the results would be the same. Validity refers to the extent to which the instrument measures what it was intended to measure. If a measurement instrument is not valid for the intended purpose, then it will be difficult to interpret the results in a meaningful way (Bui, 2009).

3.8 Ethical Considerations

Ethics in research refers to the application of fundamental ethical principles and is a matter of principled sensitivity to the rights of others (Bulmer, 2008). Ethical integrity is important to ensure the protection of the participants being researched, the researcher and the research itself. Research should be honest respectful, objective and confidential. Cohen, Manion and Morrison (2003) assert that readers have a right to expect that research is conducted "rigorously, scrupulously and in an ethically defensive manner".

Ethics were a primary consideration for both, the interviews and the survey. However, they were mainly associated with general issues in gaining access, collecting data, data processing and storage. Overall this was a low risk study where ethical issues were concerned.

For this research the Network Managers of individual Skillnet networks agreed to participate in the study. It was agreed that the identity of the network managers who participate in the interviews not be revealed in the thesis. The same applies to member companies of the networks. There was complete transparency in all aspects of the study, network managers as well as representatives of the member companies were fully aware of the research project. They were also fully assured of the confidential nature of the study and that full anonymity was secured. All survey questionnaires were submitted anonymously (NM sent them to member companies). An information sheet was attached to the questionnaire administered to the participants. The informed consent form and information sheet were prepared according to Code of Ethics, used in Trinity College Dublin (see Appendix A and Appendix B). The cover e-mail and information sheet provided the purpose of the research, storage and accessibility of the data. Moreover, 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.

In addition, the following measures were undertaken to ensure ethical integrity:

- All research material was securely stored.

- All interview data were strictly confidential.

- All interviewees were identified by e-mail only. Interviewees could check interview notes, providing them with the opportunity to verify that interview material was fair and accurate.

- Questionnaire respondents were not required to identify themselves.

3.9 Summary

This chapter investigated multiple research methods available to investigate the research topic. It was decided to conduct an observation, interviews and an online questionnaire with representatives of the ICT sector in order to investigate the research topic further. The research design chosen was both qualitative and quantitative to provide a fuller picture of the ICT skills gap and skills shortage in Ireland. The philosophies of research methods were explored. Ethical approval was obtained from the School of Computer Science and Statistics Research Ethics Committee prior to the commencement of the study. In respect of participants involved in the research study for the purpose of collecting

data, informed consent was obtained in all cases. In the next chapter, the empirical findings from the data collected are presented.

Chapter 4: Data Gathering and Analysis

4.1 Introduction

This chapter comprises the analysis, presentation and interpretation of the findings resulting from this case study research. The research instruments consisted of an observation, semi-structured interviews (Appendix C) and a online questionnaire (Appendix D). The qualitative data was collected through interviews and observation. The quantitative data was collected by means of a survey, and is data gathered from participants who are representatives of the companies in the ICT sector.

This chapter begins by presenting qualitative data from the observation and then follows by presenting and analysing both qualitative and quantitative research collected through interviews and the survey. Following this, the secondary data from one of the network's is also presented (quantitative data). Finally, a summary of the findings is presented.

4.2 Observation

As observations can be conducted on nearly any subject matter (Lowe and Zemliansky, 2010), participant observation was used to understand how real is the skills gap in the ICT sector. The subject of the observation was an event, a launch of the new programme in User Experience (UX) Design. The observation of this study provided helpful information on the current skills gap in Ireland.

4.2.1 Observation Analysis and Findings

Participants and aim of the programme

The launch was held in Dublin in July 2016. Over 30 people participated in the briefing session. The ISA Software Skillnet in association with the Dun Laoghaire Institute of Art and Design (IADT) launched a new qualification in UX Design for professionals working in the software industry. The briefing was for companies and prospective students who were interested in participating in the programme including:

- Senior Executives responsible for UX

- HR and training managers

- Developers

- Designers

- Project managers

- Product owners

- Business analysts

The new part-time advanced qualification has been developed by IADT with UX Skills working group (IBM, SAP, Fineos, Ericsson, Sysnet GS, Decare, Fenergo). The programme design allows working professionals to develop their knowledge and skills through a project-focused and highly practical approach, which will enable them to design effective, engaging and enjoyable user experiences. Companies and staff who would like to participate in the programme will be grant-aided by the Software Skillnet. The first programme is expected to take place in September 2016.

How and when was the gap in this area identified?

UX was identified by member companies as an area where there was a gap in 2014. In order to develop this programme, a group of experts in Ireland, member companies, heads of UX and UX specialist together with ISA Skillnet developed a Postgraduate Diploma in UX Design. What is really impressive is the fact that the programme was designed within a very short time frame of four months.

Sector representation

There were four different speakers presenting during the briefing, representing the ICT sector from companies such as SAP, IBM, Fleetmatcis. There was also a speaker representing academia – a doctor and the lecturer from IADT. These speakers have been vital during the briefing as they gave the overview of current ICT sector and difficulties to find talent in UX design.

This method of research enabled the researcher to view representatives of the companies in the ICT sector as well as potential participants in the programme and ascertain whether the statement about the skills gap and skills shortage was in agreement with what media and researchers report. This observation was regarded within the research design of this study largely as a triangulation device. Although only one observation was taken, this observation can be considered as one of the rich source of data collection. The outcome and analysis of the observation confirms that there are gaps in the ICT sector and this programme is confirmation of how the stakeholders and interested parties try to fill such gaps. Participant observation is a powerful tool for investigating the way that individuals think, feel, and act within a natural setting. It is particularly well suited in cases where the processes and interactions of interest may be obscured from public view or are poorly

understood (Waddington, 1994). For this study, participant observation provided an additional perspective of the issue with skills gaps, complementing the more reflective insights obtainable via the other two methods. It was also valuable learning and an insight into the sector from real stakeholders' point of views.

4.3 Interviews

Interviews were conducted with three Network Managers of six selected networks representing different counties: Dublin, Galway and Cork. To ensure the anonymity of the interviewees their names and the network' details will not be disclosed.

Two interviews were conducted over the phone and one interview was face to face. The interviews had a semi-structured format. The interview's purpose was to use conversation, discussion, as well questioning, of a network manager to provide insight on the topic and themes around it. All participants were provided with sample interview questions in advance of the interview. The interviews were organised to ensure that they were all conducted at the respondents' convenience. The interviews lasted between 30 and 90 minutes, and they were collected in July and August 2016. All interviews were carried out by the researcher. Even though the researcher had provided participants with sample questions, the goal of the researcher was not to get all the questions asked. Instead the researcher's focus was on gaining through the interviews and understanding of the issue of skills gap and skills shortage in the ICT sector and the importance of the topic for both enterprises in the industry and the whole country. Moreover, as the interview progressed, interviewees themselves raised additional or complementary issues, and these form an integral part of the research findings. In other words, the interviews were not based upon a set of relatively rigid pre-determined questions and prompts. One interview was partially recorded (face to face) and for the phone interviews notes were taken by the researcher. The recorded interview was then transcribed and then reviewed by the researcher. In the analysis of the interview transcript and notes, the researcher focused on the words, phrases and themes in the data.

4.3.1 Interviews Analysis and Findings

Based on the literature review the interview responses are categorised under themes representing specific areas or/and issues identified in the literature review. The primary purpose of the discussion is to determine whether the skills gap and skills shortage exists in Ireland. The qualitative data collected from interviews allowed the following themes to be seen from the responses:

- **Theme 1:** Skills shortage and skills gap – definitions

- **Theme 2:** Is Skills Shortage in Ireland a Myth?

- **Theme 3**: How Skill Gaps are identified in companies in Ireland?

- **Theme 4:** Changes/Shifts in the ICT training (training networks example)

- **Theme 5:** Skills shortage and impact on organisations

- **Theme 6:** Female participation in ICT sector

Responses of the interviewees are categorised against the themes. All of the three interviewees agreed that there is skills gap and skills shortage in the ICT sector in Ireland. In addition, the issue of women under representation in ICT sector has been confirmed.

Theme 1: Skills Shortage and Skills Gap – Definitions

Interviewees were asked if they thought that owners and/or heads of departments understand the difference between the skills shortage and skills gap and whether the definitions were clear to them? All the interviewees have good understanding of the definition of skills shortage and skills gap. For example, one interviewee defined skills shortage as follows:

> *"To me the difference would be that the skills shortage is when there are no people coming out of college, where the skills gap is when they don't have the skills that the industry or company requires".*

However they did confirm that there is a confusion in employers' minds over their capacity to attract labour and the concept of existing skill gaps or deficiencies in current employment, which have more to do with training inadequacies than 'shortages'.

Theme 2: Is ICT Skills Shortage in Ireland a Myth?

All three interviewees agreed that skills shortage in Ireland is not a myth and it is unfortunately a reality. One of the interviewees said:

> *"So in my opinion it is a very real and I would know that more often than not, certainly the large companies would have a lot of people to hire, they even go out of the country..."*

Employers within the STEM fields as well as other sectors in Ireland, desire to hire skilled talent but have difficulty locating and attracting it. They also confirmed that Ireland is not the only example as ICT talent shortage is a global issue.

The term "skills shortage myth" appears in media from time to time in the United States and when probed that question in relation to Irish grounds, one of the interviewees made the following observation:

> "No, not at all. And the reason why this is not happening here is that they are very well capitalised and they have access to funds and investments. America is very protected... they also making that sort of structured plan about how they are going to manage the labour force over the next 5 years. Here in Ireland, this is literally done on a daily basis, so they meet the situation and they need to expand very quickly, which is often too late...; it would be a good to have a labour force strategy, instead of that what we have a super market strategy".

While another said: *"it's not a myth, no. It exists indeed. First of all sector surveys of companies' proof that there is a skills shortage in the ICT sector".*

Another one also agreed that ICT skill shortage is not a myth and said the following when asked if companies compete between each other or follow the trend when comes to hiring of skilled workforce:

> "Not at all, they're different businesses, on-line betting, they're simply growing, they're completely different technology wise, they're completely different businesses (internal communication). They happen to be growing at the same time and even though they are using the same technology they're different businesses and they are not in a competition for ICT skilled workforce...they are very much open, they are doing their own stuff, analysis and they're very open to share the learning with others."

Theme 3: How Skills Gap is identified in the ICT Departments in Companies in Ireland?

When asked about the skills gap and the methods of identification such gaps in the ICT departments, two interviewees confirmed that most of companies have a process in place while one interviewee said that they only do the TNA when the problem appears:

> "Well, they do not do it scientifically. They usually do it when they hit the problem or when they realise that they cannot do it or when there is a need for a product or developing a service and then there is "oh". That's at least 20% of them. Then there is a group of companies that, when a client says we cannot have that, and then they say to the client "no problem" and then you see the job advert."

Identifying and prioritising the critical skill needs is the purpose of the training needs analysis. Companies take different approaches how they identify skills gap and quite often the approach depends on the company size. One of the interviewees said:

> *"Some of them are more structured than others, especially the big companies",*

while the other said:

> *"Within the large companies, I would say they are better at doing that, they would be more structured. Smaller companies would be more hit-and-miss and they may not have the lead in time. It would be the case that the multinationals would know probably six months in advance that they need x number of developers in Java language, where the smaller company would not have that lead in time and you are looking maybe at two months in advance. They would not be as organised."*

One of the interviewees said that based on her experience companies take a future plans in to account:

> *"...they do TNA, I don't know how they do their training needs analysis and how they come up with the skills gaps. But in the picture you see, whatever way they do it they have a big plan, well, most of them..."*

while another said:

> *"They would look what projects they have coming up or next year or whatever, probably actually would not even look at year. In the ICT sector they would more look maybe 6 months ahead, they would be looking to see what projects they have coming up and what technical skills they would need people to have, and the difference makes up whatever is needed..."*

One of the interviewees also added that some of the companies would share their training plans:

> *"Some of them would give me their plan for Q1 and Q2 and say, you know we want all of this, what can you do of that? Others will just say, can you do Java training".*

Theme 4: Changes in the ICT Training (Training Networks Example)

During the interview, the Network Managers described what major changes have occurred within their networks during the past three to five years. They mutually agreed that the core skills such as programming languages, networks as well as cloud will remain certainly tops the list of skills sought:

> *"The core skills set is going to be continuing need for large numbers of people for at least 10 years unless there is a dramatic change in the sense from the Internet of Things. That can be added on. However they all in some way built on*

the core skill sets, the minimum of the engineering. The engineering skills, the people who can write code, the people who can deal with networks, cloud etc.".

"I would say the programming language would remain the same".

"They are similar, the Linux, Scrums and the SQL, the ICE, they are sort of on-going".

Interviewees made comments regarding the huge demand for training around processes, agile and product change. Some of the networks organised a few times this year courses such as Certified Scrum Master, Product Owner or Debox:

"It would be more where we would see a larger groups around processes, more and more companies go the agile route, we would do more the course like Certified Scrum Master, Product Owner, Debox, their processes around the product change".

"I have more demand for Scrum courses and Devops certification this year. ISTQB seems quite popular as well including the advance level".

It is no surprise that programming languages are still in high demand with Java as top on the list and this was evident during the interview. Java is one of the most widely adopted programming languages, used by some 9 million developers and running on 7 billion devices worldwide. Also JavaScript was mentioned as another one of the world's most popular and powerful programming languages, used to spice up web pages by making them interactive. Also C++ as the best language to learn for performance-critical applications such as "twitch" game development or audio/video processing is getting more and more popular:

"This year I am seeing more web development courses around Java, Java Script and Angular JS, and different libraries around Java Script seem to be popular at the moment. We would have companies using different technologies so some of them would be using C++, some of them Java and generally they do not mix over but there is a demand for both of the development streams".

While another interviewee commented:

"2016/17 is all about open networking, hybrid networking. So a lot of companies rather than using Microsoft a lot more would be sending people to learn Linux. For example, I advertised the Linux course and I had so many from one company that I had to put a cap on them".

Another one also added comment about the specific company needs in training courses:

"But what's changing now I suppose is that they are starting to be more specific courses to companies. Like one of my member company told me already that they have done TNA and if we can provide them with Scala and Casandra training. The larger companies are still sort of the same around the training, but the smaller ones are looking at database and the big data and developing these databases, they're looking at more individual technologies. So as you can see they have very specific needs. I am starting to get more queries about that sort of stuff. Like two years ago nobody would have said to do Casandra".

And this was also confirmed by another respondent that, "exact training requirement from the company is getting more and more popular; for example, the last course was around Cyber Security, one of my member companies have opened a new department and 13 people went through that training".

There was also agreement among interviewees that the future courses would be concentrated around Cloud, Big Data, Analytics and Security in particular. We live in the world where the sector of technology has a negative impact on people's lives, businesses, governments, peace, safety and security will become more and more important. Organisations will be forced to increase spending on security technologies and security training become one of the most important ones. For example, one interviewee said:

"Cloud, Big Data, The Internet of Things (IOT), Security. None of that Cloud and Big data, none of them have really filtered through yet. Same as security. But obviously it is going to be huge".

Theme 5: Skills Shortage and Difficulties in Recruitment

During the interview, the Network Managers were provided with a list of jobs within ICT sector. The search was done on 19th April on two Irish websites, www.jobs.ie and www.monster.ie. They were asked wether the list would correspond to the skills that they see where the skills shortage is? The list of jobs can be seen in Table 4.1

Table 4.1: Jobs browsed by IT sector on Jobs.ie and Moster.ie

194 IT Jobs found on Jobs.ie (19/04/2016) – examples	1000+ IT Jobs found on Monster.ie (on 19/04/2014) – examples
C# .net Developer	Applications Analyst (Java)
Head of ICT	Automation Test & Quality Engineer
Helpdesk Support Administrator	Business Analyst
IT/Desktop Support Technician	C# Developer
IT Team Leader	Cloud Infrastructure Engineer (Windows)
IT Systems/Business Analyst	Front End Developer
Java Developer	

Senior QA Engineer	iOS developer
Software/IT Engineer	Java Developer UI
Software Tester	Javascript Developer
Systems Administrator	Junior Java Developer
Web/UX Designer	Mid-Level ASP.NET Web Developer
	Senior IT Portfolio Manager, Internal systems
	Senior Network Engineer (Design/CCDP/CCNP)
	Senior Test Analyst
	System/Product Architect
	Vision research engineer

All interviewee agreed that the list match with the current ICT skills shortage. However they expressed a disappointment by not seeing some of the jobs. For example, one interviewee said:

> *"All of them would be but what's not on this list are the jobs around security. There won't be that many people, businesses that want that security skills but this area will remain a hot, highly in-demand skill well into 2017 and beyond".*

Another interviewee said that the list did not contain any jobs around Scrum Master or Product Owner:

> *"I did not actually see any Scrum Master on that list, I was kind of surprised that there is none, nobody is looking for a Scrum Master or Product Owner. That makes me think that either they taking people in the company and just up-skilling them".*

According to Gartner (2016), organisations around the world are increasingly adopting the DevOps culture, and by the end of 2016, 25% of top global 2000 organisations would have adopted DevOps as a mainstream strategy. One of the interviewees also made reference to lack of DevOps jobs:

> *"I expected to see DevOps Architects or Devops Automation Engineers on that list. We run Devops courses and the demand for them is increasing".*

DevOps is a philosophy, a cultural shift that merges operations with development. It is gaining serious traction with companies looking to bridge the gap between developers and operations, as shown by research firm Foote Partners' latest quarterly 2016 IT Skills and Certifications Pay Index.

Following on the topic of skills shortage the issue of hiring people outside of the country emerged. All respondents felt that there is an increase in demand for ICT Skills not only in Ireland but worldwide. As Ireland cannot create a supply of highly skilled ICT professionals overnight, companies have no choice as going outside of Ireland to look for ICT skilled workforce. Employers express increasing concern at the growing skill shortages in the sector. All interviewees provided an examples of companies where there was no skilled workforce in Ireland and they had to look for employees abroad:

> *"One of my member companies were going over to Spain this year with a hiring panel and held blocks of interviews for Java developers, because they could not get them here in Ireland."*

> *"There are no skills that are required in the industry. I know a lot of companies that have to look for ICT staff abroad in countries like Italy, Poland or Spain as they cannot find them here. It is a huge problem for this industry as well as pharmaceutical and manufacturing sector where they need ICT skills also".*

> *"Certainly the large companies would have a lot of people to hire, they even go out of the country to fill shortages. I know for example that one of the multinational companies tried to recruit people in Ireland but they could not so they went over to Poland to interview people. This was very recently, last month. So I do think there definitely must be a shortage within Ireland as a lot of companies seem to be going out of Ireland to try to fill the vacancies".*

Another interviewee added:

> *"In my area there are a lot of ICT companies and they just hiring all the time, trying to hire a developer there is a huge shortage. They're working and competing with the same pool of candidates for the interview as they're looking for the same talent, They're looking for the same small group of people and they're finding it difficult".*

One interviewee also gave an example of companies going outside of EU to hire employees:

> *"There would be other companies doing that as well, certainly multinational where they have a lot of people to hire. I would say others, the smaller ones may not be going out but they may have a lot of people coming from India. For example one of the companies, that is a member of the network, a big international one would do a lot of around networks so India must be a good place for people with skills as network type of stuff. They would have brought a lot of people from India".*

Theme 6: Female Participation in ICT Sector

According to European Commission (2016) only 30% of the around 7 million people working in the information and communication (ICT) sector are women. They are under-represented at all levels in the ICT sector, especially in decision-making positions.

All interviewee expressed the view that the gender gap in STEM remains a challenge, influencing both social and economic progress. The lack of women in the ICT industry is not a problem of selected countries or regions, it is a global issue. The interviewees made the following comment in relation to encouraging female into technology sector and the parents' role:

> *"We are trying to work on it but are we there yet? Probably not. But you know, if you actually look why is there a skills shortage in ICT a lot comes to parents. They don't see ICT as an attractive sector, well ICT was not a cool place to work, they were not encouraging children as there was not a lot of jobs in early 2000. It is a very different place now".*

> *"The younger the better, we should target the parents not the students. Parents are very influential".*

Another comment was in relation to the gender balance in the organisations:

> *"There would be a gender balance. Certain companies would have good few female, the likes of big multinationals would have a gender balance, they much more aware. They know that women bring a very different dynamic to the workplace".*

Interviewees also spoke about women participation on the training courses:

> *"Most of trainees on my courses are men. For example, Linux course, I would say I never had a female on this course. Then Scrum, it would be probably mix. Devops, Docker and ISTQB predominantly men."*

Another interviewee added:

> *"Some of them would be on a programming courses, it would not be 50/50, would be probably nine men and one female".*

4.4 Questionnaire

One hundred and eighty-three questionnaires were initially sent to companies in the ICT sector. One hundred and twenty-three survey responses were completed in total over three weeks between August and September 2016. Part of the requirements of the Ethics Committee of Trinity College was that participants would be given the option to exit from the survey at any point and that a response to any question was optional and did not prevent a participant from continuing onto the next questions or the next section of the

survey. Given this limitation, twenty seven responses were not considered as usable. The unusable survey responses were either blank or only partially complete with major portions of the survey blank.

As can be seen in Table 4.2 there were 183 questionnaires sent of which 123 were received. 99 were valid responses and were used to interpret the results while 24 responses were completely discarded from the analysis.

Table 4.2: **Questionnaires sent to Member Companies**

Questionnaires sent	183
Responses received	123
Valid responses	99
Responses discarded	24

The questionnaire response rate is presented in Figure 4.1.

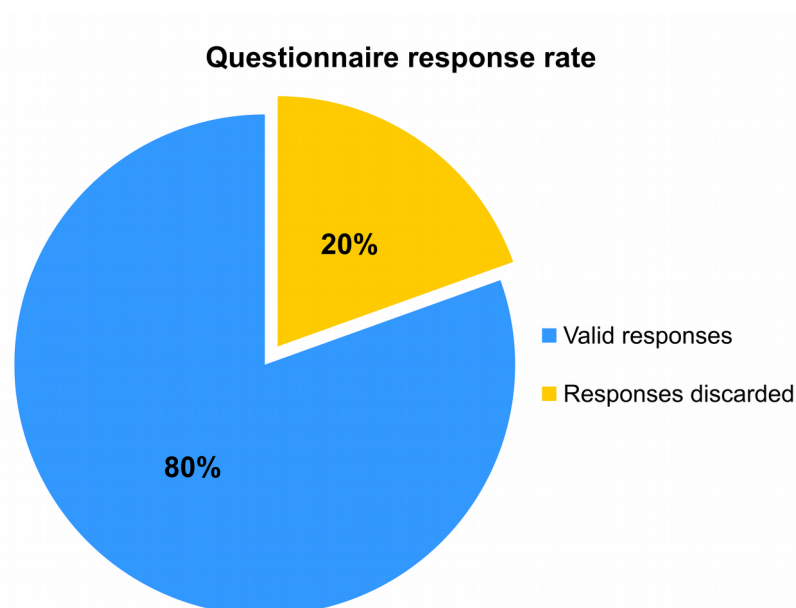**Questionnaire response rate**

Figure 4.1: Questionnaire response rate

Data gathered through the questionnaire were subjected to frequency counts. In other words, the subjects' responses for each individual question were added together to find the highest frequency of occurrence (i.e. the number of times that a particular response

occurs). These responses to the questions are also presented in percentage forms where possible. The result of each question is presented in tables and/or charts.

The survey comprised of the following sections:

- Section 1 – Company Profile

- Section 2 – Skills Shortage and Skills Gap

- Section 3 – Recruitment and Training of ICT Professionals

- Section 4 – General

Section one contained four questions, section two – eight questions, section three – five questions and the section four included a question to allow respondent to include any comments. The survey findings of the individual analysis and cross tabulation are detailed in the subsequent sections.

4.4.1.1 Section 1 – Company Profile

This first section of the questionnaire/survey focused on the nature and background of respondent's organisation. The survey was anonymous, however three aspects of respondent information were obtained: the number of people employed in the organisation (question 1), number of people employed within IT/ICT department or within IT roles (question 2) and the sector the company operates in (question 3).

Question 1: Company size

Participants were asked to indicate how many people were employed within the organisation. 100% of respondents completed this question. Of that number 46 respondents (46%) indicated that were employed in the organisations with 500+ staff, 13 respondents (13%) in the organisations with 100-249 employees and 16 respondents (16%) were hired in the SME with up to 19 staff. From the Figure 4.2 it is clear that organisations with 500+ employees had the highest response rate while organisations with 50-99 employees (6%) and 250-499 employees (8%) appear to be disproportionately represented in comparison to other categories.

How many people are employed within your organisation?

Figure 4.2: Company size
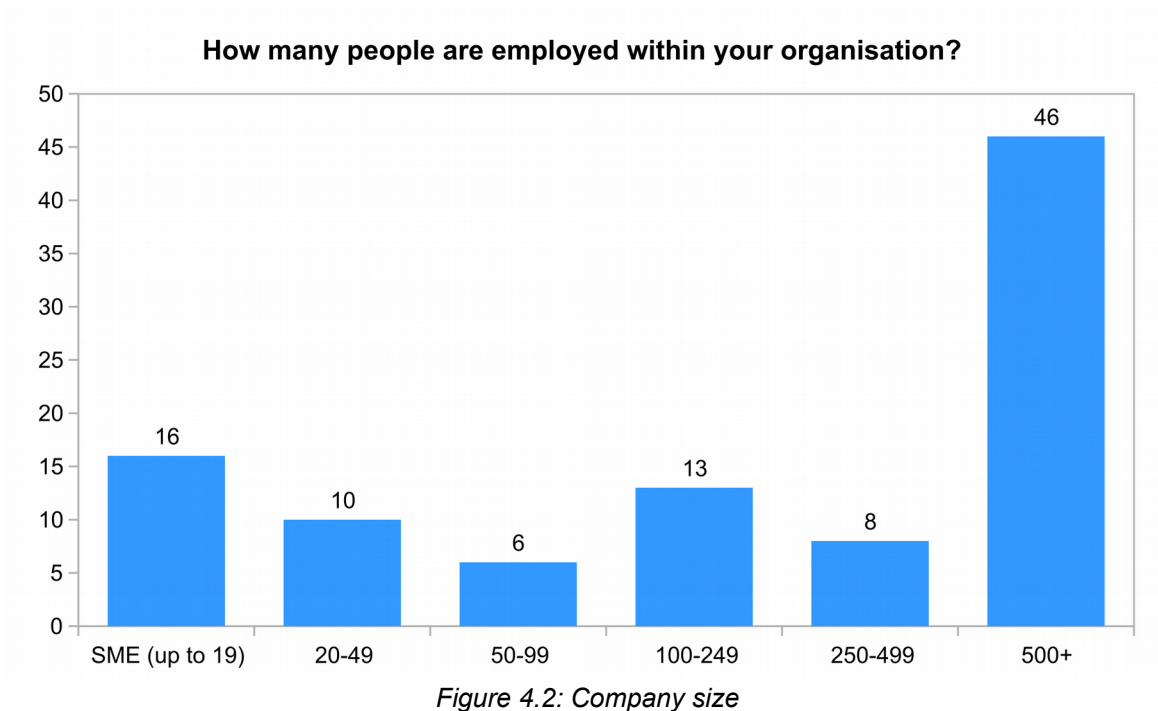
Question 2: Number of people employed within IT/ICT department or within IT roles

This question was also answered by 100% population. The number of employees within ICT departments is evaluated. From the data as per figure 4.3, it is clear that 59 respondents (59.60%) indicated that more than 30 people are employed in the ICT departments in their organisation.

Figure 4.3: Number of people employed within an IT/ICT department
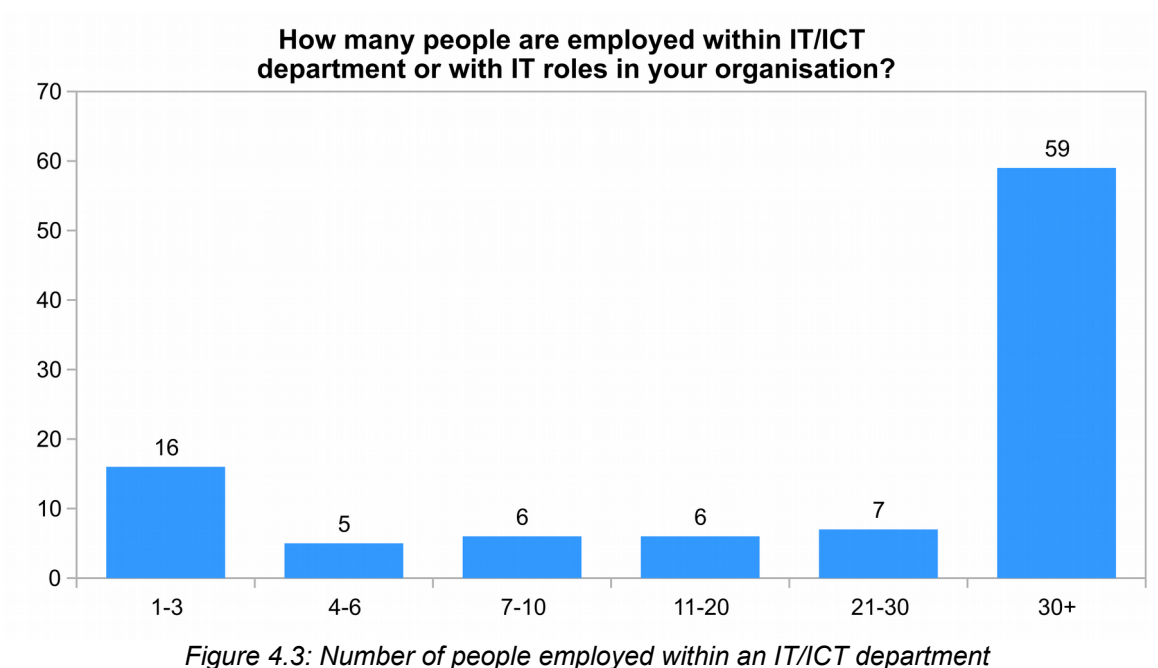
Analysing the number of people each organisation employed in their IT/ICT departments, over 7% of the sample had up to 30 people, more than 6% were in the category between 11-20 employees and 7-10 employees. Only 5% of respondents had up to 6 people. What's interesting is the fact that more than 16% of people employed in the IT/ICT department is between 1-3. The Table 4.3 shows comparison between company size (number of employees) and number of people employed in ICT sector.

Table 4.3: **Company size vs number of people employed in ICT sector**

Company Size	People employed in IT/ICT					
	1-3	4-6	7-10	11-20	21-30	30+
500+		1	1	2	2	39
250-499					2	5
100-249	1		1			10
50-99	2	1		1	1	1
20-49	4		1	2	2	1
SME	9	3	3	1		

Question 3: Company sector

In spite of the fact that the survey was sent to companies in the ICT sector, the sample covered organisations belonging to a wide range of various industries. Some of the companies participating in the research were affiliated with more than one sector and they have been allocated to the category "mixed".

Please indicate what sector(s) your company primarily operates in.
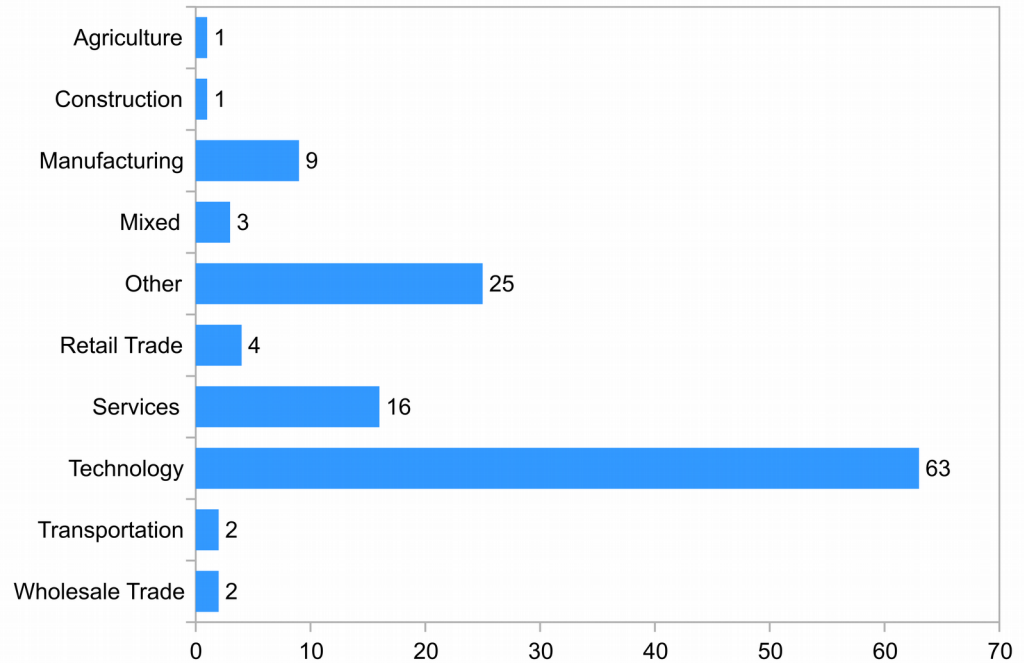
Figure 4.4: Company sector

Under sector "Other" some of the respondents entered in the box provided the following sectors: Energy, Aviation, Telecommunications, Pharmaceutical, Financial, Local Government, Insurance Software, Education and Training and Optical retail.

Question 4: Characteristics of IT/ICT department

Respondents were also asked about their IT/ICT department. This question was completed by 100% population. 47% of respondents indicated that their IT/ICT department is in-house while 34% of respondents have both in-house department and use outsourced/managed service and/or offshore. The percentage breakdown is displayed in Figure 4.5.

Is your IT/ICT department:

Figure 4.5: IT/ICT department type
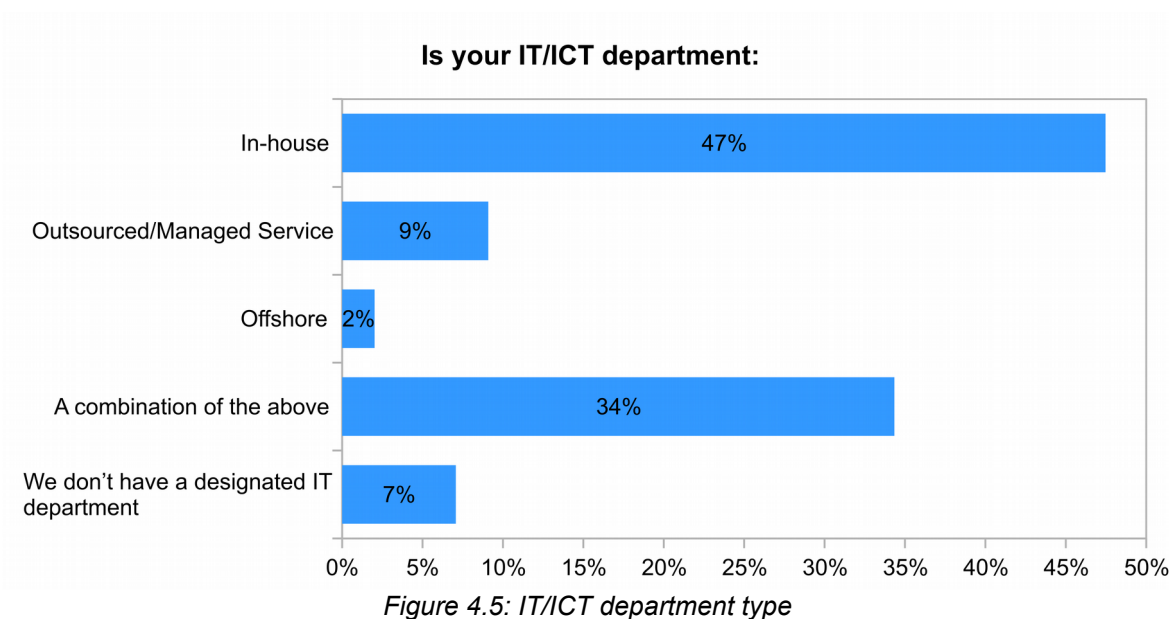
4.4.1.2 Section 2 – Skills Shortage and Skills Gap

The purpose of this section of the survey was to understand the skills shortage and skills gap in the ICT sector in Ireland. Five of the questions were with one selection only option and one question "Please tick all that apply". Two of the questions were Likert-type scale, for which the respondents were requested to indicate the importance "Extremely important", "Very important", "Moderately important" or "Not important" as well as the impact "High impact", "Moderate impact" or "No impact" with each statement. A four-category and a three-category scale was utilised as indicated in the Table 4.4 and Table 4.5.

Table 4.4: Example of Likert-type scale question with 4 possible answers

Extremely Important	Very Important	Moderately Important	Not Important

Table 4.5: Example of Likert-type scale question with 3 possible answers

High Impact	Moderate Impact	Low Impact

Question 1: Employment of ICT specialists

Respondents were asked if their organisations employ ICT specialists. From the data in Figure 4.6 nearly 93% of respondents (92 responses) indicated that they employ ICT specialist in their organisations while 7% (7 responses) do not hire any.

Does your organisation employ ICT specialists?
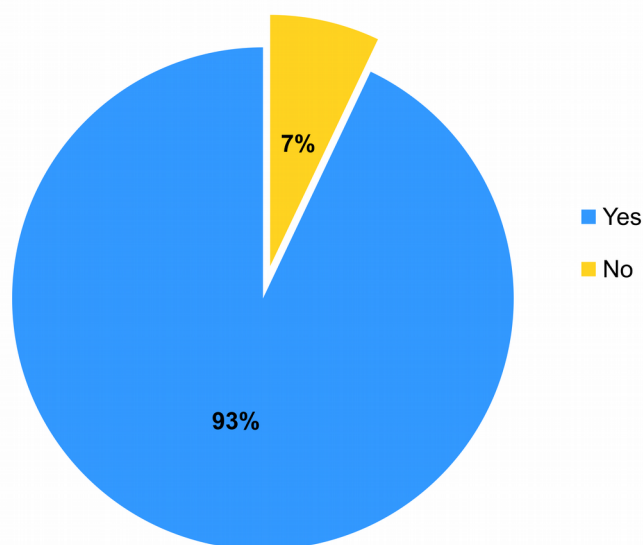
Figure 4.6: Employment of ICT specialists

Question 2: Skills shortage in the organisations

Participants were asked to select one of the statements in relation to skills shortage. As can be seen in Figure 4.7, 55% respondents (54 responses) indicated that the skills shortage is already impacting their ability to recruit. 20% of the population (20 responses) said that they currently do not have a problem finding experienced ICT professionals while 17% of respondents (17 responses) indicated that they outsource or use external services. 8% of respondents (8 responses) do not know whether there is a growing global skills shortage of ICT professionals.

Which of the following statements best fit your organisation's current situation?
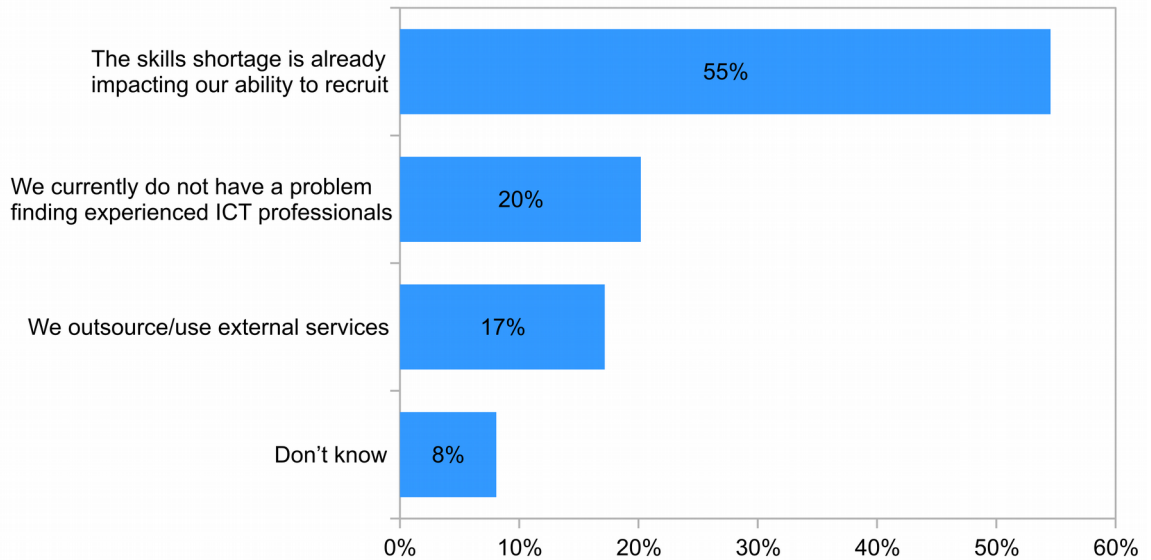
Figure 4.7: Skill shortage in the organisations

Question 3: Length of time to fill an IT role

There were 99 responses to this question which is 100% of the population. 38% (38 respondents) said that it takes between 3-6 months to fill an IT/ICT role, 36% (36 respondents) it takes less than 3 months, while 8% (8 respondents) 6months+. 17% of respondents (17 responses) did not know the answer to this question.

How long, on average, does it take your organisation to fill an IT/ICT role?
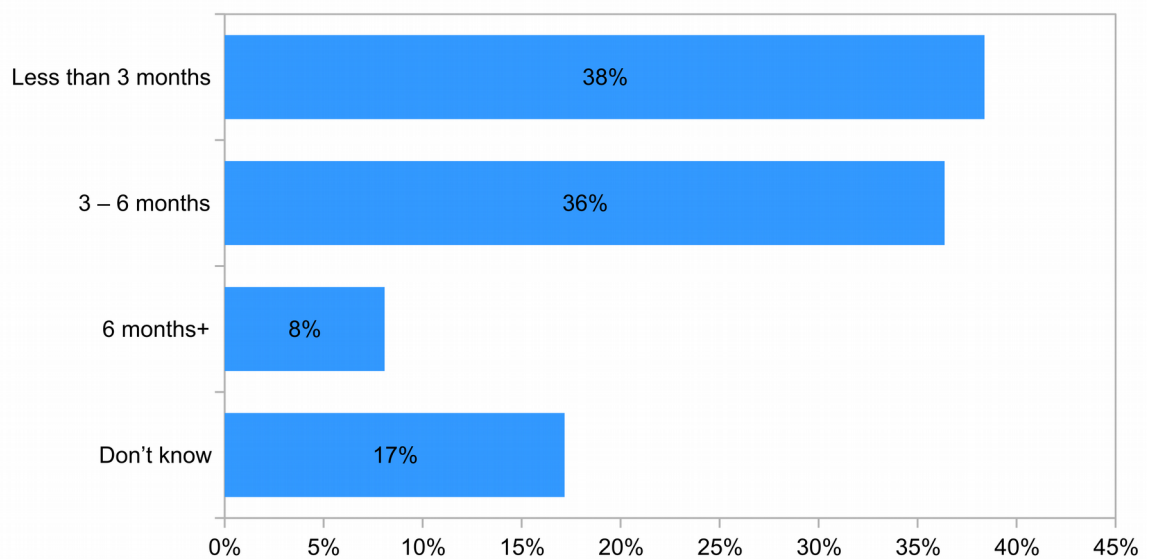
Figure 4.8: Length of time to fill an IT role

Question 4: ICT recruitment process

Respondents were asked whether the ICT recruitment process is getting shorter or longer compared to previous years. This question was answered by 98% of the population (97 responses). 52% of that population (50 responses) said that the ICT recruitment process is getting longer compared to previous years, while nearly 45% (44 responses) said that is about the same. Only 3% of respondents (3 responses) indicated that the recruitment process is getting shorter.

Compared to previous years, is your organisation's ICT recruitment process getting:
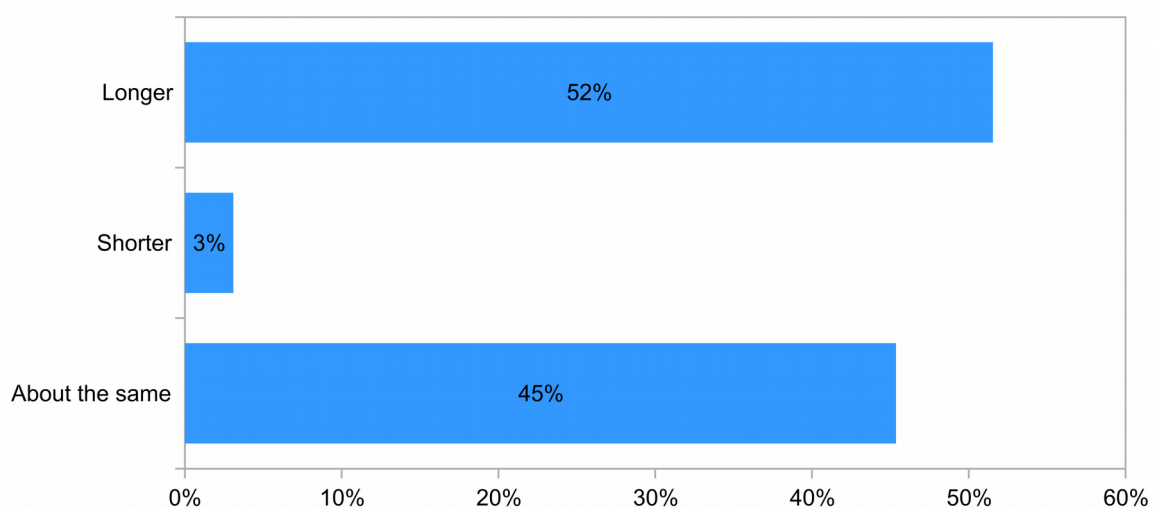
Figure 4.9: ICT recruitment process

Question 5: Unfilled ICT vacancies and impact on stakeholders

When asked about the extent to what unfilled ICT vacancies in their organisations impact on other stakeholders such as customers, partners, investors, etc., 59% of respondents (57 responses) indicated "some impact", 28% "significant impact" and only 13% "no impact".

To what extent do unfilled ICT vacancies in your organisation impact other stakeholders, such as customers, partners, investors etc.?
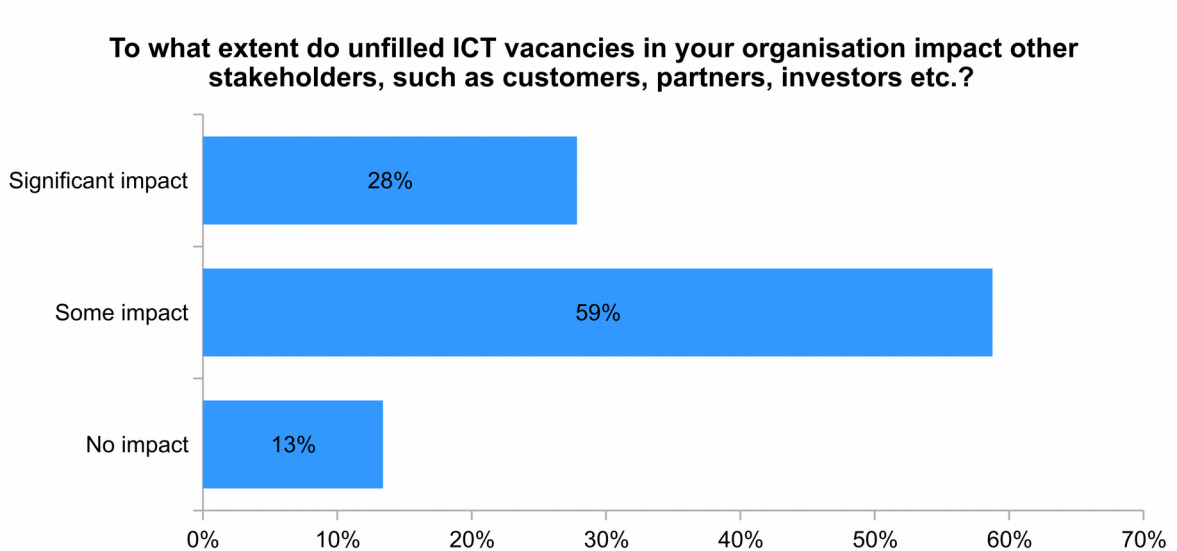
Figure 4.10: Unfilled ICT vacancies and impact on stakeholders

Question 6: ICT skills shortage

Respondents were asked about specific areas in which ICT skills shortage is the most apparent. Responses to questions about areas in which ICT skills shortage is the most apparent reveal three main areas. Secure software development (45 responses), cloud computing (43 responses) and business applications (37 responses) seem the most frequently reported where the skills shortage exists. Other areas include "Mobile" and "Other". These included areas such as "Cloud, UC, Network", "Software Development", "Testing", "Data Analytics", "SQL Database Administrators both production and development" "QA", "Python developers", "Business Analysis", "Big data analysis" and "GIS/Spatial".

In which of the following areas is the ICT skills shortage most apparent?
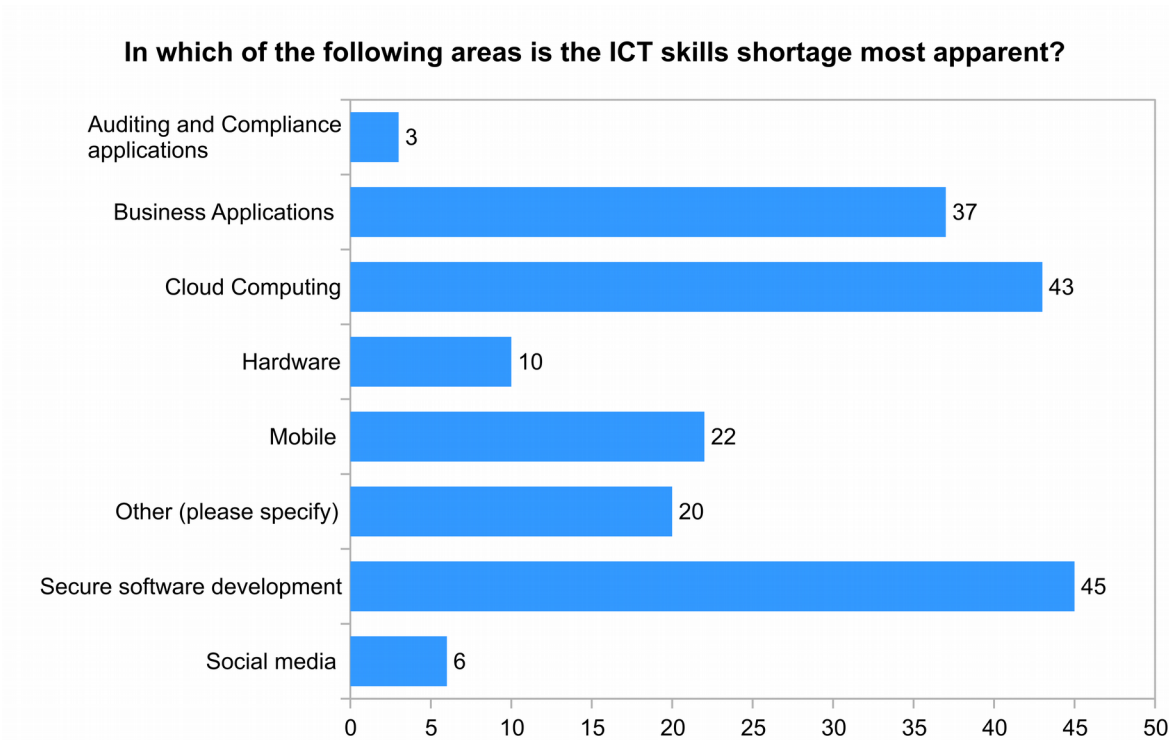
Figure 4.11: ICT skills shortage

Question 7: Importance of techniques to mitigate the effect of skills shortage for ICT workforce

This question asked respondents to rate several techniques to mitigate the effects of existing skills shortages for ICT workforce in terms of importance. The purpose of the question was to determine what would help to decrease the skills shortage in Ireland.

Internal employee training and development was the factor that could lighten existing skills shortage, with 43 of respondents rating it as "Extremely important" to them. This finding is not surprising as the personal development is crucial for employees. However, involvement with local schools/colleges (38 responses), and Outsourcing of certain functions (33 responses), were also found to be "Very important".

How important are the following techniques to mitigate the effects of existing skills shortages for ICT workforce (engineers, developers etc.)?
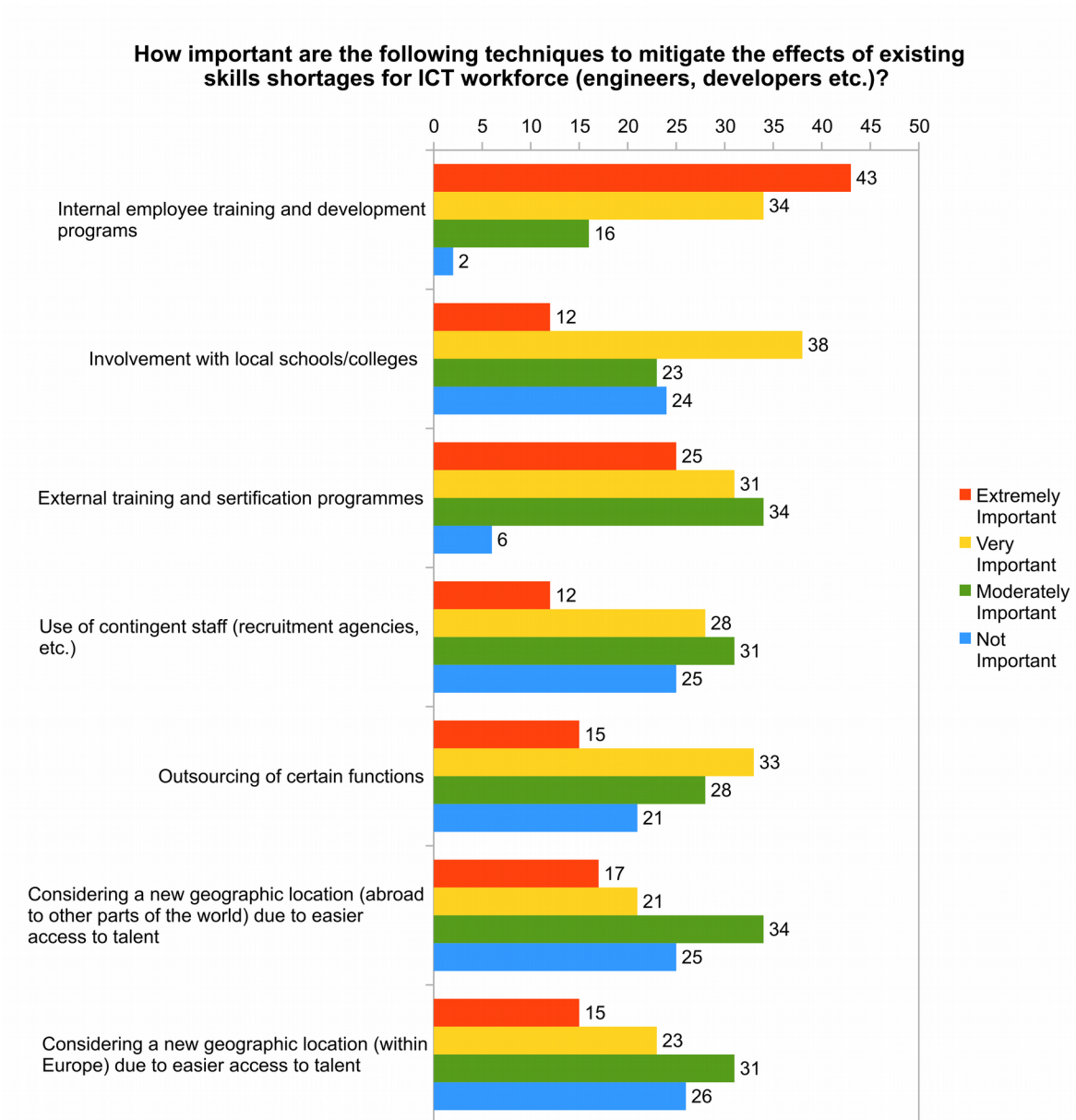
Figure 4.12: Importance of techniques to mitigate the effect of skills shortage for ICT workforce

Question 8: Impact and factors contributing to the future talent shortage

This question was directed towards eliciting whether there was a factor or number of factors that contributed to the future talent shortage. The Figure 4.13 represents what the overall distribution of responses was.

To what extent do the following factors contribute to the future talent shortage?
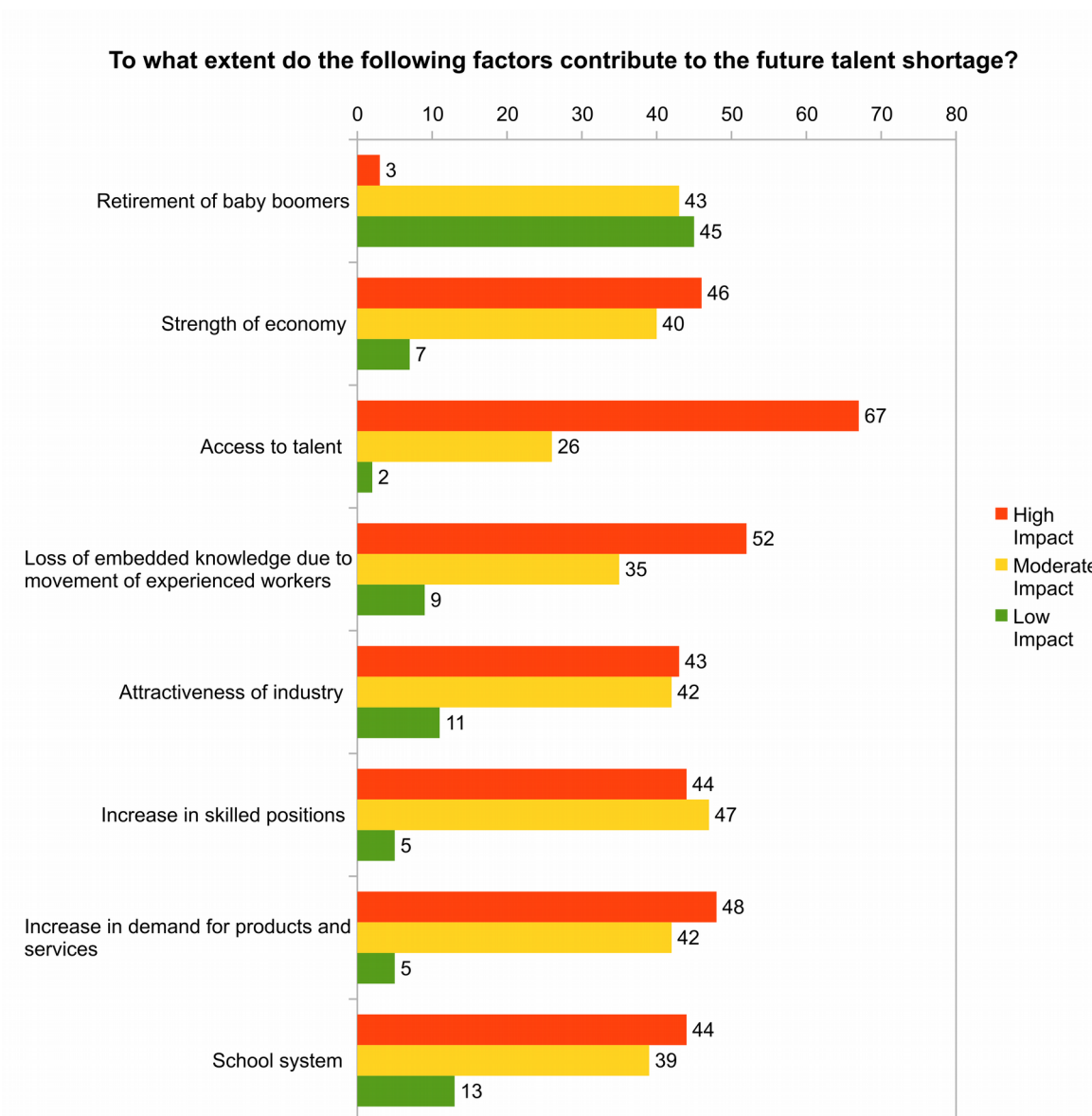
Figure 4.13: Impact and factors contributing to the future of talent shortage

It can be seen that 67 respondents agreed that access to talent has a "High impact" on the future talent shortage. Also more than 50 respondents agreed that loss of embedded knowledge due to movement of experienced workers, impacts hugely to the future of the talent shortage.

4.4.1.3 Section 3 – Recruitment and Training of ICT Professionals

Question 1: Recruitment responsibility in the organisations

The survey was targeted at companies in the ICT sector. As Figure 4.14 shows, the majority of respondents (43 responses) indicated that the responsibility for managing

human resources in their organisation lies with HR Manager, while another group of respondents (30 responses) with all managers.

Who is responsible for managing human resources in your organisation?

Figure 4.14: Recruitment responsibilities in the organisation

Question 2: Challenges faced during recruitment of skilled and highly skilled ICT workers

Data from the survey shows that finding candidates with solid work experience, with up-to-date technology knowledge, leadership skills and business management skills are ranked as "very challenging". It is important to note that finding candidates with solid work experience is of most concern to the majority of respondents as can be seen in Figure 4.15

**What are the major challenges faced during the recruitment
of skilled and highly skilled ICT workes?**
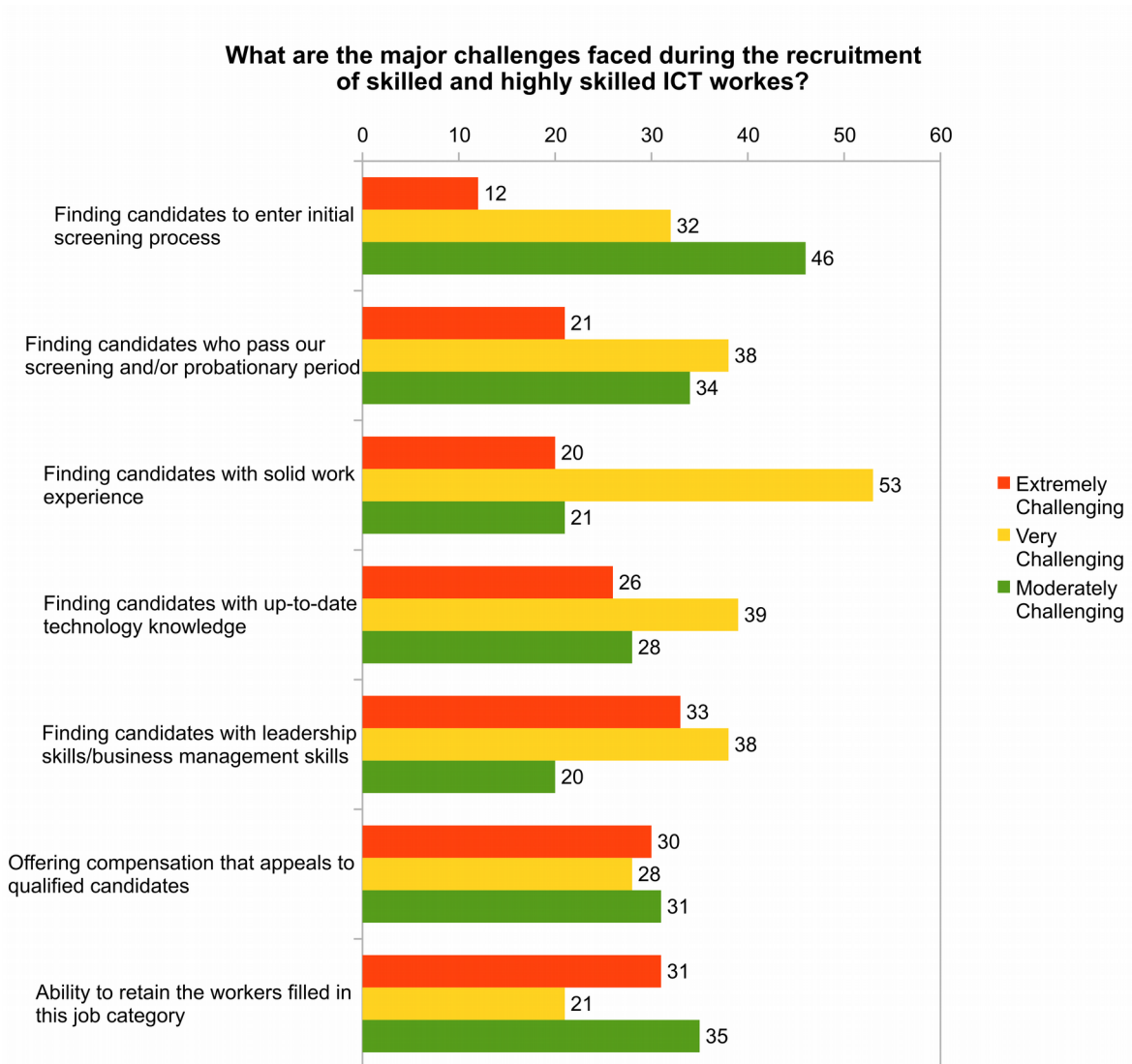
Figure 4.15: Challenges faced during recruitment of skilled and highly skilled ICT workers

Question 3: Skill needs/gap identification in organisations

Respondents were asked about the skill needs/gap identification methods. This question was the first open ended question in the survey which seemed to have a major impact on the participant's response. Forty three participants skipped this question. As this question was an open question, number of different methods were indicated. The results of this question are presented in the Table 4.6 below.

Table 4.6: **Methods used in organisations for Skill needs/Gap Identification**

Methods used in organisations for Skill needs/Gap Identification	Number of respondents
TNA/Gap Analysis	11
1:1 management sessions/Regular Appraisals/training assessments by IT Manager or Training Manager	10
Training (coaching, mentoring, Certifications/3rd level education)	7
In-house/In-company training	5
Tests/Exams	4
Graduate programmes and work placements/partner with an organisation/college that can bridge the skills gap	3
Competency Skills Matrix	3
Personal contacts, networking, public advertising	3
Business Development, Strategy, Risk Management	3
Hiring non-EU nationals & paying for their employment visas	1
Confidential or not aware of the process	4

Question 4: Training and development in organisations

77% respondents indicated that they carry out training for both ICT specialists as well as other staff. Only 23% said that they do not provide training for their employees.

Does your company provide any type of training to develop ICT related skills of employees during 2016?

Figure 4.16: Training in organisations

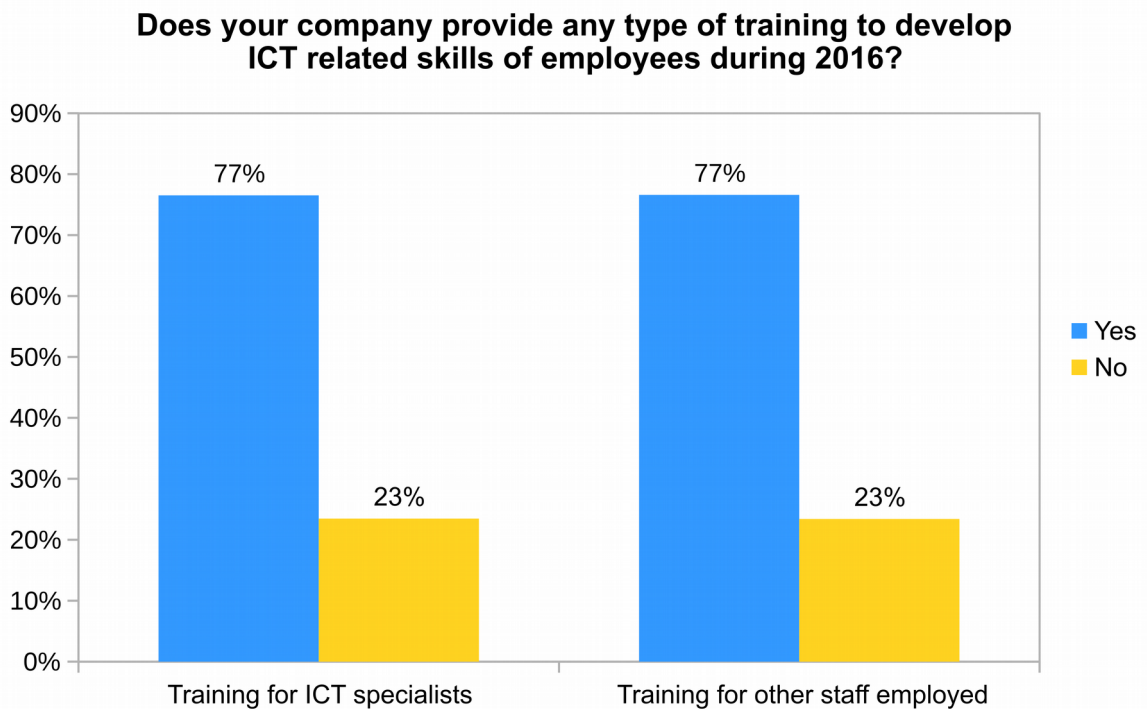### Question 5: Women in ICT sector

Two participants skipped this question. As can be seen in Figure 4.17, 51% of respondents (49 responses) stated that ICT industry is failing to attract young talent and women into the profession, while 30% (29 responses) did not agree with the statement. 20% of respondents (19 responses) left a comment to this question which brought some interesting feedback.

**Do you agree that the ICT industry is failing to attract
young talent and women into the profession?**
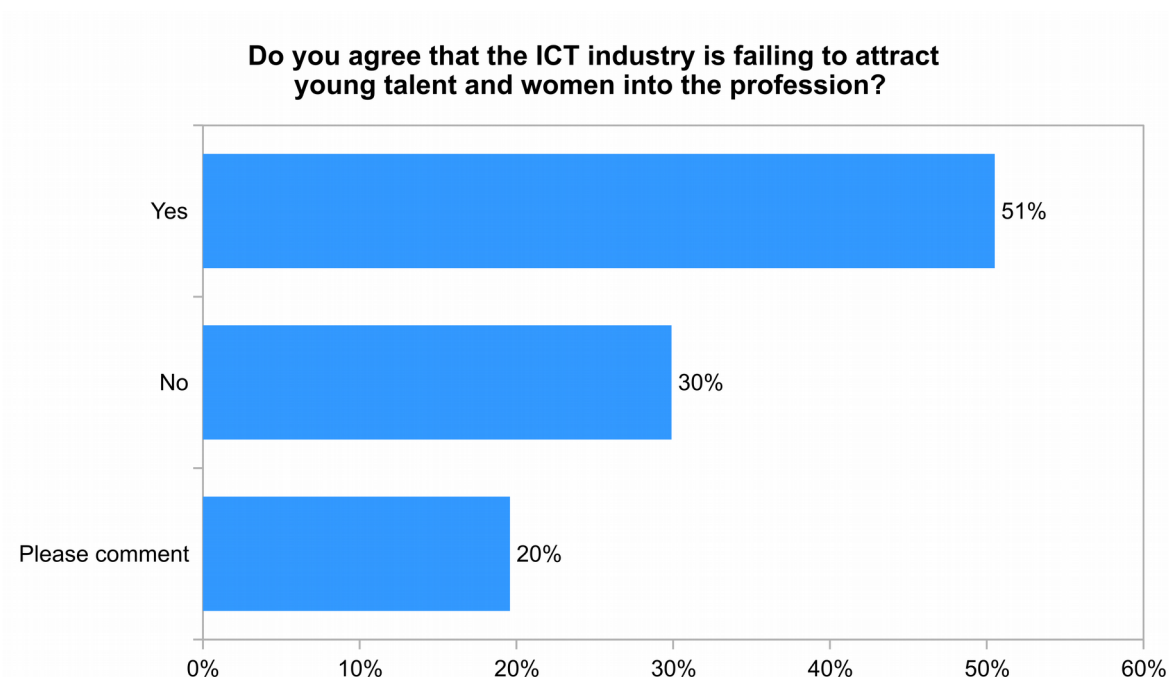
Figure 4.17: Women in ICT sector

Participants referred to the issue in the Irish education system. One of the respondents said:

"My organisation recognises STEM is a challenge in the Irish education system"

while another one:

"We have no issue getting interns interested in our industry".

Number of respondents agreed that ICT sector is dominated by male and that is not enough promoted women:

"The deep tech would appear to be male dominated. Attracting the talent is a major area that needs to be addressed. ICT does not get the same exposure as software for example, but it is at the core what supports all technology evolution."

"The ICT sector seems to be dominated by men. It is not promoted to female as an attractive/interesting sector to work in."

"The percentage of women candidates for vacant positions is small but in our organisation experience is paramount and female candidates have been successfully recruited based on their capabilities and experience".

"Women are still a very small percentage of graduates, it is improving. There is a need to encourage more work experience at TY (Senior Cycle). Need promote IOT and technology and continue to promote honour's maths."

"The number of women with ICT degree is very low. Naturally, so is the number of female professionals on the market"

"There is a difficulty identifying female candidates for ICT roles. On the other hand, female candidates that are identified tend to be very strong and are much more successful in the hiring process"

"I see no shortage of young talent, but a big shortage of women. It is a very attractive industry at the moment due to competitive job market, high salary and benefits, etc. It is an employee's market out there. "

"Yes – out of my last 50 CVs only 1 has been female! That's causing imbalance in the whole organisation and we are all the worse off for it."

Only two respondents who commented to this question did not agree with the fact that there is gender unbalance. One of the respondent said:

"I haven't witnessed this as a woman in the industry for 13 years" while the second one said: *"We support equal opportunities".*

The item of promotion of ICT sector among female in the secondary school was highlighted:

"More could be done at secondary school level to make girls aware of ICT related jobs as a viable option for women in the workplace."

"With all girl secondary schools offering no engineering subjects – how do you think girls will take engineering in college? or go on to engineering roles?"

Two comments to this question related to the talent and skillset in the ICT sector:

"Biggest problem is that there is an absence of Experience Skillsets in key technologies. The resources that do exist generally favour Corporate Companies such as Amazon, Google, Facebook.".

"Some very talented people have recently joined our company".

There were also two comments with undecided opinions:

"I'm not sure. Given the fact that there seems to be many young non-nationals filling IT roles here in Dublin, that could very well be the case."

"I'm more undecided than a NO on this one, we've a very even mix of gender in our team here. Do the numbers and gender of students entering ICT college courses reflect the above?"

4.4.1.4 Section 4 – General Comments

Only 12.5% (12/99) left comment in the box provided.

There were number of comments in relation to Irish education system. One respondent said:

"We need to get the information on Careers in IT to all levels of our education system, starting as young as 5 years old. We need to educate all pupils especially girls on the world of ICT and encourage pupils especially girls at a young age to consider a career in ICT. We also need IT to be a core subject on the secondary schools cycle for both Junior and leaving Certs",

while another said:

"Colleges need to be continually updating their IT courses and encourage students to work on open source projects and personal projects outside of their course" ,

and another commented:

"The current skills shortage is an outcome of the building boom years when not enough young people took up CAO places on good course... and in turn those who did enter the courses because points dropped were not the right raw material. We simply have to import talent."

The issue of recruitment process in Ireland as well as outside of Ireland, and the visa programme was mentioned, with one respondent saying:

"Our company have now done two recruitment drives for analyst and developer positions in Mainland Europe due to lack of suitable candidates in Ireland."

and another one:

"The country needs to consider opening up the employment visa program to specific skill sets (e.g. ICT) in order to supplement shortages in the availability of suitably trained EU professionals."

Moreover, one respondent said that,

"With regard to identifying resource gaps, the recruitment and hiring process can be quite different between companies. In my current company, we give each candidate a test which varies depending on what department they are being recruited for (dev, build & release, QA) which we've found to be a good

*approach to sort who is serious and competent from who is not. However, other
aspects of our recruitment process are very poor. "*

The competition between companies for skilled ICT workers was highlighted, one said:

*"There is a lot of competition for skilled IT staff due to the increasing importance
of ICT and the digitisation of society under way".*

In addition, the importance of finding workers with a mix of skills seems a challenge, one
responded said that, "main challenge is not finding staff but finding good staff with a mix
of interpersonal and technical skills."

A number of comments were based around the topic of women in the ICT sector and
unbalanced treatment. One respondent said:

*"I am a woman in a technical role, we find it hard to recruit female employees to
our industry – we get few female applicants. the industry (technology) doesn't
attract women. I think there is a perception that there is less flexibility and the
hours are long".*

Another commented:

*"I have worked in IT since 1997 and as a female the industry is very
unbalanced. IT was seen as a male dominated industry. In IT
Operations/Support there are less women. However there are more women on
the Business Analysis and Project Management side. As a female, I can say I
have encountered sexism and totally inappropriate comments which has been
extremely frustrating due to being overqualified for roles I am in anyhow. Some
comments include: "You are the Token Woman in IT", "Why would you want a
pay rise, sure you will be having babies in a few years time" and "The client
preferred you on-site as they fancied you"."*

There were also comments in relation to salaries:

*"One of our biggest challenges is the high salaries that graduates earn" and the
fact that "Financial Services pay much higher salaries than other industries."*

Lastly, there was a comment specific to the promotion of STEM in Dublin only, where
respondent said:

*"ICS and SFI promote STEM at Dublin level but message not always reaching
outside Dublin. ICT is Business (BIS), Programming, Data and many job
options, it is not always clear to Career Guidance Teachers and Parents - there
is a need for more profiling of jobs on TV and Media Smart Futures (Inst of
Engineers) & Careerportal do a good job, places like Ploughing Championship
is getting the message to parents but needs to continue to rural schools. Cork is*

*getting more PR in 2016 with TYCO and other companies hiring but need to
continue efforts outside Dublin."*

4.5 Summary

This chapter examined findings of the research. A number of common themes were
identified during the literature review.   The analysis presented in this chapter has
emphasised some of the issues in relation to ICT skills shortage in Ireland. In addition a
number of sub-themes emerged during the course of this work, especially those relating to
aspects of future training courses in the ICT sector, education system and promoting ICT
by parents from an early age. The findings from the research are broadly consistent with
those that emerged during the literature review, with considerations around female under
representation in the ICT sector. The next chapter details the conclusions and
recommendations of the study.

Chapter 5: Conclusions and Future Work

5.1 Introduction

The purpose of this research was to carry out a case study on ICT skills shortage and skills gap in Ireland through Training Networks Programme. The aim of this research was to determine whether ICT skills shortage and skills gap exists in Ireland.

The purpose of this section is to relate the research findings to the literature review to highlight key issues on the topic from training networks, member companies and market context. Moreover, the chapter looks at the conclusions of the research undertaken in this study, looks at whether the findings can be generalised outside of the target population used, discusses the limitations of the research and assesses the need for further studies into this field of research.

5.2 The Research Question and Objectives

The research question asked whether there is ICT skills shortage and skills gap in Ireland. The queries/sub-questions important to the research were as follows:

- to examine the views of enterprises to see if ICT skills shortage and skills gap exists in Ireland

- to examine the views of other key stakeholders in relation to the ICT sector

- to find out how Irish enterprises identify skills gap and if the process is adequate;

In order to answer this research question and objectives, the literature explored the situation of ICT skills shortage in context not only Irish perspective but also other European countries and overseas. The skills shortage myth has been also introduced as well as the importance of TNA prior to conducting training in the organisations. The literature put a context on the addressing skills shortage through government initiatives as well as the issue of the under representation of women in the ICT sector.

The result of the study is conclusive, the ICT skills shortage and skills gap exist in Ireland. In addition the findings delivered a number of comments and suggestions under the more than one heading. Both the findings as well as areas for future research are presented further below.

5.3 Research Findings

There are number of important findings from the analysis of chapter four. Below is a summary of the findings that the research has discovered.

- ICT skills shortage and skills gap in Ireland

The findings support the view that there is indeed ICT skills shortage and skills gap in Ireland. Organisations have difficulties filling their available vacancies and struggle to find workers with the desirable ICT skill set. More than half of respondents agreed that the skills shortage is already impacting their ability to recruit and that the recruitment process is getting longer compared to previous years. Since information technologies have radically changed much over the last couple of decades, employers have had persistent difficulties finding workers who can make the most of these new technologies. The ICT sector is confronted by lack of professionals with highly technical skills. More than half of respondents described finding candidates with a solid work experience as very challenging. Also finding candidates to enter initial screening process is a challenge. In addition to technical skills, employers look for candidates with leadership and management skills and they described them as very challenging factor during recruitment. The fact that companies had to go outside of the country to look for highly skilled ICT professionals in countries such as Spain, Poland, Italy or even India is another confirmation of the skills shortage in Ireland.

Skills gap, a misalignment between the skills required to do the job in the best possible way and the skills of employees is also common in Ireland. The research found that more than seventy per cent of respondents provide training for ICT specialists. This is a very positive message. Also the findings from interviewees with Network Managers of training networks confirm, that companies try to tackle employees skills gap as well as emerging skills gap through the training programmes.

What is important to add to the above and what was highlighted in the literature review is the fact that there is a confusion among employers around the definition of skills shortage and skills gap.

The existence of skills shortage and skills gap are important in the Irish economy. They can potentially lead to a loss of competitiveness due to the wage rates and to lower productivity in ICT sector where such skill-related problems exist (Bennett and McGuinness, 2009).

- Training Needs Analysis in organisations

The study found that TNA is carried out in most of organisations and is aligned with company objectives and the needs of individuals. This supports research by Reed and Barrington (1999) where the employee learning in the "set" is essentially targeted directly at organisational needs. TNA depends on company size and can be either structure or unstructured. As per findings, the TNA process in large organisations is structured, planned and done regularly. This match with the literature review chapter, where the research by Iqual and Khan (2011) found that training must be planned in a cyclical manner and therefore will lead to high quality training. However as per interview findings there are organisations where the skill gaps are not identified and training is organised only when they come across the problem or the need for a particular set of skills arises. This corresponds with Brown's (2002) statement that, if organisations implement training without first conducting a needs assessment, they may end up under training or over training or simply misinterpret the need.

- Areas of ICT skills shortage

The research found that there is a shortage of highly skilled professionals for the most of areas that have been listed in Table 2.1 in the literature review chapter. In addition, there is a demand for workers with security, networking and cloud computing. This supports the EC (2012b) and their research which states that, the ICT sector seems to be confronted by lack of professionals with highly technical skills in areas such as ICT security and cloud computing. The data from the primary research (observation) shows that there is also a shortage of professionals with skills in UX Design. User Experience Designers plan and create the look and feel of a website (or mobile application) to meet the demands, needs and desires of a brand's target audience. This is a quite new area, however businesses are recognising the growing importance of this role as consumers continue to demand better products and experiences. As there was no training programmes in Ireland in UX Design, the ISA Software Skillnet has designed this programme through a collaboration between companies in the Irish Software Association (ISA) and IADT. The programme will fill the software industry's needs gap in this area.

- Changes in the training

Key findings from the case study that were addressed in the literature reviewed were training programmes in ICT sector. The literature reviewed did not indicate any specific areas what courses are currently in demand and what would be needed in the future.

Nevertheless, the research generated a number of areas of training that is currently in demand from the point of view of skills needed by the ICT sector. Languages for core development such as Java, C++, JavaScript are in *continuous* demand. This corresponds with the recent TIOBE index (as of June 2016) placing Java as the most popular programming language, followed by C and C++. The TIOBE Programming Community index is an indicator of the popularity of programming languages. The index is updated once a month. The ratings are based on the number of skilled engineers world-wide, courses and third party vendors. Popular search engines such as Google, Bing, Yahoo!, Wikipedia, Amazon, YouTube and Baidu are used to calculate the ratings (TIOBE, 2016). Other areas of training that have been mentioned in the study as the future needs would be around Cloud, Big Data, Analytics and Security.

- Female participation in the ICT sector

This study has also provided data and insight in relation to under-representation of women in the ICT sector. The study found that the female participation on a training programmes is very low. A very important point of the study that came up during the interviews and would help to promote the ICT sector are parents. ICT sector is still seen as unattractive and boring and stereotypes which see the sector as more suitable for men are very common.

5.4 Generalisability of Findings

Generalisability is the ability to confidently apply the results of a study to the wider relevant population or situation (Rees, 2016). To increase generalisability of the findings in this study, a triangulation concept was applied through the use of qualitative and quantitative methods. Although the triangulation was included in this research and while this study is of interest to the public, academia and to companies in the ICT sector, its generalisability should be treated with an element of caution. In this study, a convenience sampling was used and the sample selected is unlikely representative of all the ICT companies in Ireland. Further research is therefore required to improve the generalisability of the study.

5.5 Limitations of research

Research approach: given the logistics and the locations of the member companies of Skillnets networks, it was necessary to gather information by on-line questionnaire. In addition, the ethical approval was only authorised in the second week of August which meant it had some impact on the questionnaire response rate.

Questionnaire limitation: one of the limitations of this survey has been the fact that all questions were optional (as per ethics rules), so the participants could either skip the question/s completely or answer partially. It would be beneficial if at least some of the questions were mandatory which would help to get more insight to some of the questions that were skipped.

Interviews: Additional number of interviews could have increased the scope of the research, in particular with any qualitative questions. However due to the summer months, potential interviewees were not available. It is worth noting that the semi-structured interviews give a perspective from inside the network, but this research could have included participants from outside of the network, such as representatives of the ICT sector or training providers to get a different perspective on skills shortage and skills gap. However, given the time constraints and summer time, this was not possible.

5.6 Advancing the Current Knowledge and Areas for Further Research

This research hoped to gain a greater insight into the knowledge of ICT skills shortage and skills in Ireland; view from the companies perspective in relation to the recruitment process for IT/ICT roles, the length of recruitment, the impact on stakeholder as well as their opinion what factors contribute to the talent shortage in Ireland. The findings achieved these objectives given the limitations of the research method.

Both ICT skills shortage ans skills gap are relevant topics at present and there are a number of directions that future research into this area can take. Following on from the research findings of this study, this section sets out a series of recommendations and areas of interest that could be investigated further:

- As this research project focused on companies within the ICT sector there is scope for additional research into other non-IT/ICT populations. A number of companies in other sectors than IT/ICT perform a lot of their activity using technology which is critical to the core business.

- In order to reduce skills shortage, Ireland needs to get more women to participate in the ICT sector, as part of the sector's workforce and, particularly, in decision-making positions as there is still the idea that the ICT sector is "too difficult" for girls in certain cultures. In addition, decision makers should make available evidence supporting the equal capabilities of women, i.e. make STEM studies more visible.

- Parents should be encouraging their children, especially girls (starting in the primary schools) to aim for career paths, such as ICT sector, which are well rewarded on the labour market; this is an important action to narrow the gap.

- In order to fix the issue of skills shortage, promoting technology in schools and making a clear pathway from school to ICT as a career is required, as well as helping people who want to move into ICT from other professions.

- The Irish government should communicate future skills that businesses need and ensure ICT courses are adapted accordingly with business needs.

- Employers should carry out TNA more often to identify skills gap within their workforce.

- There needs to be an increase in awareness of available programmes which are funded by the government such as TNP.

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Appendix A: Informed Consent Form

TRINITY COLLEGE DUBLIN

Informed Consent Form (Semi-structured Interview)

TITLE OF THE PROJECT: A case study on the ICT skills shortage and skills gap in Ireland through the Training Networks Programme.

LEAD RESEARCHER: Joanna Piechota, School of Computer Science and Statistics, Trinity College Dublin

RESEARCHER CONTACT DETAILS:

Joanna Piechota, piechoj@tcd.ie

BACKGROUND OF RESEARCH & ACADEMIC RATIONALE

The research focuses on two main areas namely, the ICT skills shortage and skills gap in Ireland.

The research aims to understand whether the skills shortage and skills gap is present and investigates the reality of the situation.

The research will increase knowledge and awareness in the field of ICT skills development, understand what are the skill requirements of the formal employment market in ICT sector as well as help to facilitate links between education, training and the labour market in Ireland.

PARTICIPATION

You have been invited to take part in the interview as a key decision maker and a manager who contributes to ICT sector in Ireland. Participation is entirely voluntary. The participant may withdraw at any time and for any reason without penalty. Participants may omit or withdraw individual responses without penalty. The interview will consist of a series of questions relating to ICT skills gap and skills shortage in Ireland.

PROCEDURES OF THIS STUDY:

The research will be based on 20-30 minute interviews with the participants. The data collected will then be analysed and then categorised. The interview may be recorded on

an audio recording device for further analysis by the researcher. However, the participant can opt out of recording at any time. No recordings will be made available to anyone other than the researcher, nor will any such recordings be replayed in any public presentation of research.

PUBLICATION:

The anonymity of the participant will be preserved in analysis, publication and presentation of resulting data and findings. In the extremely unlikely event that illicit activity is reported I will be obliged to report it to appropriate authorities.

DECLARATION for the participant of the interview:

- I am 18 years or older and am competent to provide consent.

- I have read, or had read to me, a document providing information about this research and this consent form. I have had the opportunity to ask questions and all my questions have been answered to my satisfaction and understand the description of the research that is being provided to me.

- I agree that my data is used for scientific purposes and I have no objection that my data is published in scientific publications in a way that does not reveal my identity.

- I understand that if I make illicit activities known, these will be reported to appropriate authorities.

- I understand that I may stop electronic recordings at any time, and that I may at any time, even subsequent to my participation have such recordings destroyed (except in situations such as above).

- I understand that, subject to the constraints above, no recordings will be replayed in any public forum or made available to any audience other than the current researchers/research team.

- I freely and voluntarily agree to be part of this research study, though without prejudice to my legal and ethical rights.

- I understand that I may refuse to answer any question and that I may withdraw at any time without penalty.

- I understand that my participation is fully anonymous and that no personal details about me will be recorded.

- I have received a copy of this agreement.

PARTICIPANT'S NAME:

PARTICIPANT'S SIGNATURE:

Date:

Statement of investigator's responsibility:

I have explained the nature and purpose of this research study, the procedures to be undertaken and any risks that may be involved. I have offered to answer any questions and fully answered such questions. I believe that the participant understands my explanation and has freely given informed consent.

RESEARCHERS CONTACT DETAILS:

INVESTIGATOR'S SIGNATURE:

Date:

Appendix B: Participant's Information Sheet (Semi-structured Interview)

TITLE OF THE PROJECT: A case study on the ICT skills shortage and skills gap in Ireland through the Training Networks Programme.

LEAD RESEARCHER: Joanna Piechota, School of Computer Science and Statistics, Trinity College Dublin

RESEARCHER CONTACT DETAILS:

Joanna Piechota, piechoj@tcd.ie

BACKGROUND OF RESEARCH & ACADEMIC RATIONALE

The research focuses on two main areas namely, the ICT skills shortage and skills gap in Ireland.

The research aims to understand whether the skills shortage and skills gap is present and investigates the reality of the situation.

The research will increase knowledge and awareness in the field of ICT skills development, understand what are the skill requirements of the formal employment market in ICT sector as well as help to facilitate links between education, training and the labour market in Ireland.

PARTICIPATION

You have been invited to take part in the interview as a key decision maker and a manager who contributes to ICT sector in Ireland. Participation is entirely voluntary. The participant may withdraw at any time and for any reason without penalty. Participants may omit or withdraw individual responses without penalty. The interview will consist of a series of questions relating to ICT skills gap and skills shortage in Ireland.

PROCEDURES OF THIS STUDY:

The research will be based on 10-15 minute interviews with the participants. The data collected will then be analysed and then categorised. The interview may be recorded on an audio recording device for further analysis by the researcher. However, the participant can opt out of recording at any time. No recordings will be made available to anyone other than the researcher, nor will any such recordings be replayed in any public presentation of research.

PUBLICATION:

All data will be used anonymously for the completion of a dissertation as part of the completion of the MSc in Management of Information Systems, Trinity College Dublin.

Individual results will be aggregated anonymously and research reported on aggregate results.

Involvement in the Research Study is voluntary and participants may withdraw from the research study at any point. Please note that the research will not hold any information on participants/individuals only on companies.

Appendix C: Semi-Structured Interviews: Sample Questions-Network Managers

General questions

- What is your view/feeling about skills shortage in Ireland?

- How real is the situation? Do you think that the skills shortage exists or it is just a myth?

- Based on your experience, do you think that owners and/or heads of departments understand the difference between the skills shortage and skills gap? Is the definition clear?

Skills shortage

- What major changes/shifts have occurred within your network during the past three to five years? What strategic challenges do these changes pose for the network and member companies within ICT sector?

- What occupational or skill shortages (if any) exist in your network/sector? Does the answer change if you look five years into the future? How?

- Would below list match the skills shortage within your network/sector?

Below is a list of jobs browsed by IT sector. The search was done on 19th April on two Irish websites, jobs.ie and monster.ie

Browse by Industry : 194 IT Jobs found on Jobs.ie (19/04/2016) – examples

- C# .net Developer

- Head of ICT

- Helpdesk Support Administrator

- IT/Desktop Support Technician

- IT Team Leader

- IT Systems/Business Analyst

- Java Developer

- Senior QA Engineer

- Software/IT Engineer

- Software Tester

- Systems Administrator

- Web/UX Designer

Browse by Industry: 1000+ IT Jobs found on Monster.ie (on 19/04/2014) - examples

- Applications Analyst (Java)

- Automation Test & Quality Engineer

- Business Analyst

- C# Developer

- Cloud Infrastructure Engineer (Windows)

- Front End Developer

- iOS developer

- Java Developer UI

- Javascript Developer

- Junior Java Developer

- Mid-Level ASP.NET Web Developer

- Senior IT Portfolio Manager, Internal systems

- Senior Network Engineer (Design/CCDP/CCNP)

- Senior Test Analyst

- System/Product Architect

- Vision research engineer

Skills Gap (between current capabilities and the skills it needs to achieve its goals)

- Why is there a skills gap in ICT sector?

- Based on your experience, what are the biggest gaps in ICT sector?

- How do member companies identify skills gap in their ICT departments?

- Based on your experience to date, does a process of identifying future training and establishing skills gap in member companies (i.e. by HR managers) is adequate/correct?

- On a scale 1 to 5 (1 being the worst and 5 being the best) within your network how confident are you that the existing process will meet member companies future training needs?

  - Not at all confident

  - Not confident in most regards

  - Moderately confident

  - Confident in most regards

  - Completely confidential

- Thinking back over the last 12-18 months, how well during that time on a scale of 1 to 4 (1 being not at all and 4 being completely) do you feel your member companies identified training needs and skills gap was actually addressed?

  - Not met at all

  - Not met in most regards

  - Met in most regards

  - Met completely

Appendix D: ICT Skills Gap and Skills Shortage in Ireland

Introduction and Consent Form

Dear Member Company/HR Manager/Training Manager/Owner,

Thank you very much for agreeing to assist in this survey research.

The following research is being carried out by Joanna Piechota. Joanna is a student in School of Computer Science and Statistics, Trinity College Dublin, and is studying a Masters in Management of Information Systems.

The survey will help us get a better understanding about skills shortage and skills gap within ICT sector in Ireland. All information given is completely confidential and is for academic purposes only.

INFORMED CONSENT FORM

LEAD RESEARCHER: Joanna Piechota, School of Computer Science and Statistics,

Trinity College Dublin

RESEARCHER CONTACT DETAILS: Joanna Piechota, piechoj@tcd.ie

BACKGROUND OF RESEARCH & ACADEMIC RATIONALE:

The research focuses on two main areas namely, the ICT skills shortage and skillsgap in Ireland.

The research aims to understand whether the skills shortage and skills gap is present and investigates the reality of the situation.The research will increase knowledge and awareness in the field of ICT skills development, understand what are the skill requirements of the formal employment market in ICT sector as well as help to facilitate links between education, training and the labour market in Ireland.

PROCEDURES OF THIS STUDY:

I, Joanna Piechota as part of the fulfilment of the M.Sc. In Management of Information Systems dissertation in Trinity College, am asking you to devote 10 minutes to complete

an online survey that will focus on ICT skills shortage and skills gap in Ireland and investigate whether skills shortage and skills gap actually exists.

Involvement in the Research Study is voluntary and participants may withdraw from the research study at any point without penalty. Please do not name third parties in any open text field of the questionnaire. Any such replies will be anonymised.

PUBLICATION: The analyzed and interpreted data will be completely anonymous and the identity of the participant or their organisation will not be revealed in any way. This data will be used in the completion of a dissertation as part of studies for a MSc. In Management of Information Systems, Trinity College Dublin.

DECLARATION AND CONSENT STATEMENT

- I am 18 years or older and I am competent to provide consent.

- I agree that my data is used for scientific purposes and I have no objection that my data is published in scientific publications in a way that does not reveal my identity.

- I understand that if I make illicit activities known, these will be reported to appropriate authorities.

- I freely and voluntarily agree to be part of this research study, though without prejudice to my legal and ethical rights.

- I understand that I may refuse to answer any question and that I may withdraw at any time without penalty.

- As this research involves viewing materials via a computer monitor, I understand that if I or anyone in my family has a history of epilepsy then I am proceeding at my own risk.

If you have any questions about the research or your role in the research please contact Joanna Piechota by email at piechoj@tcd.ie or by phone on 353 087 7432622

Do you agree to the Terms and Conditions of completing this questionnaire?

Yes, I agree

No, I don't agree

SECTION 1 – COMPANY PROFILE

This section helps us understand the nature and background of your organisation.

Note: Please note that all questions are optional

Q1. How many people are employed within your organisation? (Please select one option only)

SME (up to 19)

20-49

50-99

100-249

250-499

500+

Q2. How many people are employed within IT/ICT department or with IT roles in your organisation? (Please select one option only)

1-3

4-6

7-10

11-20

21- 30

30+

Q3. Please indicate what sector(s) your company primarily operates in: (Please tick all that apply)

Agriculture

Construction

Manufacturing

Mixed

Retail Trade

Services

Transportation

Technology

Wholesale Trade

Other (please specify)

Q4. Is your IT/ICT department: (Please select one option only)

Inhouse

Outsourced/Managed Service

Offshore

A combination of the above

We don't have a designated IT department

SECTION 2 – SKILLS SHORTAGE AND SKILLS GAP

This section helps us understand skills shortage and skills gap in ICT sector in

Ireland.

Skills shortage describes a range of situations in which an employer finds it hard to

find a worker with the right skills whereas **skills gap** refers to the gap between current

capabilities and the skills it needs to achieve its goals.

 Note: Please note that all questions are optional

Q1. Does your organisation employ ICT specialists (i.e. employed specifically to design, develop, install, operate, support, maintain, manage, evaluate and research ICT or ICT systems)? (Please select one option only)

Yes

No

Q2. Recent reports have highlighted a growing global skills shortage in ICT professionals. Which of the following statements best fits your organisation's current situation? (Please select one option only)

The skills shortage is already impacting our ability to recruit

We currently do not have a problem finding experienced ICT professionals

We outsource/use external services

Don't know

Q3. How long, on average, does it take your organisation to fill an IT/ICT role? (please select one option only)

Less than 3 months

3 – 6 months

6 months+

Don't know

Q4. Compared to previous years, is your organisation's ICT recruitment process getting: (Please select one option only)

Longer

Shorter

About the same

Q5. To what extent do unfilled ICT vacancies in your organisation impact other stakeholders, such as customers, partners, investors, etc.? (Please select one option only)

Significant impact

Some impact

No impact

Q6. In which of the following areas is the ICT skills shortage most apparent? (Please tick all that apply)

Auditing and Compliance applications

Business Applications

Cloud Computing

Hardware

Mobile

Secure software development

Social media

Other (please specify)

Q7. How important are the following techniques to mitigate the effects of existing skills shortages for ICT workforce (engineers, developers etc.)? (Please select one option per row)

	Extremely important	Very important	Moderately important	Not important
Internal employee training and development programs	O	O	O	O
Involvement with local schools / colleges	O	O	O	O
External training and certification programmes	O	O	O	O
Use of contingent staff (recruitment agencies, etc.)	O	O	O	O
Outsourcing of certain functions	O	O	O	O
Considering a new geographic location (abroad to other parts of the world) due to easier access to talent	O	O	O	O
Considering a new geographic location (within Europe) due to easier access to talent	O	O	O	O

Q8. In your opinion, to what extent do the following factors contribute to the future talent shortage? (Please select one option per row)

	High Impact	Moderate Impact	Low Impact
Retirement of baby boomers	O	O	O
Strength of economy	O	O	O
Access to talent	O	O	O
Loss of embedded knowledge due to movement of experienced workers	O	O	O
Attractiveness of industry	O	O	O
Increase in skilled positions	O	O	O
Increase in demand for products and services	O	O	O
School system	O	O	O

SECTION 3 – RECRUITMENT & TRAINING OF ICT PROFESSIONALS

This sections asks questions about the recruitment process of ICT professionals and training activity in your organisation.

Note: Please note that all questions are optional

Q1. Who is responsible for managing human resources in your organisation? (Please select one option only)

The Chief Executive Officer/Owner of the company

HR Manager

All managers

Independent person inside the company

An expert out of the company

Independent department

Other (please specify)

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Q2. What are the major challenges faced during recruitment of skilled and highly skilled ICT workers? (Please select one option per row)

	Extremely challenging	Very challenging	Moderately challenging	N/A
Finding candidates to enter initial screening process	O	O	O	O
Finding candidates who pass our screening and/or probationary period	O	O	O	O
Finding candidates with solid work experience	O	O	O	O
Finding candidates with up-to-date technology knowledge	O	O	O	O
Finding candidates with leadership skills/business management skills	O	O	O	O
Offering compensation that appeals to qualified candidates	O	O	O	O
Ability to retain the workers filled in this job category	O	O	O	O

Q3. Which are the methods that you use in your company for skill needs/gap identification? (Please comment)

Q4. Does your company provide any type of training to develop ICT related skills of employees during 2016?

	Yes	No
Training for ICT specialists	O	O
Training for other staff employed	O	O

Q5. According to a number of reports (i.e. Manpower 2015 Talent Shortage Survey, Solas Report on Future Skills Needs), the ICT industry is failing to attract young talent and women into the profession. Do you agree this is the case? (Please select one option only)

Yes

No

Please comment

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SECTION 4 – GENERAL

Please provide any additional comments (Please enter "N/A" if not applicable)

<div style="border: 1px solid black; height: 60px;"></div>

Would you like to submit your answers?

Yes

No, exit without submitting