WOMEN4IT
2019

STUDY:

NEEDS ASSESSMENT AT EUROPEAN AND NATIONAL LEVELS

Iceland Liechtenstein Norway grants
Norway grants

WOMEN4IT 2019

Study of needs assessment at European and national levels completed

Abstract

Needs Assessment Research includes the review of theory and practices to bridge the gap between existing and required skills, to identify new trends in employability and skills in demand as well as an in-depth evaluation through national field research in the 7 piloting countries, to set priorities and provide feedback for the development of the digital occupation profiles. The outcomes of the study include 10 suggestions for digital occupation profiles for the project beneficiaries which have been validated through the survey and focus groups.

By Dr. Maria Giannacourou and Pantelis Nikolaidis

June 2019

The project Nr.2017-1-094 "YOUNG-ICT WOMEN: Innovative Solutions to increase the numbers of EU vulnerable girls and young women into the digital agenda" benefits from a 2.714.304 € grant from Iceland, Liechtenstein and Norway through the EEA and Norway Grants Fund for Youth Employment. The aim of the project is to increase the numbers of EU vulnerable girls and young women into the digital agenda.

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DELIVERABLE D2.1: Study of Needs Assessment at European and National Levels Completed

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Glossary - Definitions

This study uses several terms that will be defined here for clarification. First, both Computer Science and Informatics will be referred to as ICT throughout the document for brevity and convenience.

Additionally, the Desk Research findings described in this document are addressed by using the following terminology:

- **Skill**: Ability to carry out managerial or technical tasks
- **Attitude**: Cognitive and relational capacity
- **Knowledge**: The set of know-what
- **Competence areas**: A set of competences clustered according to specific criteria
- **Skill recognition**: a process designed to verify and provide recognition of a set of skills held by an individual, but not reflected in a formal qualification.

PART A

Chapter 1: Introduction

This report is an intellectual output of the EEA and Norway Grants Fund for Youth Employment Project WOMEN4IT: Innovative Solutions to increase the numbers of EU vulnerable girls and young women into the digital agenda, 2017-1-094. It presents the results of the Needs Assessment desk and field research to highlight key elements and issues regarding young women access to technology, labor markets, digital training as well as labour market demands.

Project Aims

The main objective of the project is to develop the digital competences of young women who are at risk of exclusion from the labour market by improving their employability through an alternative, integrated approach. The solution will upskill them, with a 'learning to learn' attitude, a sense of initiative, and the social skills necessary to find a job. Conducting needs assessments will help reaching this outcome since through the systematic review and study of multi-sourced data the identification of gaps between current and desired/required knowledge, skills, behavior and practice will be revealed.

To close the loop, the system will consult with employment services. A new participant alliance and adaptable tools will make the proposed solutions sustainable and transferable to different territories and target groups.

Research on Innovative Solution Aims

Research on innovative solutions is one of the nine (9) WPs of WOMEN4IT project and it will contribute in the provision of innovative solutions to increase the number of young women in the digital economy through mapping the theory, practices and policies that underpin the understanding of young

women needs regarding access to technology and digital training as well as labour market needs.

A good match between the skills demanded by the labour market and those acquired in training is important for promoting strong and inclusive growth for women. Studies show that female human capital accumulation has a considerable impact on technology adoption, innovation and economic growth and although women are beginning to achieve gender equality and close the gender gap in IT by developing digital fluency, they still remain underrepresented in the workforce in many developed countries.

Thus, helping women to access the skills they need to be successful can improve gender equality, promote inclusive growth and affect positively productivity, while also improve the efficiency of human capital allocation.
However, the nature of jobs is quickly changing due to automation, social and economic factors, and it is difficult to predict which skills jobs will require in the future, thus threatening to widen the skills gap and making career planning more difficult. In order to overcome this problem, a participatory needs assessment has been chosen, i.e. a systematic approach to setting project priorities carefully analyzing beneficiaries' needs, but in close cooperation with employers and stakeholders so as to identify current and desired status on important values or project outputs and best support young women who are the target group of this project.

More specifically, research on innovative solutions aims to:

1) Collect information on needs assessment in European and National level to reveal skills shortages/mismatches in the local labour market and improve the understanding of digital skills needs at national level,
2) Identify effective innovative approaches and good practices currently in use and their contribution to employment of NEETs/target groups.
3) Identify future trends in employability regarding digital skills to prepare trainees for the work challenges,

4) Provide the necessary input for next project phases and especially WP E: Design of Profiling Solutions

The research, data collection, analysis and interpretation activities will lead in the development of:

- DELIVERABLE D2.1: Development of Consolidated Report on Needs Assessment at European and National Level

Purpose of the Needs Assessment

Needs Assessment Research includes the review of theory and practices to bridge the gap between existing and required skills, to identify new trends in employability and skills in demand as well as an in-depth evaluation through national field research in the 7 piloting countries, to set priorities and provide feedback for the development of the digital occupation profiles. The outcomes of the study include 10 suggestions for digital occupation profiles for the project beneficiaries which have been validated through the survey and focus groups.

The research questions that this study aims to answer are as follows:

- What are the most needed digital profiles / occupations?
- Which employers believe are the most necessary digital skills for job occupants?
- Digital skills shortages
- Employers' attitudes towards ICT
- Women barriers to employability
- Future employability trends
- ICT skills training strategies

Outline of the Study

This document is organized in 4 parts and it includes 9 chapters, as follows:

PART A

Chapter 1 - INTRODUCTION

This chapter presents the aims of the WP and of the Needs Assessment Desk Research.

Chapter 2 - POLICY CONTEXT

This chapter summarizes young women employability and ICT sector issues.

Chapter 3 - METHODOLOGY AND WORK ORGANIZATION

This chapter provides an outline of the methodology used for this study.

Chapter 4 - YOUNG WOMEN EMPLOYABILITY

This chapter presents a theoretical framework for employability and demonstrates employment trends to illustrate challenges.

Chapter 5 – TARGET GROUP

In this chapter the description of target groups main characteristics is presented.

Chapter 6 – WORKPLACE CONTEXT

Parameters that affect the work organization, tasks, roles and IT adoption are presented here.

Chapter 7 – TRAINING ON DIGITAL SKILLS

This chapter presents the role of training in supporting people to build the competence necessary in the workplace today.

Chapter 8 - DIGITAL SKILLS MAPPING AND ASSESSMENT

This chapter presents an overview of the European assessment frameworks and the links them with the assessment of young women skills and needs. It also describes the proposed evaluation framework for the development of profiles.

Chapter 9 – FUTURE EMPLOYABILITY TRENDS

This chapter presents the perceived effects of digitalization on sectors, technologies and skills to come up with suggestions regarding profiles.

Chapter 10 – SUGGESTIONS FOR DIGITAL OCCUPATIONS PROFILES

This chapter, based on the findings from the desk research, concludes in 10 digital occupation profiles.

Chapter 11 - CONCLUSIONS AND CHALLENGES

This chapter summarizes the main findings of the desk research.

PART B

Chapter 12 - BASELINE REPORT

Presentation of the labor market, the economic sectors as well as the different circumstances and dynamics leading to different results concerning digital growth in the piloting countries.

Chapter 13 - CONCLUDING COMMENDS

This chapter summarizes main findings.

PART C

Chapter 14 - EMPLOYERS' SURVEY

The analysis of the results from the survey conducted in the 7 partner countries is presented.

Chapter 15 - CONCLUDING REMARKS – EMPLOYERS' SURVEY SUMMARY

Based on the analysis, key findings are presented.

REFERENCES

This section presents the literature sources and the websites reviewed for the development of this study.

ANNEXES

This section presents the Baseline Report (Annex 1), the data collection tool for employers / stakeholders (Annex 2), the framework on which the digital occupations profiles were based (Annex 3).

CHAPTER 2: Policy Context

Globalization, automation and digitalization will continue to change labour market demands as well as the skills required of people entering employment. These megatrends are likely to have a disproportionate impact on ICT sectors in Europe. As the job market continues to evolve, it is critical to ensure that the skills development is well-connected to local employers to reduce skill shortages and foster employability. Training opportunities can help reduce skills mismatches, and provide a smoother transition into the labour market for many individuals.

Local labour markets across the OECD are undergoing a fundamental shift as the skills required to succeed in work are significantly changing. Many jobs will be restructured or may disappear altogether. Technological progress and digitalization are contributing to the increasing automation of routine and repetitive tasks in many industries. Increasing integration in global value chains makes it profitable for firms to split up the production process into separate tasks, which can be easily outsourced, thus changing the nature of the working relationship from dependent to contractor. This phenomenon is reinforced by technological progress that reduces the cost of contracting external workers for specific projects, and create new types of jobs (e.g., platform economy). Some workers will benefit from the increasing flexibility (e.g., by providing better work-life balance), others however will mainly bear the risk of reduced welfare coverage and training opportunities. Also, the importance of mechanisms that give formal recognition to vocational skills acquired through work-based learning can shorten the path to a qualification, reducing costs for learners. These trends also resulted in increasing polarization of labour markets into high-skill and low-skill jobs, which is undermining the middle class and contributing to rising income inequality. As a result, policymakers need to make sure that all workers will benefit from productivity gains via increasing automation and labour market flexibility.

The relevance of this trade-off is particularly acute in certain regions and local communities. The OECD report, Job Creation and Local Economic Development 2018, demonstrates the uneven impact of automation and non-standard jobs across regions within OECD countries (See Figure below). Some regions are in a better position to take full advantage of new job opportunities, while others mainly experience a reduction and deterioration of the quality of jobs. Furthermore, disparities across regions in education and skills outcomes tend to reinforce regional unbalances within countries.

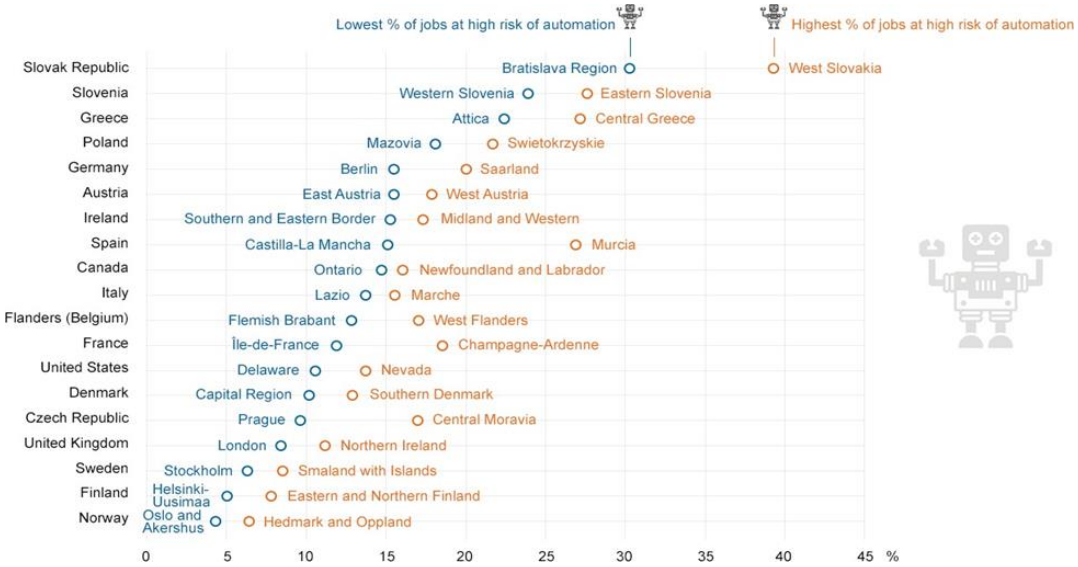


Figure 1: Regional differences in the share of jobs at risk of automation. Share of jobs at high risk of automation, TL2 regions, 2016

Source: OECD (2018) Job Creation and Local Economic Development 2018: Preparing for the future of work.

To address these challenges, employability policies must acknowledge national differences and adapt to the needs of the local workers and firms, (see Box 1). They must reflect the changing work environments across the Europe or the impeding disruptions in local labour communities. They need to adapt more quickly to emerging labour market requirements, engage employers and reach out to appropriate groups in the labour force accordingly. In addition, employment services and skills development programs should deliver

adequate lifelong learning opportunities to people across the countries, while contribute to increasing living standards through increasing productivity.

Box 1: Implementing a local employability and skills strategy in Northern Ireland

Armagh City, Banbridge and Craigavon (ABC) Borough Council have developed an Employability and Skills Strategy, which has a strong employer engagement focus to include a role in an Employability and Skills Forum within the Borough to provide input into the skills needs of the area. This also includes membership from government, the private sector, training and education providers and others. ABC's Skills Strategy also has a sectoral focus, recommending the introduction of a competitive bursary scheme for local SMEs in the Council area's 5 priority sectors - Digital and Creative Technologies, Advanced Manufacturing, Materials and Engineering; Life and Health Sciences; Agri-Food; and Tourism – which focuses on re-skilling and up-skilling the existing workforce within the ABC Borough Council area.

According to OECD (2018), work-integration opportunities are often combined with skills development activities. These integration opportunities can take the form of on-the-job training or training activities aimed at enhancing employability. For instance, Simplon.co - a French social enterprise - provides free coding training to unemployed people, illustrating how social entrepreneurs can take advantage of technological progress to improve social inclusion (see Box 2).

Box 2: Simplon.co: harnessing technologies to improve social inclusion

Simplon.co, a network of learning centers (factories), has been offering, since 2013, free coding training to the unemployed. The "factories" provide accelerated learning on topics such as development, data, cyber security, with the ambition to bring diversity and social inclusion in the coding world. They also provide support in the search for apprenticeships or employment.

The training offered by Simplon.co primarily targets individuals who are under-represented in the digital professions such as women or individuals with little education, people from disadvantaged neighborhoods, the unemployed, dropouts, people with disabilities, and refugees. The network, which has the label of a French Solidarity Enterprise with Social Utility (ESUS), adopts a hybrid economic model, based in part on the traditional financing allocated to vocational training in France (employment pole or regional funds) while also receiving sponsorship and subsidies.
After four years in existence, Simplon.co has trained nearly 1 500 people, of which 78% returned to employment (including permanent and fixed-term contracts). Some of the trainees were also hired by another branch of Simplon.co, called Simplon Prod, which produces websites, mobile apps, or delivers maintenance services.
Today, more than 40 "factories" have been created in France and abroad, notably in Africa, where the network implemented several experiments. In 2017, Simplon.co created a school in Dakar, in partnership with Orange (a French multinational telecommunications corporation). Other projects are also being implemented in North Africa. Another branch of Simplon.co called Simplon Corp provides training to employees of major companies such as L'Oréal or Louis Vuitton to raise awareness and/or upskill them in their digital transitions.

Source: https://simplon.co/qui-sommes-nous/

CHAPTER 3: Methodology and Work organization

The Needs Assessment Desk Report Study (NAS) draws on a wide range of sources identified by the desk research, making also use of an information request template (excel file) and a shared repository for collected international relevant reports by the partners. The documents (all related to the project aims, focus on: young women employment trends, needs regarding access to technology, digital skills and skills shortages identified by the labour market) are grouped under different chapters in this report. The reviewed documents

included policy and research reports, articles and books, surveys, descriptions of initiatives, good practices, etc.

Desk Research Overview

For mapping purposes, the series of surveys and bibliography were identified in two main ways:

1. The thematic search mainly with the following criteria: Digital skills, Digital Occupations, Competency Framework, Female Employability, ICT Employability, and ICT & Gender.
2. Finding primary research results from the European Commission, OECD and UNESCO. All three organizations have the characteristic of datasets that are available for research. Particularly:

a. Concerning the European Commission: DESI Reports - Human Capacities and Digital Skills, the annual survey on the use of ICT by households and individuals, as well as on the Joint Research Center, and the CEN Workshop on ICT Skills.

b. Regarding the OECD, search focused mainly on results from the OECD PISA and the PIAAC.

c. Regarding UNESCO, search mainly focused on the results from ICT and Gender assessment.

To help provide important information, we have included in a Box format short examples and initiatives in other countries by way of comparison.

A key purpose of this report is to formulate research questions and identify gaps in information where further data will be gathered from the ground (through interviews, surveys, and focus groups in the project participating countries), particularly as regards the outlined topics in the relevant sections. In the Annex section, the data collection tool for employers is provided.

Also, NAS intents to provide national partners with information to allow the development of a questionnaire for the purpose of surveying target groups to identify trends and untapped opportunities within each country based on existing European and international frameworks.

CHAPTER 4: Young Women Employability

Employment and Employability

Women's' participation in the labour market has long be proven not only a value-case imperative (a "fairness and equality" issue), but an economic imperative as well. In a variety of studies (IFC, 2013; Noland, M. et al. 2016; The World Bank Group. 2014), gender diversity is shown to contribute to better outcomes for businesses (growth, productivity and innovation) and to improve ties with both their workforce and their customers as women control household spending (e.g. 64% and 30 trillion dollars of consumer spending in 2013). This figure was predicted to rise by almost a third by 2018 (WEF, 2016). However, the chances for women to participate in the formal labor market worldwide remain almost 27 percentage points lower than those for men. In addition, the global female labor force participation rate between 1995 and 2015 decreased from 52.4 percent to 49.6 percent (ILO, 2016).

Gender gaps in employment constitute a problem for developing and developed economies alike. According to the OECD, the average gender wage gap in OECD countries is over 15 percent. Women have also a lower representation at the management level, across industries (Noland et al. 2016), and they represent less than 5% of the CEOs of publicly listed companies in OECD countries and 2.8% of those in the European Union. The World Economic Forum (WEF, 2015) estimates that the global gender gap in economic opportunity has closed by only 3 percent in the past 10 years, suggesting that it will take another 118 years to close this gap completely.

In Fig. 2, female employment percentages in Europe are shown. Comparing EUROSTAT data on women and men, it is revealed that women's employment range from 34.5% to 84.5%, while men's employment range from 65,2% - 90.5%. In combination with the data presented in Box 3, female employment rates are still considerably lower than those of their male counterparts.

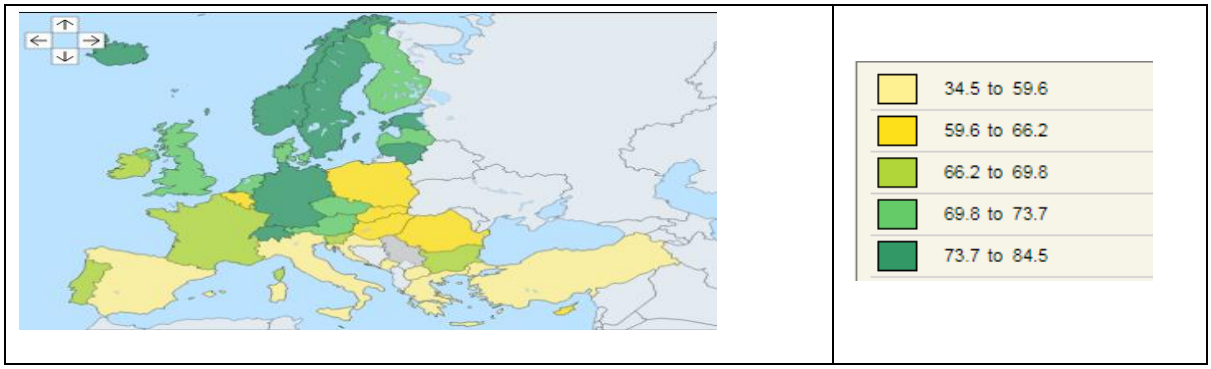


Figure 2: Female employment percentages in Europe (EUROSTAT, 24/10/18)

In addition, a recent survey among 13 major developed and emerging economies revealed that female employment is concentrated in low-growth or declining occupations, such as sales, business and clerical work, (E/CN.16/2016/3).

Box 3: Female employment in Europe

In all EU Member States, women are underrepresented in the labour market*. The Social Scoreboard headline indicator in the area of gender equality in the labour market is the gender employment gap, which is the difference between the employment rates for men and women. In 2016, the gender employment gap amounted to 11.6 percentage points for the EU, with a 76.9% employment rate for men and 65.3% for women. The gap is particularly high for non-EU born and Roma women. Overall, it remained stable compared to 2015. However, in a longer-term perspective, it is substantially lower than in 2008, when the gender employment gap was 15.0 percentage points. This long-term improvement was mainly driven by an increase in the female employment rate. Still, in 2016 six Member States had a female employment rate below 60%, together with a high employment gender gap (highest values recorded for Malta, Italy, Greece and Romania, flagged as "****critical situations****"). **The gap is also increasing** in a number of Member States, significantly faster than average in Finland, Belgium, Cyprus and Greece (in these countries, employment rate increased for both genders, but faster for men than for women). Lithuania, Latvia and Sweden are assessed as "****best performers****"]. (Joint Employment Report 2018, p.35).*

Theoretical background

The concept of employability used in this research emphasizes the individual's skills and skills development. Employability is commonly defined as the combination of factors and processes that enable people to progress towards or find employment, to remain employed, and/or to advance in the workplace (Houston, 2005).

As persons enhance their skills, develop experience, and become more competitive job applicants, their employability improves. However, the link between skill development and employability is not always clear since it is affected by:

- the job skill level, and
- the demand for these particular skills by the employers.

Thus, for highly skilled workers whose skills are not seen by employers as easily substitutable or interchangeable, additional skills may increase the bargaining power and economic gain. On the other hand, workers with computer training are only more employable if potential employers value those skills and job competitors do not possess similar skills.

Therefore**, employers play a crucial role in shaping employability prospects** and it is important to discover their perceptions regarding skills and job occupants, as well as **job seekers' motivation regarding skills acquisition and use.** In fact, employability is a multi-faceted variable and could be said that is affected by skill acquisition, motivation to use the skill as well as the opportunity to put the skill in effective use.

Thus, to better understand the concept of employability we need to understand the interaction of individual and external factors affecting the individual's ability to operate effectively within the labour market, i.e. factors on the demand and supply side.

The frameworks for employability usually include (McQuaid and Lindsay, 2005; Hillage and Pollard, 1998):

From the **supply side**:

- Individual factors such as: essential attributes (basic social skills, reliability, etc.); personal competencies (motivation, confidence, etc.); transferable skills (basic level such as literacy, key level skills such as problem-solving, communication, team-working skills, and high level such as self-management, commercial awareness, possession of highly transferable skills), qualifications and educational attainment, work knowledge-base (including work experience and occupational skills), demographics, and job related behavior (career management skills, e.g. awareness of one's own abilities and limitations, awareness of opportunities in the labour market, job-search, current unemployment/employment duration, work history, etc.).

- Personal circumstances such as: responsibilities and access to resources (transport, social capital and financial capital),

From the **demand side**:

- Local labour market demand, employer attitudes, as these affect the availability of suitable opportunities, required skill levels, occupational structure of vacancies, level of competition for jobs,
- Macroeconomic factors such as stability,
- Work conditions: remuneration extent of part-time, temporary and casual work, recruitment factors, and employers' formal recruitment and selection procedures,
- Employment policy factors such as public services and job-matching, accessibility and limitations on training, extent of local/regional development policies.

These factors cannot be considered as forming a hierarchy, as the nature and importance of different factors will change with circumstances. In addition, in many cases these factors interact.

Thus, the individual's ability to realize assets and skills depend upon external socioeconomic factors, personal circumstances and the close two-way interaction between them. External conditions such as local labour market demand and employer attitudes impact upon the availability of suitable opportunities, while individual and personal circumstances affect the ability of individuals to seek and benefit from opportunities.

How the changing world affects employability

Due to the fast changes observed in technology, society, economy and their consequences on workplaces, a high premium is placed on the ability of individuals to deal effectively with work related transitions so as to regain control over a situation which by many is seen as spiraling out of control. **To become employable nowadays requires career adaptability and career resilience**, especially since the world of work no longer provides employees

with work-holding environment for the duration of their career lives, (Maree, 2017). The tendency is to move from "job security" to "**career security**" embedding a lifelong learning culture in the workplace and replacing "education for employment" to "**education for employability**"[1].

That is why the most common theories, such as human capital theory, emphasizing education's and formal qualifications' positive correlation to job access, and labour queue theory emphasizing the role that on-the-job competencies play to employability, cannot fully explain current labour market conditions. The truth, as usual, lies in the middle, as **degrees usually need to be supplemented by transferable skills or social skills** in order to gain employment and it should take into consideration a developmental dimension. In addition, many employers are not willing to take on new recruits without demonstrated ability in certain skills.

Technological changes can result in job losses, but also provide new employment opportunities and new ways to construct appropriate careers to minimize the effects of repeated transitions in the workplace.

ICT and employability

Today, ICT skills are considered crucial for those entering the workforce and a must-have for those trying to find a better-paid job because of the diffusion of ICT in all economic sectors. In addition, an ICT-skilled workforce is considered as a strategic asset that can spur economic growth, promote competitiveness, and business productivity to the extent that some researchers are pondering whether it is more advisable to direct efforts towards creating jobs or developing skills.

ICT implementation and adoption have enabled and presented opportunities for new ways of working, for organizing and managing work and is expected to

[1] Realizing Human Potential in the Fourth Industrial Revolution. An Agenda for Leaders to Shape the Future of Education, Gender and Work, (2017). WEF

grow in significance in terms of labour demand over the next 20-30 years across Europe.

In addition, ICT can be used for exploring careers, education and employment, such as:

- assessing individual skills for employability,
- profiling skills to identify strengths and weaknesses in order to improve employability,
- enabling access to careers information and guidance to support employability,
- enabling access to labour market information,
- enabling job search, and
- self-directed learning and participation to extended social networks that promote employability.

However, the link of ICTs to employability is not so clear, especially beyond the IT sector. Although, ICT skills are seen as 'gateway skills' which increase a person's likelihood of finding employment, and serve to enhance a person's employability profile, it is difficult to pinpoint the exact combination of elements between individual factors, characteristics of the training programs and other external factors that affect the employability pathway or to develop a list of ICT technical skills that will guarantee employability as these are highly dependent on the context they will be deployed, and on the individuals.

The needs and challenges individuals face should be taken into consideration before the benefit of ICT skills is realized (Gillard et al., 2007). Evidence shows that the most effective means of improving employability and closing skills gaps are more generic measures aimed at improving the capacity of workers to acquire new skills and learn in an evolving economy. Other studies also conclude that there is more evidence on individual circumstances than on other components of the employability framework (Green at al., 2013).

Therefore, to improve the impact of ICT on employability a holistic perspective should be adopted. Garrido et al (2009 and 2010) studying the development of digital skills for immigrant women pointed out that individual factors such motivation and confidence as well as external factors such as the opportunity to use the digital skills acquired and support for social and labour market inclusion were decisive factors in advancing their employability.

Women and ICT for employability

The new ways that ICTs have enabled, such as teleworking and flexible working arrangements are considered as having a positive effect on the employability of those who have difficulties in accessing the labour market, among which are women with caring responsibilities. So, distance learning, to increase their employability opportunities, and tele-working arrangements are especially valuable for women since they allow them to work and develop their skills or enable upskilling to keep up with the constant changes in jobs and working environment from home and at times suitable to their individual needs.

NEETS and ICT for employability

ICTs can be considered an opportunity or a threat for the NEETs population as these can enable them to participate in education and work but, at the same time, a lack of access to, or ability to use, these technologies can lead to digital exclusion. Millennials, young people between the ages of 18 and 29, may have been raised on technology, and could be highly engaged through social media, that is they can be technology savvy, but for education and work they need to be *digitally literate*, which encompasses multiple skills as well as knowledge and understanding of the digital world. Digital literacy is relevant to employability in a competitive world, which in addition requires self-motivation for constant growth and a clear career strategy. Thus, NEETs could be at risk of further marginalization unless they make full use of the advantages that the new technology is offering.

Due to the importance of evaluating individual user needs so as to balance these with the wider context and ensure effective consideration during the

design and implementation of project objectives, a more detail analysis is presented in the following sections.

Chapter 5: TARGET GROUP NEEDS AND DEMANDS

Extent of the problem

Education

The following Figure explains in one glance the situation: few women select STEM education, fewer select a career in STEM and even fewer remain.

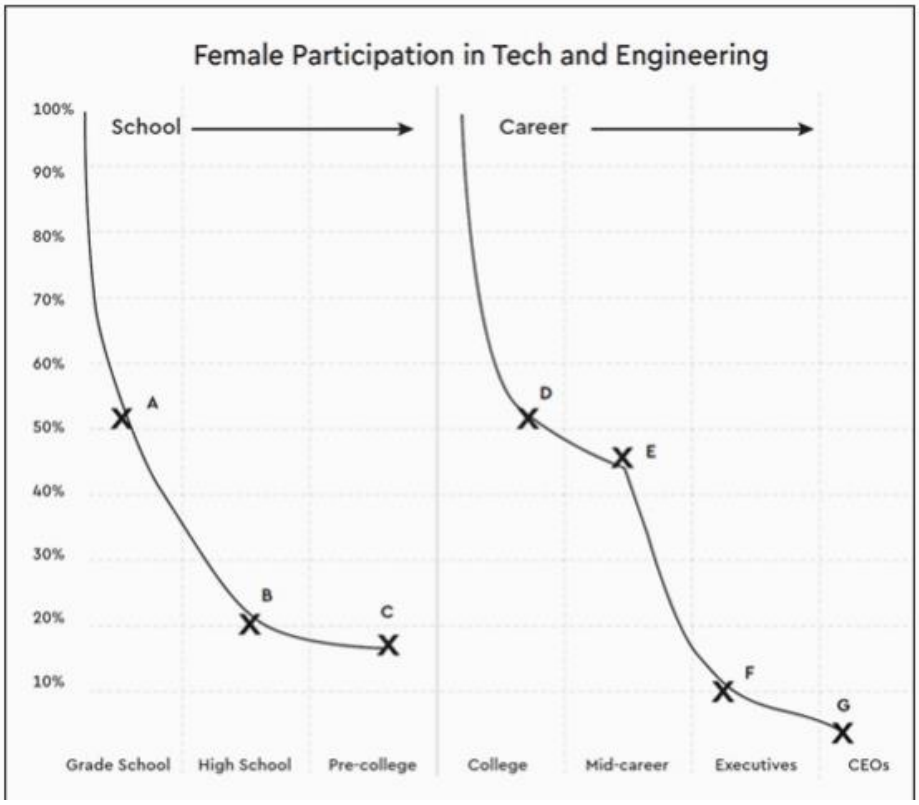


Figure 3: Declining points in women's participation

Source: https://www.oecd-forum.org/users/91062-tarah-wheeler/posts/31567-leaving-at-lightspeed-the-number-of-senior-women-in-tech-is-decreasing)

OECD PISA results suggest that the performance of boys and girls in science is overall equal. However, very few women select to follow a career in science. Some of the explanations put forward in the literature are: biological differences between men and women, girls' lack of academic preparation for a science major, girls' poor attitude toward science and lack of positive experiences with science in childhood, the absence of role models, science curricula which are irrelevant to many girls, and the pedagogy of science classes which seems to favor male students[2].

Except theories implying biological reasons that cannot be sustained, since observed differences in scientific or mathematical ability of women are too slight to explain women's under-representation in STEMs, and which imply that no action need be taken to improve the situation, the rest of the explanations show the direction that interventions should take in order to improve female participation: individual empowerment and customization of educational practices to be more inclusive of women. In Box 2, a simple intervention is presented which shows that even small details can make a palpable difference.

Box 4: Why should women want to work in Computer Science?

Due to the marketing strategies of the last three decades, many women have developed misconceptions about computer science. While the notion of the geek coder is alive and well, many young women may be unaware of the myriad jobs available and the opportunity to make a palpable difference.

The University of California at Berkeley experienced a revolution in their introductory computer science classes after changing how they marketed the course. What used to be known as Introduction to Symbolic Programming is now called The Beauty and the Joy of Computing. The result? For the first time in 2014, women in the class outnumbered men.

https://www.computerscience.org/resources/women-in-computer-science/

[2] Blickenstaff, J.C. 2005. Women and science careers: leaky pipeline or gender filter? Gender and Education Vol. 17, No. 4, October 2005, pp. 369–386.

Employment

Several studies point out the economic benefits of bringing more women into digital jobs could create. A 2013 European Commission study reported a €9 billion annual GDP boost in the EU[3]. The same report revealed an alarming drop in ICT female graduates since only 29 out of every 1000 female graduates have a computing or related degree, and only 4 go on to work in ICT directly, leaving thus an enormous potential unexploited. A more recent survey (2018[4]) shows a decrease in the number of ICT women graduates, 24 out of every 1000, of which only 6 pursue a relevant career. This study also claims that if more women were to enter the digital jobs market, it could create an annual EUR 16 billion GDP boost for the European economy.

According to a Eurostat report (2018) including data from 2016-2017 surveys, 8.2 million persons were ICT specialists (3.7 % of the total number of persons employed in EU). During the last decade, the number of ICT specialists increased by 33 % across the EU, compared with the 2 % growth for total employment and were largely unaffected by the financial and economic crisis. The large majority of ICT specialists were men (83 %), in contrast to the distribution for total employment, where the genders were more balanced (54 % men and 46 % women) and two thirds of ICT specialists were aged 35 years or over (64 %), with the highest shares found in Italy (76 %) and Finland (71 %). By contrast, the highest shares of younger ICT specialists aged 15 to 34 years were recorded in Malta (63 %), Latvia and Poland (both 54 %). The majority of ICT specialists (62 %) in the EU had completed a tertiary education level although this share varied from 33 % in Italy to 82 % in Ireland. Thus, in the IT industry, diversity is also an issue. Although ICT services provide relatively well-remunerated employment for women, the share of women in ICT specialist occupations remains very low. However, a distinction should be made between employment in the ICT sector and employment in ICT specialist

[3] Women Active in the ICT Sector, https://publications.europa.eu/en/publication-detail/-/publication/9153e169-bd6e-4cf4-8638-79e2e982b0a3/language-en.
[4] Women in Digital, https://ec.europa.eu/digital-single-market/en/women-ict.

occupations. ICT sector employment refers to jobs in enterprises whose main economic activity is to provide ICT services, while ICT specialists' occupations refer to specialized jobs that require skills in the production of ICT goods and services (UNCTAD and ILO, 2015).

The number of women choosing IT for a career has been stagnant over the last few years, around 16% in UK (Focus: Women in IT). A similar situation is evident in Europe (see Figure 4) and US (See Figure 5).

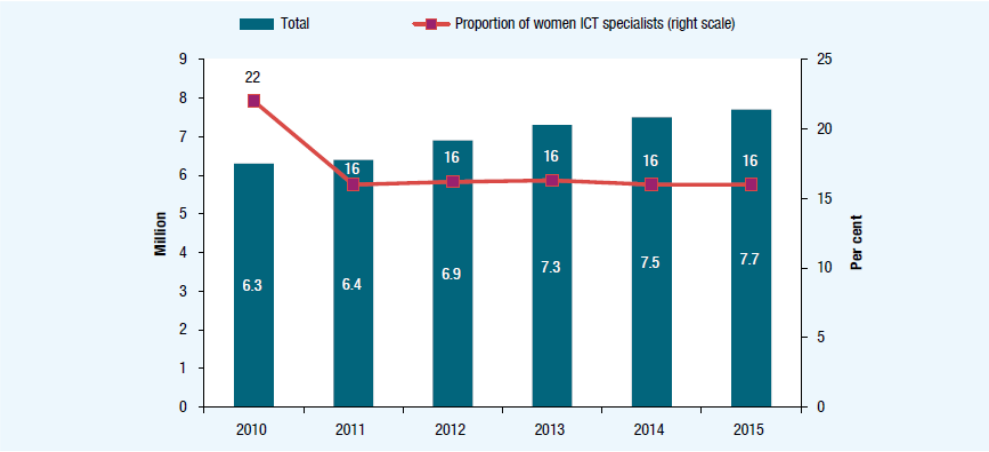


Figure 4: Percentages of women ICT specialists 2010–2015, (Source: UNCTAD/IER/2017/Corr.1, p.26).

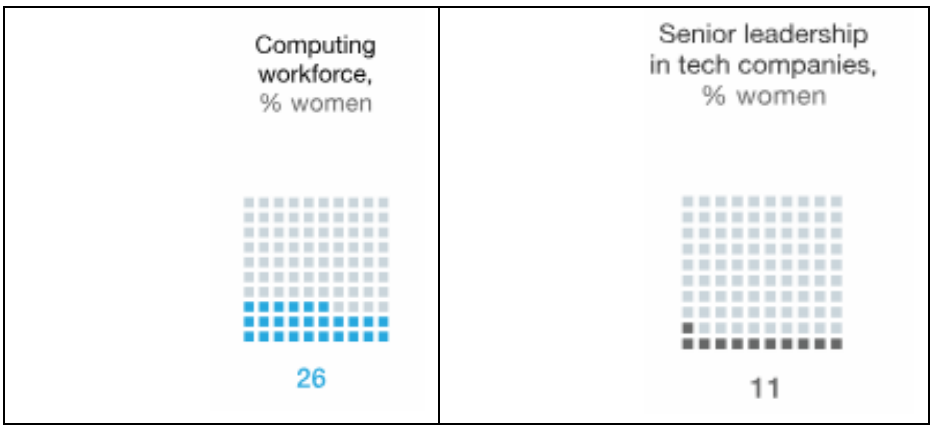


Figure 5: Figure 6: Percentage of women in IT sector and in leadership positions in tech companies, Source: McKinsey & Company. Rebooting representation: Using CSR and philanthropy to close the gender gap in tech)

The percentage of women in the total number of ICT specialists in the EU has remained very low, at around 16% since 2011. In the United States, women's share in computer-related occupations was also low, (26%), in 2015, compared with their share in total employment of 47%.

Regarding different subsections of the technology industry, and technology leadership, women in US seem also to occupy less high status managerial/leadership positions (11%). Tech Nation's research findings in UK (2018) show small differences affecting the gender split. *The gaming industry has a wider gap between male and female directors, with 13% women and 87% men, and similarly in Telecoms, more highly male dominated, with directors tending to be older than the average. Overall in the technology industry, Tech Nation found 23% of directors are women, and in the UK economy more broadly, 29% of women are directors of companies, as opposed to 71% men.* But, with 19% of technology workers made up of women in UK, technology leadership seems to be more gender balanced than general technology roles. Across all industries, women currently make up on average 33% of junior level staff, 24% of mid-level staff, 15% of senior level staff and 9% of CEOs (See Table below).

Table 1: Women's workforce participation, by industry, %, Source: Future of Jobs Survey in 15 countries, World Economic Forum.

			Senior roles		Mid-level roles		Junior roles		Line roles		Staff roles	
Industry group	CEOs	Board members	Current	2020	Current	2020	Current	2020	Current	2020	Current	2020
Industries Overall	**9%**	**28%**	**15%**	**25%**	**24%**	**33%**	**33%**	**36%**	**30%**	**34%**	**35%**	**39%**
Basic and Infrastructure	2	35	9	17	13	21	22	29	14	23	20	27
Consumer	10	21	16	24	26	33	33	37	31	34	37	41
Energy	0	32	11	20	19	27	24	27	19	25	22	30
Financial Services & Investors	9	19	20	30	33	40	43	43	35	39	42	43
Healthcare	6	–	15	28	31	44	39	46	44	49	41	48
Information and Communication Technology	5	19	11	20	21	29	32	34	23	32	33	38
Media, Entertainment and Information	13	22	25	33	25	32	35	36	38	43	47	46
Mobility	9	17	13	21	21	30	28	33	25	31	34	36
Professional Services	9	23	22	34	33	40	39	43	44	44	44	46

In general, women working in the ICT sector tend to be young, with a high educational level, earn higher salaries, occupy higher positions and work for larger companies in comparison to women working in non-ICT sector. However, in comparison to men working also in the ICT sector their educational level is lower than men's as well as their monthly earnings[5]. Men tend to occupy technical and professional positions, while women tend to occupy clerical, service or manual positions and women tend to leave the sector in mid-career more often than men. It is also reported that 25% of women find themselves working in same gender teams which could indicate in-group favoritism or, based on research which shows that women may not support each other's progress specifically in situations where they are outnumbered by men[6], it could be argued that positive attitudes towards hiring women on behalf of the firms was based on previous successful experience as gender-role congruity bias is reduced when information clearly indicate high competence[7].

Possible explanations of the observed differences in ICT sector between genders

While considerable effort has been devoted to reaching a gender balance in ICT professions, since working to close the diversity gap in the technology industry could also help to close the sector's skills gap by widening the pool of people available to fill these roles, the effect is not as expected. In the following sections, some possible explanations will be presented.

ICT sector characteristics

Although the ICT sector is associated with better economic conditions and greater flexibility, at the same time it contains high levels of stress and

[5] Women in Digital, https://ec.europa.eu/digital-single-market/en/women-ict.

[6] Ryan, K. M., King, E. B., Adis, C., Gulick, L. M. V., Peddie, C., & Hargraves, R. (2012). Exploring the asymmetrical effects of gender tokenism on supervisor-subordinate relationships. Journal of Applied Social Psychology, 42, 56–102. doi:10.1111/j.1559-1816.2012.01025

[7] *Koch AJ, D'Mello SD, Sackett PR. (2015)*A meta-analysis of gender stereotypes and bias in experimental simulations of employment decision making, *J Appl Psychol. 2015 Jan; 100(1)..*

presents major problems in balancing work and family life, since it requires long hours of work outside normal working hours as well as the need to constantly update relevant knowledge.

These characteristics could influence women's career choice and could partially explain why few women pursue a career in the ICT sector. In order to explain the mid-career drop-out phenomenon observed in women more often than men, the theory developed by Castano and Webster (2011) could be useful. They present a "life course" approach to the understanding of women's pathways through ICT studies and careers based on institutional, social, cultural and labor market contexts. Contrary to the "leaky pipeline" model, a progressively reduced "flow" of women through ICT education and employment which implies an orderly, linear progression through the stages of education, labour market entry and career development and does not allow for personal or social situations that could influence career formation and development, the life course approach advocates that life events (family relationships, educational choices and achievements, family formation, geographical mobility patterns, labour market participation patterns and decisions) separately and in combination influence women's ability to engage in the ICT field in certain critical points called transitions. These transitions are also influenced by social expectations as well as women's perceptions of their personal competences.

Challenges and facilitators

Computer programming emerged as a field in the 1940s, and women were in the forefront of this new technology. The first programmers to work on the US Army's enormous ENIAC computer to compute ballistic trajectories were all women. At the time, software was seen as less important than the male-dominated hardware field and was considered easy work, similar to typing, and so suitable for women. Today, however, things are very different: women make up less than a fifth of technical roles in the tech industry.

Cultural traditions and stereotypes are considered as having a great effect on women's participation in the ICT sector. In a 2016 survey among 1500 graduates in the US regarding career preferences[8], the following results were obtained (See Table below)

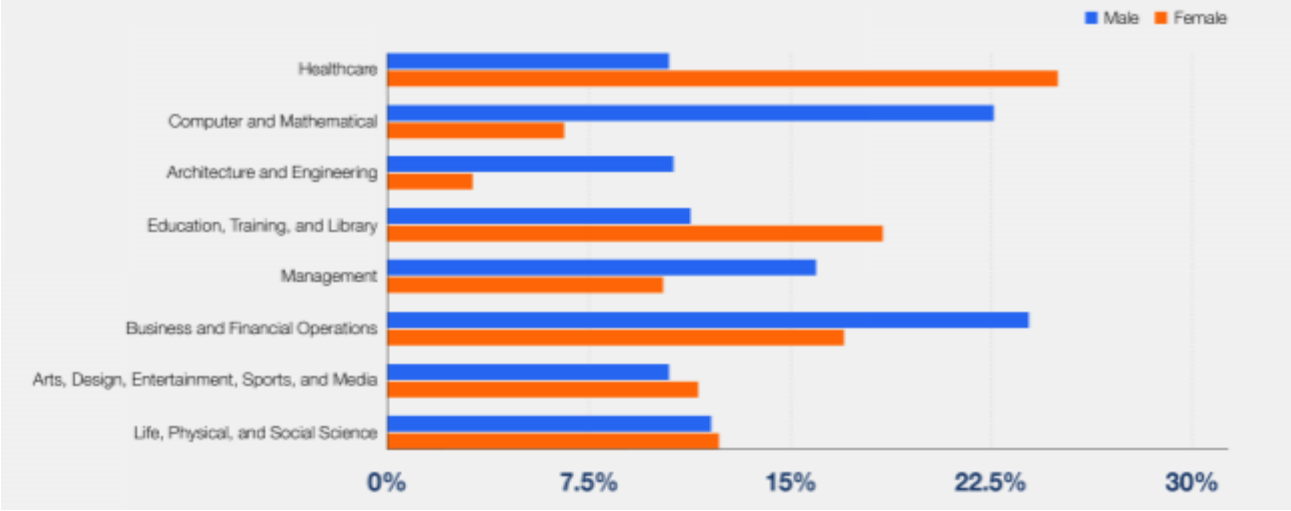


Figure 6: Gender gap in career choices, Source: Indeed 2016, n=1500, respondents could choose more than one choice

Thus, women seem to show much stronger interest in the traditional "caring professions" (1 out of 4 women in comparison to nearly 1 out of 10 men). Business and financial operations come first for men while computers and mathematics is the second most popular career choice for them, attracting 22% of respondents. However, only 6% of women report an interest in finding work in this field; their second most popular choice is education, training and library occupations.

Other barriers influencing women choice towards pursuing a career in the ICT sector, except stereotypes, include[9]:

[8] http://blog.indeed.com/2016/07/18/do-millennial-men-women-want-same-things-job/
[9] Women active in the ICT sector. European Union, 2013.

*"**Internal barriers, socio-psychological factors** pulling back women from the sector and its top positions: lack of self-confidence, lack of bargaining skills, risk-aversion and negative attitudes towards competition.*
***External barriers, ICT sector features** strengthening the gender gap: strongly male dominated environment, complex reconciliation between personal and professional life, and lack of role models in the sector".*

In the following Table the most important barriers to women's participation in the ICT sector are presented with proposed prevention and mitigation measures.

Table 3: Women's ICT sector participation barriers and measures, Source: Women in the Digital Age. European Union, (2018.)

		Barriers to women's participation in digital											
		Biases about what's appropriate for each gender	Biases about tech capabilities	Stereotypes about digital	Experience gap	Confidence gap	In-group thinking	Risk aversion	Weak professional networks	Biases about entrepreneurship capabilities	Household and family structures	Tokenism	Ambition gap
Prevention and mitigation measures	Role models												
	Training												
	Digital literacy & exposure to tech												
	Reformed ICT formal education												
	Mentoring												
	Transparency and inclusiveness												
	Networking												
	Access to funding												
	Flexibility & conciliation measures												
	Quotas & targets												
	Sponsorship												
	Long-life learning initiatives												
	Aware rising against unconscious biases												
	Increased women's confidence in tech and digital innovation												

Job motivators vs job de-motivators

STEM careers struggle to attract the interest of women. So, knowing what young women value when considering a career, could provide useful insight on how to persuade them pursue a career in ICT.

A survey by "Indeed" among 1500 US graduates (males and females)[10] revealed that the top 2 priorities are common for both genders: location, with 65% stating that their future job should be in the city or region that they prefer, and career advancement, with 46% of both men and women reporting that a job should offer them opportunities for climbing the corporate ladder.

However, the genders differ in other key areas. Women more strongly emphasize the desire for a supportive team environment (58.4% vs 39.5% of men) and flexible hours (45.6% vs 40.1% of men), while working for a company with a valuable brand is more important to men (20.6% vs 14.9% of women). Similarly, men place a stronger emphasis on finding opportunities to take on challenging work (24.2% vs 19.3% of women). At this early stage in their careers, little emphasis is placed by the respondents on having autonomy within their job (7% of men and 6% of women), (See Figure below).

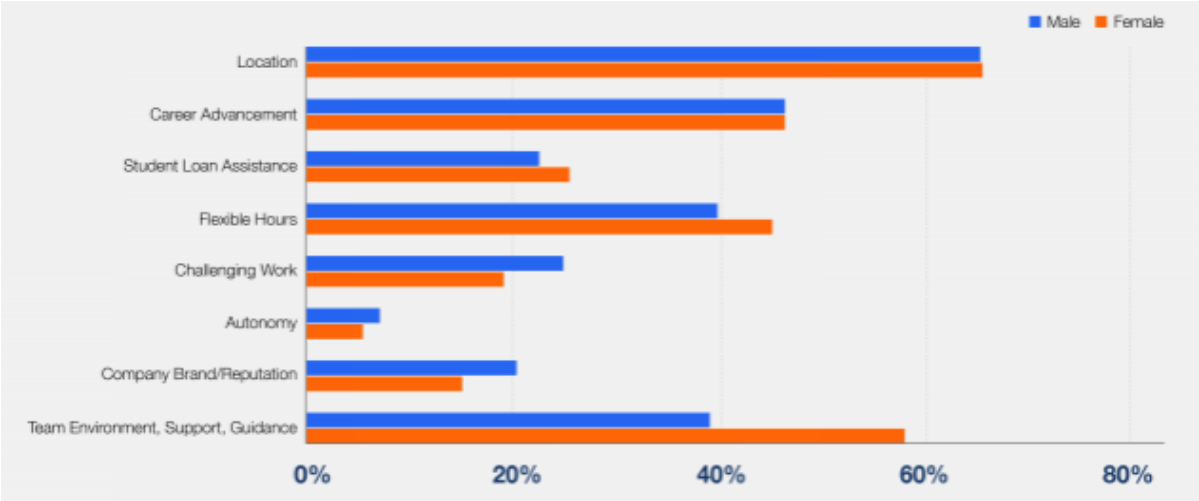


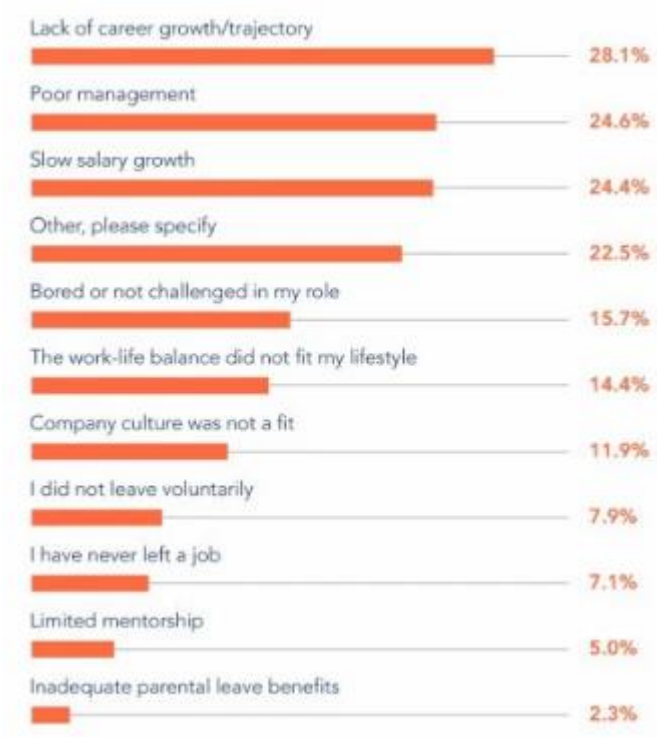
Figure 7: What Millennials want in a workplace

[10] http://blog.indeed.com/2016/07/18/do-millennial-men-women-want-same-things-job/

These results are coupled with another survey among 1,000 women in the field of tech on how tech companies might retain them[11]. According to their responses lack of career growth is the most common reason women leave tech jobs (28%). The second most-common reason for leaving was poor management (25%) and slow salary growth came in as the third most-common reason (24%) respondents left their last job. Twenty-four percent of younger women, aged 24-35, in comparison to older women, also stated that lack of diversity in the teams or management would is a reason to leave the job.

An interesting finding is that issues related to lifestyle, such as work-life balance (14%), culture fit (12%) and inadequate parental leave policies (2%) were less common reasons for leaving a job (See Table below).

Table 2: Why women leave tech jobs, Source: Indeed



[11] https://www.cio.com/article/3321897/careers-staffing/why-women-leave-tech.html

CHAPTER 6: Workplace Context

Gender roadblocks in the workplace

To introduce more women into the tech industry, one way is to tackle the "mind of the hiring manager". Due to unconscious bias, people often hire or promote people who look and think like them, which, in the tech industry, are predominantly men.

Due to unconscious bias, people often hire or promote people who look and think like them, which, in the tech industry, are predominantly men.

Theoretical background

According to the Gender Gap Report (World Economic Forum, 2016) it is estimated that more than 100 years are needed to close the gender economic gap. In the workplace, gender inequalities partly stem from the discrimination directed against women and several studies have documented discriminatory practices against women by decision makers including recommend a male candidate rather than a female one for a managerial position[12].

Research findings suggest that:

- men are preferred for male-dominated jobs (i.e., gender-role congruity bias),
- male evaluators exhibit greater gender-role congruity bias than do female evaluators for male-dominated jobs (in-group favouritism can explain the behavior exhibited by the later)
- gender-role congruity bias does not consistently decrease when decision makers are provided with additional information about those they are evaluating unless when information clearly indicates high competence of those being evaluated.
- gender-role congruity bias persist even when decisions do not require comparisons among candidates, but concern individual candidates,

[12] Verniers, C., & Vala, J. (2018). Justifying gender discrimination in the workplace: The mediating role of motherhood myths. *PloS one*, *13*(1), e0190657. doi:10.1371/journal.pone.0190657

- decision makers who were motivated to make careful decisions tend to exhibit less gender-role congruity bias for male-dominated jobs,
- experienced professionals showed smaller gender-role congruity bias for male-dominated jobs than did less experienced ones.

Thus, it is expected for ICT job positions that require technical skills, which are considered as fundamentally masculine skills, discriminatory practices will be accentuated. In addition, since the percentage of women in decision making roles is low and career growth in the tech sector is discouraged, the chances of women to be evaluated by the same gender is small.

The current state of IT diversity and inclusion initiatives

Diversity and inclusion are defined as "the variety of diverse people and ideas within a company, and the creation of an environment in which people feel involved, respected, valued, connected, and able to bring their "authentic" selves (e.g., their ideas, backgrounds, values, and perspectives) to the team and to the business"[13] .

Findings from surveys in European[14] and American organizations[15] reveal that organizations lack key infrastructure to support diverse employees. In Europe only 35% of organizations provide training on embracing differences in the workplace and even fewer offer training on embedding inclusive behaviors into everyday job responsibilities (23%), while according to the response of Chief Information Officers in US only 36% said that their organizations aimed to recruit and hire diverse employees, 22% said that they focus on training and development, 15% said that there are programs that can help keep talented underrepresented employees on board for the long term, while the 44% said that they have no specific initiatives in place to recruit, develop, or retain a diverse workforce. Instead they focus on attracting talent (See Figures below).

[13] Bersin by Deloitte (https://www2.deloitte.com/content/dam/Deloitte/ca/Documents/human-capital/ca-en-human-capital-diversity-and-Inclusion-in-canada.pdf)
[14] Diversity & Inclusion Benchmarking Survey European Data Sheet, (2017), PWC.
[15] Repairing the pipeline: Perspectives on diversity and inclusion in IT, (2018) Deloitte

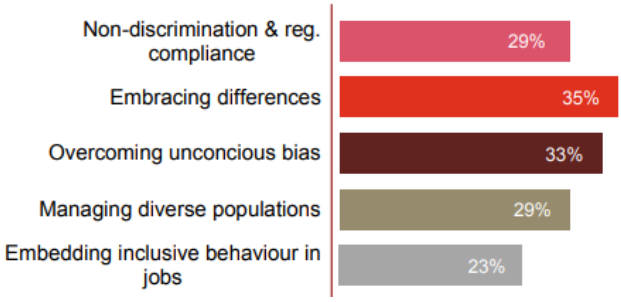


Figure 8: European organizations training programs

Figure 9: Diversity initiatives for the IT workforce, US

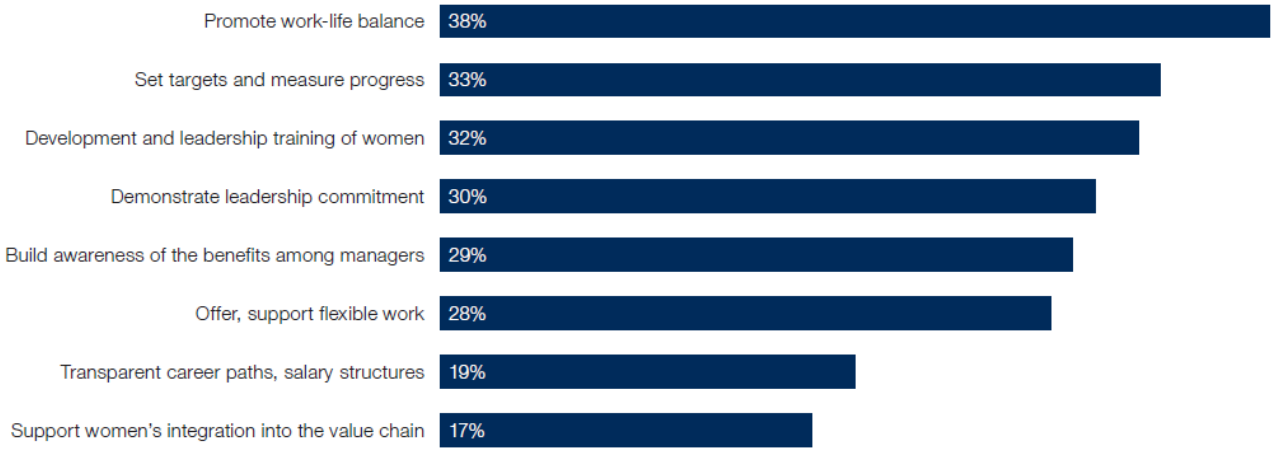
Among the approaches proposed to enhance diversity in work areas are (Women in ICT, 2012):

- Recruitment - positive discrimination techniques to narrow the gap between the discrepant shares of men and women in the ICT sector,
- Career Development - to counterbalance the male-dominated networks and environment which implicitly or explicitly exclude women, mentoring programs and/or leadership and managerial skills development programs can be designed targeting female employees,
- Support in balancing life, family care and work.

It is interesting to note that in the Industry Gender Gap report (2016) by World Economic Forum based on an survey of executives from 371 leading global employers, the results revealed that diversity measures focus primarily on progressing women through the pipeline to avoid losing already developed or developing talent and very few respondents reported strong increases in hiring women into junior and entry level roles. Thus, their main emphasis seems to be the retaining of the talent on which they have invested, not recruiting more women.

In the same report, the integration strategies respondents stated they pursue regarding women's workforce, include (See Table below):

Table 1: Integration strategies pursued by survey sample



These strategies aiming to promote gender parity, do not work as a checklist of actions. Rather they are seen as a holistic set of priorities starting at the top, requiring long-term commitments, and a deep understanding of the corporate, industry, and cultural context, as well as the organizational culture and local policy environment, characteristics that enrich the previous taxonomy.

Digital Workplace

ICT effect on productivity

ICT is a key driver of productivity and growth at economy, industry and firm level: firms with high levels of ICT are more likely to grow, in terms of employment, and less likely to go out of business. ICT, being a general-purpose technology, is diffused throughout the economy and its impact is pervasive as they are used in virtually every sector (See Figure below).

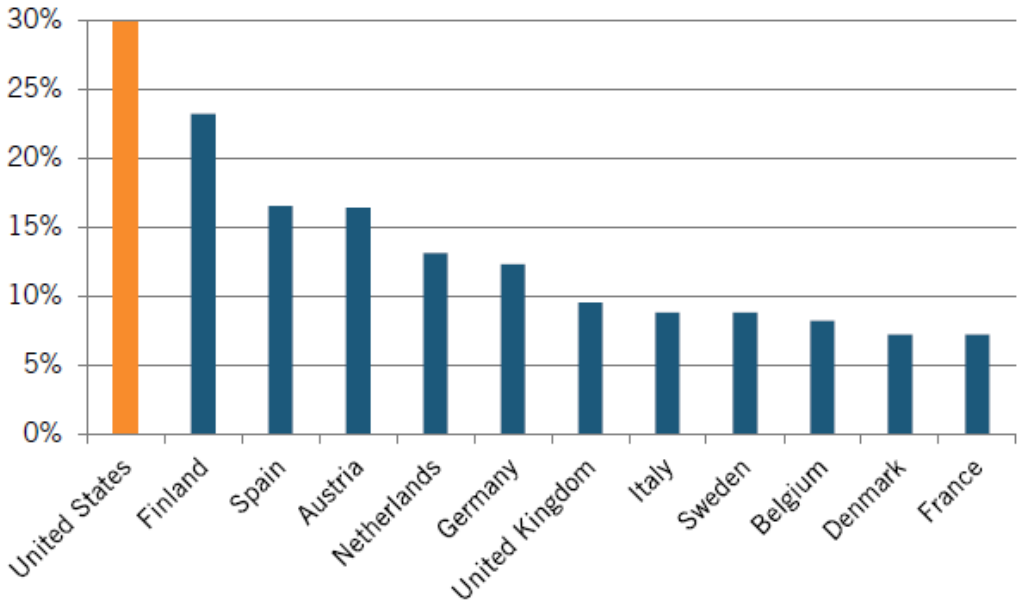


Figure 10:Share of productivity growth from ICT, Source: EU KLEMS, "Growth and Productivity Accounts: Statistical Module, ESA 2010 and ISIC Rev. 4Industry Classification," (2017), http://www.euklems.net.

ICT is constantly evolving. Innovative technologies such as cloud computing, IOT, and AI are expected to drive future productivity. Although software has generally remained stable, a significant rise is observed in ICT services, such as data storage, information-processing services, computer systems design, internet publishing, etc.

However, to raise the productivity significantly it is necessary to fully embrace the use of ICT. Initiatives such as the Digital Agenda and Digital Single Market strategy (DSM) are trying to channel the efforts towards that direction. DSM, issued in 2015, is the new flagship initiative in terms of digital policies in Europe. DSM makes a distinction between real and digital spaces and aims to remove the fragmentation and barriers that exist in Digital stemming from poor, inadequate and outdated regulations in contrast to the physical Single Market. The aim is to increase access to digital goods and services for consumers and businesses across EU, create the right conditions for digital networks and services to flourish (e.g. ending roaming charges, foster cross-border content within online platforms) and provide legislation that is at pace with the new technological wave.

ICT ADOPTION

The large gains from ICT are to be realized not from the production of ICT (ICT output), due to the strong competitive position and economies of scale achieved by U.S. and Asian companies and particularly China, but from the adoption of ICT (ICT use), (See Figure below). Along the same lines, European Commission[16] states that 75% of the value added by the Digital Economy comes from traditional industries, rather than ICT producers, mainly because ICT-using sectors constitute a much larger part of developed-country economies than ICT-producing sectors, so they have a much larger effect on the whole economy.

Thus, even countries with no ICT production can benefit by embracing the digital economy, since it has been calculated that even current levels of ICT intensity can contribute to the long run growth of labour productivity about 0.5-1.1% per year[17, 18].

ICT use and ICT output effects on GDP

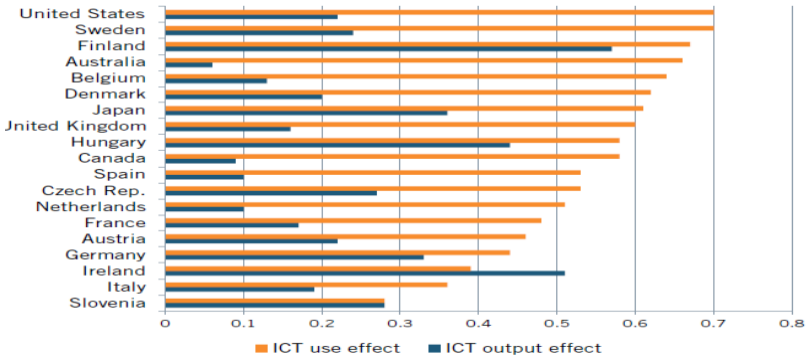


Figure 11: ICT use and ICT output effects on GDP, Source: Oulton. N. 2012, "Long Term Implications of the ICT Revolution: Applying the Lessons of Growth Theory and Growth Accounting" Economic Modelling 29, no. 5.

[16] European Commission, *A Digital Single Market Strategy for Europe.*

[17] Bryne, D and Corrado, C. (2017), "ICT Prices and ICT Services: What Do They Tell Us About Productivity and Technology?," (Finance and Economics Discussion Series 2017-015, Federal Reserve, Washington, https://www.federalreserve.gov/econresdata/feds/2017/files/2017015pap.pdf.

[18] Oulton. N. 2012, "Long Term Implications of the ICT Revolution: Applying the Lessons of Growth Theory and Growth Accounting" Economic Modelling 29, no. 5.

Two are the major streams of research for firms' adoption of ICT: one examines the link between human capital and adoption, and the other the link between the business environment and adoption. In this study, we concentrate mostly on the former[19].

Evidence suggests that in order for firms to get the full productivity gains from ICT, business processes should be redesigned around the use of the new technologies. In a recent OECD study[20], it is reported that **lack of ICT skills, poor matching of workers to jobs and low managerial quality** limit digital technology adoption and therefore the rate of diffusion.

In the following Figure below regarding the diffusion of ICT technologies across EU countries and industries is presented for firms with more than 10 employees, (OECD, Andrews et al, 2018).

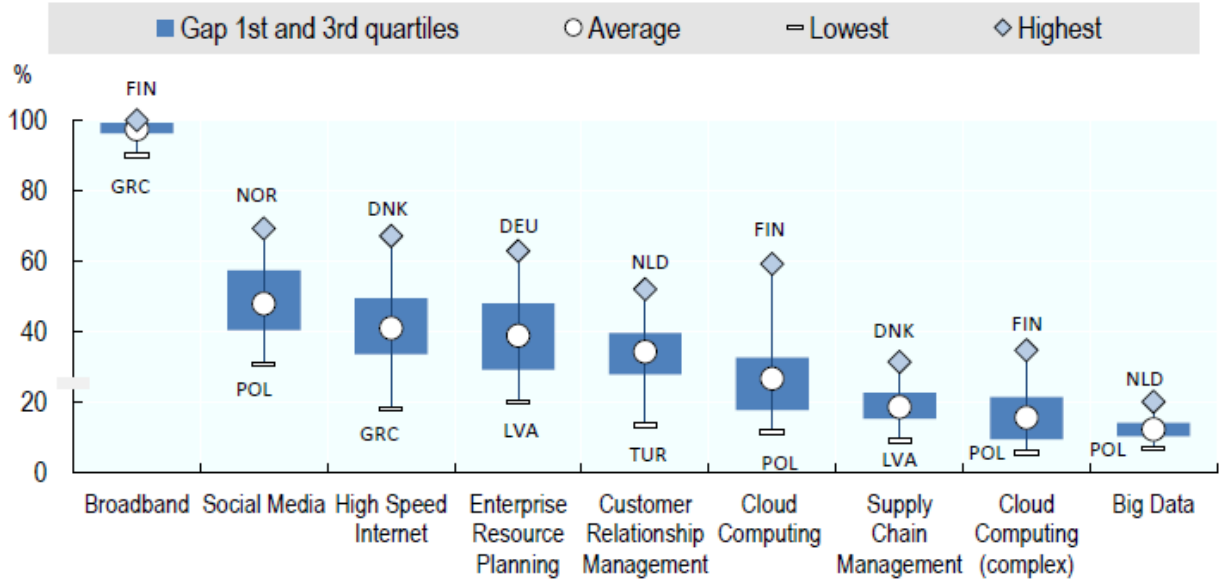


Figure 12: The diffusion of digital technologies across EU countries, Source: Andrews et al, 2018.

[19] **During WOMEN4IT data collection phase, in order to make useful comparisons and create typologies that will facilitate interpretation of findings, certain aspects of the link between business environment and adoption is, to a certain point, also investigated.**

[20] Andrews, D, Nicoletti, G and Timiliotis, C. (2018). "Digital Technology Diffusion: a Matter of Capabilities, Incentives or Both?" (Working paper, OECD Economics Department, Paris.

Across EU countries, it seems that the percentage of broadband diffusion is quite high among all EU countries, social media, high speed internet and ERP, average rates, are somewhere in the middle, while CRM and cloud computing are around 20-40%. Supply chain management, complex cloud computing and big data are below 20%.

Similar results have been obtained from the European Digital skills survey in 2017[21] reporting that *the vast majority of European workplaces uses desktop computers (93%), broadband technology to access the internet (94%), portable computers (75%) and other portable devices (63%). Much smaller proportions of workplaces use an intranet platform (22%), CNC machine or tools (8%) or programmable robots (5%).*

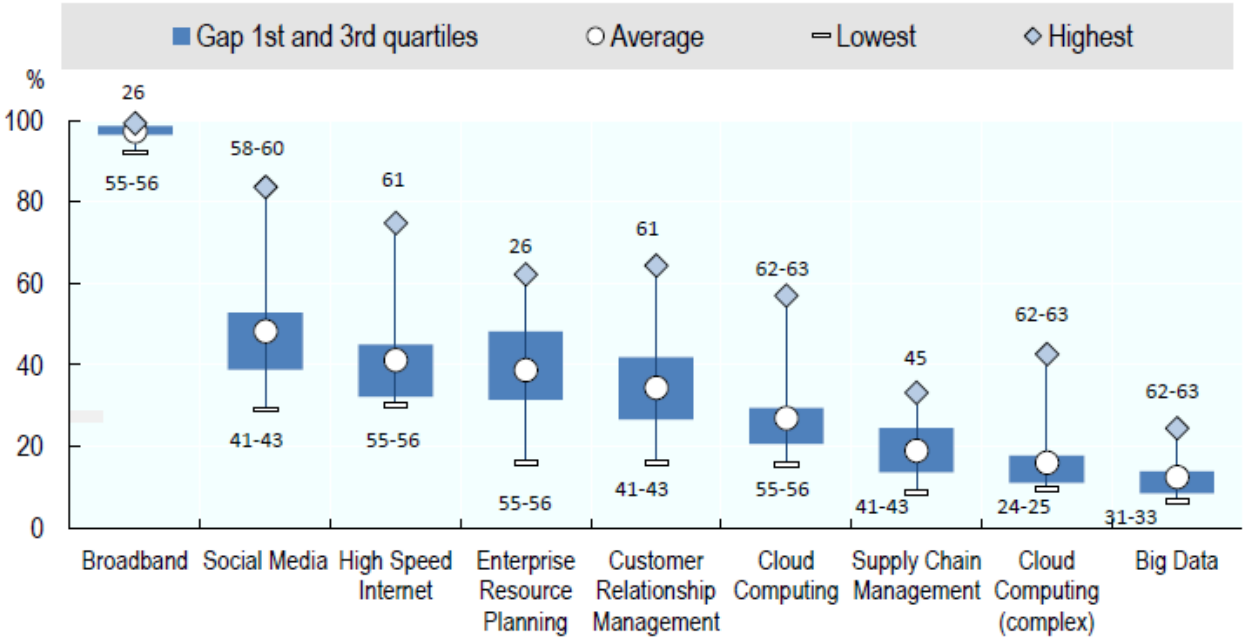


Figure 13:Diffusion across industries, Source: Andrews et al, 2018

[21] ICT for work: Digital skills in the workplace, 2017.

In Figure 29 above, NACE codes are used as following: *24-25 corresponds to Manufacture of basic metals & fabricated metal products excluding machines & equipment; sector 26 to Manufacture of computer, electronic and optical products; sector 31-33 to Manufacture of furniture and other manufacturing; repair and installation of machinery and equipment; sector 41-43 to Construction services; sector 55-56 to Accommodation and Food and beverage service activities; sector 58-60 to Publishing activities; motion picture, video & television, programme production, sound recording & music publishing; programming & broadcasting; sector 61 to Telecommunications; and sector 62-63 to Computer programming, consultancy and related activities, information service activities. programme production, sound recording & music publishing; programming & broadcasting; sector 61 to Telecommunications; and sector 62-63 to Computer programming, consultancy and related activities, information service activities (Andrews at al, 2018).*

It seems that industry sectors results follow closely countries results: all industries are quite high in the adoption of broadband, with "Manufacture of computer", as expected, at the top, social media and high speed internet, average rates, in the middle, while ERP, CRM and cloud computing around 20-40%, and supply chain management, complex cloud computing and big data are below 20%. Thus, it is indicated that the use and type of digital technologies is uneven across economic sectors with only few sectors achieving high adoption rates in specific technologies that are more closely related to their activities.

How ICT adoption is proceeding

When ICT is introduced in a company, 3 are the key areas that are being affected: **customer experience, operational processes and business models[22].**

[22] DIGITAL TRANSFORMATION: A ROADMAP, (2011), MIT Center for Digital Business and Capgemini Consulting

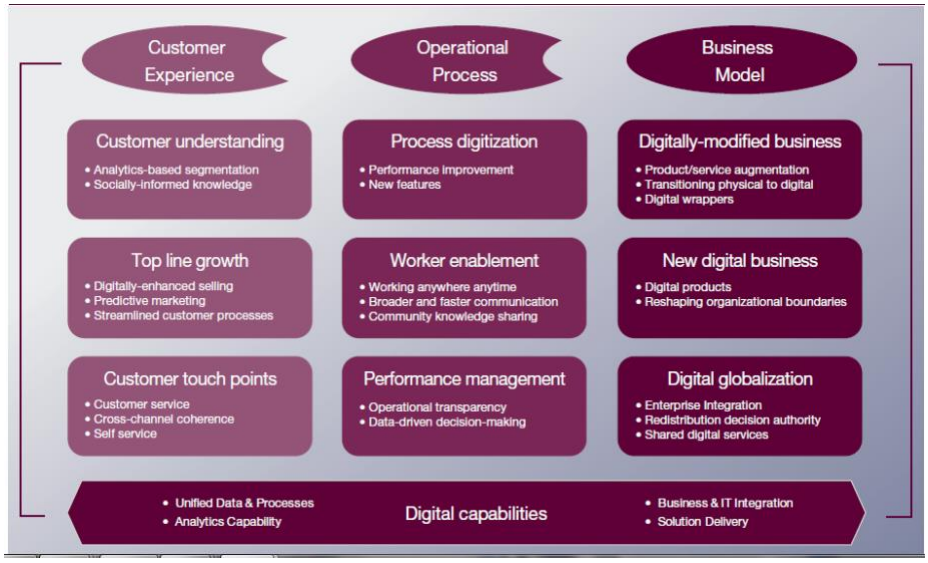


Figure 14:Focus of digital transformation in companies, Source: DIGITAL TRANSFORMATION: A ROADMAP, 2011

Transforming customer experience

To gain a better understanding of their customers firms are explore social media, promoting e their brands more effectively, creating online communities to advise and build loyalty, and/or building analytics capability to understand their customers in more detail. Some firms are moving beyond simple multi-channel models to enable new forms of digital strategy such as B2B, or B2B offerings or through providing customer apps.

Process digitization

Companies use automation to make processes more efficient and scalable. For example, ERP can enable significant efficiency and quality gains in core transactional, financial, and supply chain processes. Other firms are going beyond simple automation and refocus on people and on more strategic tasks.

Transforming business models

Firms are building digital or service wrappers around traditional products. Thus, firms introduce digital products that complement traditional products. But, cutting across all three key areas are the digital capabilities, since these are the fundamental building block for transformation in customer experience, operational processes, and business models through unification of data and processes.

Barriers in the adoption of ICT by companies

Although the full impact of the NDE on jobs, international competition, and the location of production is unknown, outcomes will crucially depend on the pace of change and the ability of organizations to understand it and manage it[23]. The integration of digital technology by businesses is the weakest element (2015 EC). In addition, because the use of digital technologies takes time before it becomes mainstream, the speed of adoption is critical to make up for lag time.

Currently, there seems to be a distinct trend in ICT adoption based on **firm size**. In the European Digital Skills Survey (2017) large companies have not only reported the highest percentage of ICT use, but also a significant increase during the last five years in all the digital technologies listed in the survey, while SMEs reported no increase or a limited increase in the use of ICT. The current use of digital technologies has been supported by specific investment strategies and the aim was to improve overall efficiency and increase the business volume. This was made possible because larger firms face fewer resource constraints and can more easily enjoy scale benefits of IT. For example, 34% of Italian firms and 33% of German firms with between 10 and 49 employees had adopted ERP systems, while 79% and 85%, respectively, of firms with over 250 workers had adopted ERP[24].

[23] NDE
[24] IFIT

So, it could be a matter of resources, since acquiring and utilizing ICT technologies requires resources that SMEs companies cannot afford: f*or micro and small-sized workplaces, it may not be viable to invest to increase ICT use. Also, for those micro and small-sized employers who have a high demand for digital skills, simply allocating staff time to acquire them is both difficult (loss of productive time), and expensive (training and development programmes need to be brought in). This is less an issue for bigger employers with more available resources who can manage capacity, develop training programmes or buy them in*[25].

This could also explain the low percentage of ICT specialists employed in SMEs[26]: 10%- 23%, compared to 46%-87% of large companies[27] to support the effective use of ICT in the processes and electronic transactions of businesses. But, it could also be **a matter of attitude**, since evidence show that micro and small-sized companies are not persuaded about the importance and usefulness of ICT[28]. A study by the Federation of Small Businesses (FSB) in UK found that 25% of small firms don't think digital skills are important for their growth. Exactly the same percentage (25%) was reported by the Federal Ministry for Economic Affairs and Energy in Germany[29].

Also, more than a quarter of small business owners are not confident in their own basic digital skills, and 46% of small to medium-sized businesses (SMEs) say their staff lack knowledge, facts that makes digital transformation seem daunting.

[25] European Digital Skills Survey (2017)
[26] **A word of caution: because of the high degree of diversity observed between EU countries, reporting averages does not always convey a true picture. So, when possible and meaningful low and high values will be presented.**
[27] https://ec.europa.eu/eurostat/cache/infographs/ict/bloc-1c.html
[28] European Digital Skills Survey (2017)
[29] Federal Ministry for Economic Affairs and Energy, Monitoring Report DIGITAL Economy, 2016.

Management attitudes towards ICT adoption

Information and Communication Technologies play a crucial role in the way businesses function and since the future of the work is digital, enterprises must adapt quickly to the new reality and rebuild technology, processes, and culture around it. The transformative change ICT can bring to organizations can also have a positive effect in Europe's lagging productivity in comparison to the US. Among the four primary reasons for Europe's failure to invest in and gain from ICT is management styles[30.] Studies show that to get the full potential, management techniques that can facilitate such transformation are necessary. In addition, there is contradicting evidence whether it is preferable to move from small enterprises to large or vice versa. There are studies claiming that the high percentage of small firms in Europe, holds back productivity as most small businesses are not innovative and have lower rates of ICT investment and productivity. Other studies report that the future lies in small business (The future of Work, ILO), as there is no need to operate on a large scale, as before, to obtain optimum profitability. These suggest the development of production chains or horizontal networks. However, all indicate that a change in mentality is necessary.

In small firms, the management style, i.e. leadership style, organizational structure and style of decision making is determined, to a great effect, by the manager-owner who controls business actions and is responsible for defining ICT goals, identifying critical ICT business needs and allocates financial resources to facilitate ICT adoption. As shown in the following Figure, owner-manager characteristics are among the key ICT adoption attributes in SMEs.

[30] Atkinson, R.D. (2018). How ICT Can Restore Lagging European Productivity Growth, ITIF. (The other 3 reasons are: regulation within product, labor, and land markets, EU consumption taxes on ICT products, and inability of the European businesses to reach larger markets for economies of scale).

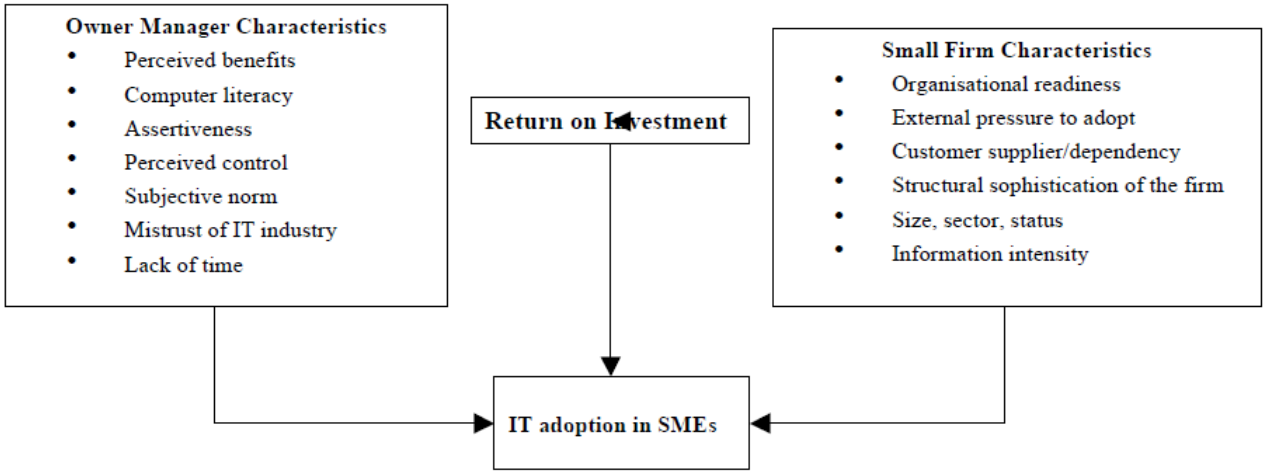


Figure 15:Factors affecting ICT adoption by SMEs, Source: Mpofu, Milne and Watkins-Mathys

Perceived benefits of ICT adoption include improving business efficiency, operational effectiveness and the need to reach out for new markets and opportunities. Because ICT adoption in SMEs requires additional costs for implementation, training, etc., convincing the SMEs owner-managers about the long-term benefits is a step that needs to be taken. Therefore, policies that simply focus on "raising awareness" are not enough if they are not coupled with more concrete evidence of actual productivity gains. Another factor mentioned in the literature is perceived ease of use, which combined with perceived usefulness (benefits) constitute the Technology Acceptance Model particularly in information systems (Davis, 1989).

Other manager's personal characteristics that influence firm's organisational readiness for ICT adoption and development of e-business include:

- entrepreneurial mind-set, risk-taking, and innovation abilities (Beckinsale and Ram, 2006),
- technical and vocational qualifications,
- ICT literacy, skills and expertise,
- attitude toward change.

Top management support of ICT adoption, by targeting possible organizational changes, is expected to positively influence other firm's members about the importance of new information technologies adoption (Low et al. 2011).

Closely related to firms' management, the human capital encompassed in the workforce is also found to be significant for ICT adoption by SMEs. High percentages of ICT experts among firms' staff or employees with specialized ICT skills increases the probability of any form of ICT adoption[31], but also the general level of ICT competence within a firm is driven by the digital environment workers are exposed to, including provision of specific ICT training. Thus, to promote the ICT gains, impetus from both poles, management and employees with technological competencies, is necessary.

Factors affecting the rate of ICT diffusion

ICT skills

Technical progress has shifts demand towards more highly skilled workers relative to the less skilled to the effect that we are talking about Skill-Biased Technical Change (SBTC). Europe appears to lag behind other international players such as the US in ICT skills while large regional discrepancies and divergences are evident. Although digital skills are required in many jobs and have become transversal skills, the percentage of adults lacking basic computer skills is high in many EU countries such as Belgium, Finland, Greece, Poland, Italy, Spain, and France, when studies show that increasing the provision of ICT training to low-skilled employees can boost the adoption rates of e.g. cloud computing and digital front-office technologies, such as customer relationship management, by around 7%[32]. Some EU countries, such as the Nordic nations, are ahead of the international competition, but others such as the southern EU countries lag significantly behind the EU leaders. *For example, use of Customer Relationship Management Software (CRM) and e-commerce differs by more than a factor of six between the nation with the highest rate of*

[31] Giotopoulos, I., Kontolaimou, A. Korra, E., and Tsakanikas, A. (2017).What drives ICT adoption by SMEs? Evidence from a large-scale survey in Greece. Journal of Business Research.

[32] Ibid

adoption as share of enterprises (Ireland) and the lowest (Greece), and a factor of five for ICT specialists as a share of total employment. The difference is even higher (eight times) for cloud computing between the leading nation (Finland) and the laggard (Bulgaria). When looking at the adoption rate of ecommerce orders by enterprises, this varies from 33 percent in Norway to just 8 percent in Romania. In 2016, more than 40 percent of enterprises in Finland, Sweden, and Demark used cloud computing, compared with fewer than 10 percent in Greece, Latvia, Poland, Romania, and Bulgaria.[33]

A categorization of digital skills and competencies needed for the future are shown in Table below:

Table 2:Identification of skills and competencies by different organizations, Source: ITU, 2018, ILO-ITU Digital Skills for Decent Jobs for Youth Campaign to train 5 million youth with job-ready digital skills; OECD, 2016, Skills for a digital world, Policy Brief on the Future of Work; World Economic Forum, 2016, The Future of Jobs: Employment, Skills and Workforce Strategy for the Fourth Industrial Revolution (Geneva), in E/CN.16/2018/3).

Job-ready digital skills for decent jobs (International Labour Organization and International Telecommunication Union (ITU))	Advanced digital skills (coding and other algorithmic knowledge) Basic digital skills (related to the use of technologies) Soft skills (such as communication and leadership) Digital entrepreneurship (online market research and using financial platforms)
Work-related skills (World Economic Forum)	Abilities (cognitive and physical) Basic skills (content and processing skills) Cross-functional skills (social systems, complex problem solving, resource management and technical skills)
Future of work (OECD)	Technical and professional skills (specific and often industry-specific skills such as installation and operation of robots) Generic ICT skills (skills needed to understand, use and adopt technologies; life-learning ability to adapt to technology changes) Complementary ICT soft skills (creativity, communication skills, critical and logical thinking, teamwork, digital entrepreneurship)

In addition to hard skills and formal qualifications, employers are concerned about how job-related skills or competencies that existing employees (or prospective new employees) possess can be used to carry out different jobs. Focusing on a core set of 35 skills and functional abilities that are widely used

[33] Atkinson, R.D. 2018. How ICT Can Restore Lagging European Productivity Growth, ITIF.

in all industry sectors and working families, the Future of Jobs report considers that these practical skills will also be subject to rapid changes and significant disruption In the near future. According to findings presented in it, by 2020 more than a third of the core skill sets required in most professions will be skills that are not yet considered important. At the industry level, the highest level of skill stability between the years 20150 – 2020 is expected in the media, entertainment and media sector, due to already occurred changes, see Table below.

Table 3: Skills stability in different industries, *Source: Future of Jobs survey, WEF*

Industry group	Unstable	Stable
Industries Overall	**35%**	**65%**
Media, Entertainment and Information	27%	73%
Consumer	30%	71%
Healthcare	29%	71%
Energy	30%	70%
Professional Services	33%	67%
Information and Communication Technology	35%	65%
Mobility	39%	61%
Basic and Infrastructure	42%	58%
Financial Services & Investors	43%	57%

Expected changes in skills include the increase in importance for skills such as complex problem solving, but only in industries not affected by automation, such as in the Professional Services and Information and Communication industry, and the decrease in requirements for physical abilities such as physical strength or dexterity.

Social skills such as persuasion and emotional intelligence will be in higher demand across industries than narrow technical skills, such as programming or equipment operation and control. Content skills (which include ICT literacy and active learning), cognitive abilities (such as creativity and mathematical reasoning) and process skills (such as active listening and critical thinking) will be a growing part of the core skills requirements for many industries.

Another survey by Oxford Economics[34], among 352 human resources professionals around the world, identified four broad areas where skills are expected to be in greatest demand due to the rapid digital transformation companies are undergoing, (Figure below)

[34] https://www.oxfordeconomics.com/Media/Default/Thought%20Leadership/global-talent-2021.pdf

Digital skills				
Digital business skills	Ability to work virtually	Understanding of corporate IT software and systems	Digital design skills	Ability to use social media and "Web 2.0"
50.6%	44.9%	40.1%	35.2%	29.3%

Agile thinking skills				
Ability to consider and prepare for multiple scenarios	Innovation	Dealing with complexity and ambiguity	Managing paradoxes, balancing opposing views	Ability to see the "big picture"
54.8%	46.0%	42.9%	40.9%	15.3%

Interpersonal and communication skills				
Co-creativity and brainstorming	Relationship building (with customers)	Teaming (including virtual teaming)	Collaboration	Oral and written communication
48.3%	47.4%	44.9%	30.4%	29.0%

Global operating skills				
Ability to manage diverse employees	Understanding international markets	Ability to work in multiple overseas locations	Foreign language skills	Cultural sensitivity
49.1%	45.7%	37.5%	36.1%	31.5%

Figure 16: Skills in high demand over the next five to 10 years, Source: Oxford Economics

All skills categories seem to include "champions" with percentages ranging from 48.3-54.8. However, in all categories, with the exception of one, skills have been assigned with more than 30%, implying that a variety of IT and soft skills are expected to be in demand for the near future.

The invention of new products or services that the new technology enables, requires also new organizational forms and changes in employee roles in comparison to traditional roles where the production process was fixed and included limited discretion, suggesting that cognitive and soft skills are also important.

However, recent OECD analysis (Grundke et al, 2017) shows that gender differences in soft skills, such as self-organisation, management and communication skills, are very small (Figure 5). By contrast, women lag behind men when it comes to quantitative and mathematics-related skills.

Matching workers - jobs

Complementarity between skills and job requirements is necessary to promote ICT diffusion. Thus, although ICT skills and the level possessed by employees are important for facilitating the adoption of digital technologies, the way these are matched to jobs within the firm is also essential.

Skills policies used to concentrate on the supply side, i.e. the skills workers possess. Lately however, the growing awareness on "how" skills are used in the workplace have led to the realization that the desired productivity gains can only be achieved if supply is accompanied by simultaneous actions to boost the demand for and effective use of skills.

Box 5: Skills use and mismatch: Do employers adapt job requirements to the worker's skills?

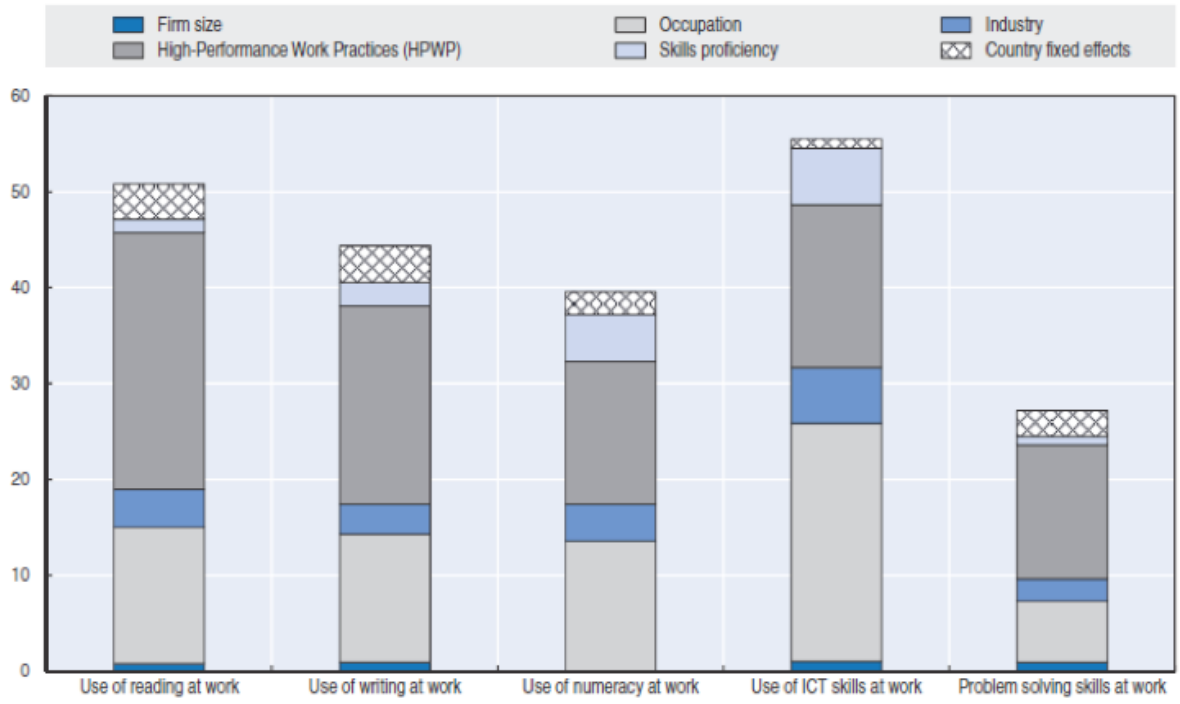
Skills mismatch – the discrepancy between the skills possessed by workers and those required by their jobs – is rarely measured at the moment of hiring, rather, it reflects the comparison of skills possessed and required for existing employees, some of whom will have a fairly long tenure with their employer. As a result, measured mismatch accounts for any adjustments to job content made by employers to ensure a better match between workers and jobs. This applies both to mismatch in information-processing skills and mismatch in qualifications.

Evidence of this adjustment can be found by looking at skills use for mismatched individuals. Data presented suggest that over-qualified workers use their information-processing skills more at work than well-matched workers in similar jobs, controlling for skills proficiency. In other words,

workers in jobs for which a lower qualification is required are still able to use some of their excess competences compared to their less qualified counterparts in a similar job. However, the adjustment of job content to their qualifications is not full as over-qualified workers still suffer a "skills use penalty" compared with their counterparts with similar qualifications holding jobs for which they are well matched. A similar, but opposite, reasoning can be applied to the under-qualified: when holding jobs requiring higher qualifications, workers use their skills less than better qualified counterparts in a similar job – i.e. the job requirements are "downgraded" to adapt to the skills of the job holder – but more than if they were holding a job that was well-matched to their qualification.
(Source: OECD, Employment Outlook, 2016, p.72)

The most important predictors of skills use at work seems to be occupations as these explain 25% of the variance in ICT skills use at work, around 14% of the variance in reading, writing and numeracy skills and 6% of the variance in problem-solving skills use at work, see Figure below.

Figure 17: Skills and use at work variance



These results could be interpreted in terms of job skill requirements. However, studies show that even in similar occupations, jobs can vary due to different firm organization and work practices. Thus, organisation of work and firm dynamics should be analyzed in order to better understand skills use. Among other factors that also contribute to skill use except occupations, qualifications level (Box 5) and firm organization are (Quintini, 2014): gender, age, and firm size.

- Women are less likely to use information-processing skills at work than men, even after controlling for job characteristics and skills proficiency,
- Young people as well as older workers make the least use of information-processing skills at work,
- Writing, reading and problem-solving skills are used more frequently by workers in larger firms, while numeracy skills are used more often by workers in small firms and larger firms in comparison to those in mid-size firms.

Automation and ICT skills shortages

Technological advancements influence current and future digital skill requirements. It is indicated that 85–90% of future jobs will require ICT skills by 2020[35]. However, 56% of the people in OECD countries have no ICT skills and more than 30% has an extremely low capacity to use digital technologies productively. In Europe, two fifths of the EU workforce have little or no digital skills MORE.

Evidence gathered through the European Digital Skills Survey (2017) among a representative sample of 7,800 workplaces in six EU member states (Germany, Finland, United Kingdom, Portugal, Sweden and Slovakia) indicated that in some job categories more than 90% of jobs require specific types of digital skills. In all workplaces managers, professionals, technicians, clerical workers or skilled agricultural workers are required to possess at least basic digital skills.

More specifically, it is reported that **basic digital skills** are required for sales workers (80% of workplace), building workers (almost 50%), plant machine operators (34% of workplaces) and even employees in elementary occupations (27% of workplaces). Advanced digital skills are required by professionals (54% of workplaces), technicians (52%) clerical workers (45%), managers and building workers (31%).

*Skills gaps related to **basic digital skills** are more concentrated among technicians (22%), elementary occupations (21%), sales workers (20%) and clerical workers (17%). Skill gaps related to **advance digital skills** are more concentrated among sales workers (18%), technicians (17%), plant machine operators (17%), clerical workers (16%) and elementary occupations (15%). Skills gaps related to **specialist digital skills** are more concentrated among sales workers (23%), followed by elementary occupations (18%) and*

[35] https://ec.europa.eu/jrc/en/news/job-market-fails-unleash-ict-potential-9692

technicians (16%). Overall, 15% of workplaces report the existence of digital skill gaps in their workforce.

The supply of digital skills is not always sufficient to meet employers' needs, even when basic digital skills are concerned. In addition, the speed at which workers are being provided with the right digital skills is, in most cases, slower than the speed at which digital technologies are evolving. Thus, *skills mismatches emerge also not only between the supply and demand of existing skills today, but also between today's skills base and future skills requirements. As it is mentioned in weforum[36], efforts aimed at closing the skills gap will increasingly need to be grounded in a solid understanding of a country's or industry's skills base today and of changing future skills requirements due to disruptive change. For example, efforts to place unemployed youth in apprenticeships in certain job categories through targeted skills training may be self-defeating if skills requirements in that job category are likely to be drastically different in just a few years' time. Indeed, in some cases such efforts may be more successful if they disregard current labour market demands and past trends and instead base their models on future expectations.*

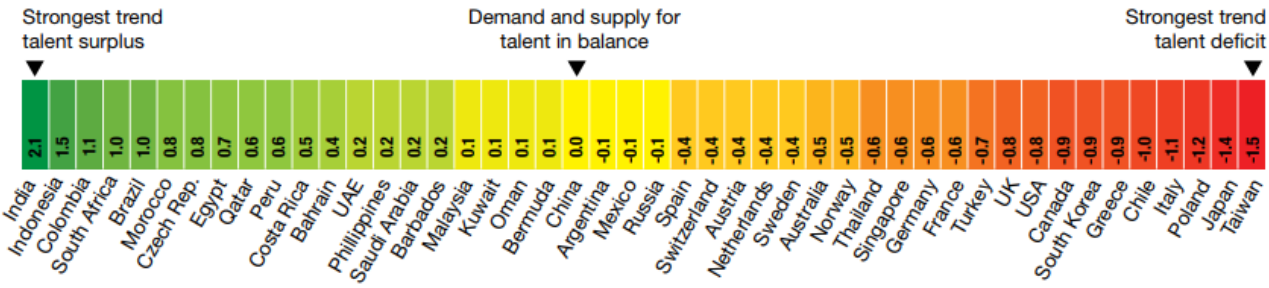
Skills mismatch and shortages have significant economic costs:

a) for individuals, skills mismatch has a negative impact on job satisfaction and wages,
b) for firms, it reduces productivity, increases the cost of hiring and hinders the adoption of new technologies, (OECD 2017).

In Figure below a heat map of expected mismatch between supply and demand for talent in 2021 in selected countries is presented (Oxford Economics)[37].

[36] http://reports.weforum.org/future-of-jobs-2016/skills-stability/?doing_wp_cron=1543073727.8550479412078857421875
[37] https://www.oxfordeconomics.com/Media/Default/Thought%20Leadership/global-talent-2021.pdf

Figure 18: Supply – demand mismatch, *Source: Oxford Economics. Numbers report the average annual % change of the deficit/surplus.*



However, there are studies which report that the European shortage of trained candidates for digital jobs in 2020 will not be as large as previously forecast. It is expected that the number of unfilled digital jobs in Europe will reach 756,000 by 2020, compared to the 820,000 forecasts. This is largely attributed to the initiatives led by EU.

In manpower Report (2018) it was reported that more employers than ever are struggling to fill open jobs. Forty-five percent say they can't find the skills they need, and for large organizations (250+ employees) it's even higher, with 67% reporting talent shortages in 2018. Top 10 jobs that employers have difficulty filling are:

Rank	Roles
1	Skilled Trade
2	Sales representatives
3	Engineers
4	Drivers
5	Technicians
6	IT
7	Accounting and Finance
8	Professionals

9	Office support
10	Manufacturing

Thus, bringing skill mismatch to minimum level can increase digital adoption rate avoiding wasting talents and allocate workers to the jobs they are best suited for, especially as firms draw from a scarce and fixed pool of skilled labour.

Organizational parameters - Managerial quality

Among the significant predictors of businesses' adoption performance is managerial quality which encompasses organization structure and leadership, as leaders should recreate the way their organizations operate since ICTs alters work and work system and lead digital transformation. Actually, changing and flexible work is seen as the most significant driver of change in advanced economies, (Future of Jobs, 2016). Work is defined as the application of human, informational, physical, and other resources to produce products or services.

The new information and communication technologies are not only supporting people to do things better and faster, but it is enabling new ways of control, coordination, and collaboration and at lower costs. Especially through ubiquitous computing, the physical space is unified with the electronic space creating an optimized space that links people, computers, networks, and objects, disrupting the way work is performed, blurring boundaries between companies, employees, competitors, providers, etc.

Changes on Jobs

Digitalization is creating new occupations in new industries, but it also leads to job losses. However, it is not the first time that technology has displaced humans: e.g. the number of typists has fallen dramatically during the previous decades, but new jobs have been created, such as computer programmers and web designers so that the total number of jobs has never declined over time

(Aeppel 2015). Currently we experience a paradox: high unemployment rates and skills shortages. Although it is generally agreed that the digital revolution creates a great divide between skilled workers and the rest, hollowing out the middle class, it is not clear whether this can be attributed entirely to the effects of technology or to macroeconomic effects. It has been estimated that 9% of jobs today are at high risk of automation, i.e. over 70% of tasks in those jobs could be automated, and that an additional 25% of jobs could change significantly as about 50%-70% of their associated tasks could be automated (OECD, 2016c). However, it is expected that as workers adjust their skills and entrepreneurs create opportunities based on the new technologies, the number of jobs will rebound.

Regarding how these changes will affect women, it is not clear. In Figure below industries with the greatest risk of automation are presented showing a rather balanced picture for men and women since automation seems to affect, for example, industries such as manufacturing that men dominate as well as retail trade that women dominate.

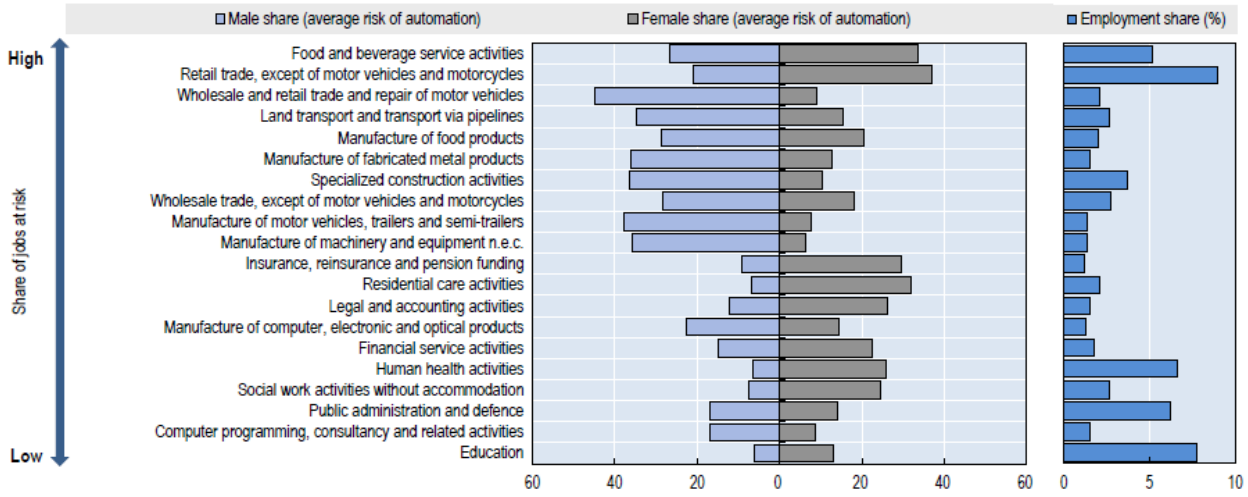


Figure 19: Industries average risk of automation. Source: OECD Secretariat calculations based on the Survey of Adult Skills (PIAAC, 2012, 2015) and Arntz et al., 2016.

Another major issue is job polarization, i.e. the hollowing out of middle-skilled jobs that could be digitalized or off-shored. High-skill and low-skill occupations is expected to continue to grow, but middle-skill occupations seems to shrink due to automation and the substitution of routine and repetitive tasks, a characteristic of many medium-skilled cognitive and production activities, by machines. On the other hand, technologies have raised relative demand for high skill level tasks, such as lawyers, but also for manual tasks such as security personnel.

Changes in the way people work

IT generally changes the way that people work, as work may be restructured to allocate routine, well-defined symbol processing subtasks to computers, while separating out subtasks requiring human skills and affects the content of jobs. For example, centralized databases enable individual workers to have the necessary information to complete an entire process that was historically fragmented, which shifts workers from a role of functional specialist to process generalist. In manufacturing, the use of flexible machinery and computerized process controls is often coupled with greater worker discretion, which in turn requires data analysis skills and general problem-solving ability.

But people differ in their abilities, and their willingness, to add new tasks in their job description and use new skills, occupy more demanding job roles or work in teams. As presented in the earlier sections of this report, the enactment of skill is correlated to the motivation of the worker/employee to use the specific skill which is influenced by work practices adopted by the organization.

According to the self-determination theory (Ryan and Deci, 2002) self-motivation and well-being will be enhanced when innate needs for autonomy, competence, and relatedness are satisfied. Evidence show that High-Performance Work Practices (HPWP), meaning the way work is organised and

jobs are designed as well as the management practices adopted by the firms, are key determinants of how skills are used.
HPWPs operate by:

(a) increasing employees' knowledge, skills, and abilities through training,
(b) empowering employees to act, allowing for employee participation in decision making, favouring more decentralized structures, providing them with the opportunity to perform the tasks and autonomy to exercise initiative, and
(c) motivating them to increase job satisfaction through mentoring, improving the social structure within the organization, which facilitates communication and cooperation among employees.

Delery & Shaw, 2001 and Evans & Davis, 2005 studies shows that organizational structures such as self-managed teams and flexible job designs link people who do not typically interact with each other, which facilitates information sharing and resource exchange increase job satisfaction, help employees work more productively and make better decisions. These in turn reduce employee turnover and improve organizational performance towards competitors.

In addition, incentive systems that employers can put in place to make better use of the skills of their workforce such as bonus payments, training opportunities and flexible working hours, are shown to positively influence skills use over and above the influence of innate and external motivation mechanisms.

Another phenomenon, which is not recent, but it is increasing, is the on-line work using digitally mediated platforms (e.g. uber) and which accounts for almost one third of the jobs in the OECD countries. It is used mostly to supplement income from other paid work and balance family responsibilities, and as such it is preferred by a considerable number of women. Online job platforms have an international reach and can provide opportunities for

women to work and exit from the shadow and grey economy in countries where cultural barriers or rules make it difficult for them to work in the formal economy. However, the way technology-induced flexibility will influence gender gaps, remains to be seen.

In general, ICTs could allow for new performance appraisal systems and more flexible organizational routines, if properly capitalizing on their potential efficiencies. Considering that among the basics contributing to employee satisfaction and consequently retention for millennials[38] are competitive salary and benefits, flexible schedule options, the ability to work from home when necessary, workplace environment promoting learning and career progression, ICT can have a positive effect.

Especially for women, more flexibility in work can increase their employment and reduce pay gaps when associated with autonomy to waive off problems in separating work and personal life. Information technology occupations appear to be moving in the direction not only of more flexibility, but also of greater linearity of earnings with respect to time worked, greater gender equality in earnings and thus, have the potential of becoming a more female-welcoming profession (Goldin, 2014).

However, digitization and the trend for greater flexibility in working time and location can have a negative impact on the work-life balance through the **"breakdown of boundaries"** causing stress and giving rise to health and safety issues. Other challenges include decreased protection and higher risks related to working remotely, as well as lower remuneration (DigiSkillsabout). The new phenomenon described as the **"digital wild west"** by the trade unions, refers to the global market completion for lower wages especially among workers from countries where no employment standards exist with workers from developed countries where standards exist as well as the possibility to create a **"digital underclass"** (future of work, ILO).

[38] https://www.thebalancecareers.com

Changes on Roles and Tasks

The use of ICT tends to increase the speed, flexibility and independency of work as ICT tools enable time-consuming work processes to be done more quickly and enable employees to carry out more work tasks on their own and work more independently. The decentralization of decision making and the greater delegation of authority to individuals and teams possessing greater levels of skills and qualifications, is bringing about structural changes in the roles employees are occupying so that information systems seems to both enrich and routinize jobs. For example, functions previously executed only by the IT staff have started to be shared by other firm members utilizing the power that ICT is providing.

The role of top executives is also expected to evolve in reaction to the growing digitization of business. Suggestions include the active involvement of chief executives not only on corporate data, but also on customer experience, digital strategy and social media. The new roles most frequently discussed are those of Chief Digital Officer and Chief Customer Officer sharing roles and responsibilities with corporate executives from the previous generation, such as the Chief marketing Officer.

Such approaches are effected due to the realization that digital transformation changes occur not from installing new tools, but from changing the mindset and behavior of the organization. Thus, larger companies could test internal innovation labs or cross-function teams that evaluate options and drive cultural change and smaller companies could consider using their technology partners in order to build a team with the right skill set as the goal is to eliminate the noise around technology and organize priorities including tools and skills to remain competitive in the digital economy.

As far as tasks are concerned, ICTs increasingly take over routine analytical tasks, but also decision making tasks requiring data analysis which can be supported by computers. The use of ICT has also increased the speed, flexibility

and independency of work as well as the differentiation of competence levels among the employees within the same job profile.

But there is another dimension, more organizational regarding tasks that is emerging as a result of digitization and work changes. In their book "Reengineering the Corporation", Hammer and Champy defined business processes as an entire group of activities that when effectively brought together, create a result customers value. Focusing on processes rather than on individual tasks they claim that companies can achieve desired outcomes more efficiently.

However, many IT organizations take the opposite approach and are task-focused, not just in applications and infrastructure but in networks, storage, and administration. Thus, IT talent with highly specialized skillsets may work almost exclusively within a single functional area. In many IT organizations, workers are organized in siloes by function or skillset. For example, network engineering is distinct from QA, which is different from system administration. In this all-too-familiar construct, each skill group contributes its own expertise to different project phases. This can result in projects becoming rigidly sequential and trapped in one speed (slow). It also encourages "over the wall" engineering, a situation in which team members work locally on immediate tasks without knowing about downstream tasks, teams, or the ultimate objectives of the initiative.

Transforming this model begins by breaking down skillset silos and reorganizing IT workers into multi-skill, results-oriented teams. These teams focus not on a specific development step—say, early-stage design or requirements—but more holistically on delivering desired outcomes.

Education vs training

ICT and changes in workplace organization affect the demand for human capital investments such as training and the screening of new workers by education.

Table 4: Categories of ICT Professions and Occupations.

MAJOR GROUPS	MAJOR/SUB-MAJOR OCCUPATIONAL GROUPS	MINOR GROUPS	EDUCATION REQUIREMENT	ICT SKILLS REQUIREMENT
Professionals	ICT professionals	Software and applications developers and analysts	Tertiary level	High level
		Database and network professionals	Tertiary level	High level
Technicians and associate professionals	ICT technicians	ICT operations and user support technicians	Tertiary level not required	Intermediate level
		Telecommunication and broadcasting technicians	Tertiary level not required	Intermediate level
Managers	Managers: Production and specialized service managers	ICT managers	Tertiary level required	Not defined

Source: ISCO-08. ILO, International Standard Classification of Occupations: Structure, group definitions and correspondence tables. ISCO-08. Vol. I. Geneva; available at: www.ilo.org/wcmsp5/groups/public/---dgreports/---dcomm/---publ/documents/publication/wcms_172572.pdf.

"Life-long learning" and the trend for multi-skilled labor with general competencies has become a central element in a high-skills, high-wage jobs strategy. This means that the barriers to access at all levels of education and training should be removed. In addition, due to the rapid changes in skills demand and the inability of formal education to keep up with that pace has led to alternative training methods and programs. This in turn has affected the demand for formal education qualification, as certain skills cannot be acquired in the classroom, see Table above.

CHAPTER 7: Training for Digital Skills

Digital transformation is changing labor markets and the nature of jobs in ways that require more regular updating and improved worker skill sets. By allowing smoother transfers of individuals between professions and sectors, or between self-employment and paid employment, adult education may be a key policy tool to help people reap the benefits of digital transformation and reduce social costs.

The UK Digital Strategy, published in March 2017, outlines UK government plans to address the digital divide, supporting public and private sector organizations and charities to provide digital skills training. The UK government is already working with industry and the voluntary sector, to increase the digital capacity of those digitally excluded, as well as those who are online but lack the trust and knowledge to make the most of them. For example, more than £ 9.5 million has been spent to support nearly 800,000 people to access basic digital skills through future digital participation programs and expand digital participation; £ 2.5 million will be invested to support more than 150,000 additional people.

The analysis conducted by the Organization for Economic Co-operation and Development (OECD) confirms the importance of education and manpower skills in reducing the risks of the Fourth Industrial Revolution. In the age of intensive automation and the increasing use of artificial intelligence, it is important to provide skills training (whether on a work or semester basis) and access to lifelong learning programs so that workers' skills remain relevant in the rapidly evolving labor market. Individual training accounts (or lifelong learning accounts) can assist workers in managing labor market turmoil. The main principle of these accounts is that workers use the funding available at any stage of their career to invest in training - either to help them with career advancement or to adapt to a new job as a result of automation.

In Singapore, which has developed a program to provide individuals with access to funding for lifelong learning and training (see Box 6).

Similarly, Spain recently developed a digital skills training plan. This is the first aid (60 million euros in the period 2018-1919) to acquire and improve professional skills related to technological changes and digital transformation. The plan is primarily aimed at people who work but are open to the unemployed.

Box 6: Individual Training Accounts in Singapore

In Singapore, the Skills Future Program provides Singaporeans with opportunities to develop their fullest potential throughout life, regardless of their starting points. Skills Future targets skills training to early and mid-career professionals, recognizing that technology and globalization are changing the nature of jobs at a rapid pace. As part of the program, all Singaporeans aged 25 and above receive an opening credit of SD$ 500 to use towards lifelong learning and training. The program also offers guidance on industry-relevant training programs that focus on emerging skills such as: (i) data analytics, (ii) finance, (iii) tech-enabled services, (iv) digital media, (v) cyber security, (vi) entrepreneurship, (vii) advanced manufacturing, and (viii) urban solutions.

Source: OECD - 2018 - Preparing for the future of work

Another interesting outcome of this research by the Organization for Economic Co-operation and Development (OECD) highlighted the importance of better involvement of employers in skills development programs to ensure that training programs are well aligned with the skills needed by the local labor market. Many countries are currently promoting apprenticeships, which combine on-the-job and out-of-work training to facilitate the transition from school to work. However, many OECD employers continue to complain that these types of jobs are still vacant. VET institutions, sectoral councils, human

resources consulting firms and other business associations are important intermediaries at the local level and often have specialized expertise to help companies think long term in their training activities.

However, the OECD latest analysis shows, on average, across countries that only about 25% of workers receiving training in 2012 or 2015 are classified as actually weak skills, most likely to be trained are those who They already enjoy high ingenuity in arithmetic and reading, when observed characteristics are fixed. Moreover, workers performing jobs of a largely routine nature (who are also at high risk of losing their jobs, as routine tasks are easier to operate) have a lower likelihood of being trained. Finally, men receive more regular training hours than women who perform similar jobs. Re-thinking and better targeting the beneficiaries of existing training programs may help the most vulnerable and give them opportunities to adapt their skills effectively during their working lives to fully utilize the digital age.

The figure below reports the relationship between training, the cognitive skills and the routine intensity of tasks that workers perform on the job. The bars represent the hypothetical percentage change in the probability of receiving training (“Probability”) and the duration of this training (“Duration”) a worker would experience, were they to increase the routine content of their job or their cognitive skills by one standard deviation, every other observable characteristics held constant.13 The height of the bar differentiates what the change would be for an individual working in less digital intensive industries (blue bars) as compared to more digital intensive ones (sum of the blue and black bars).

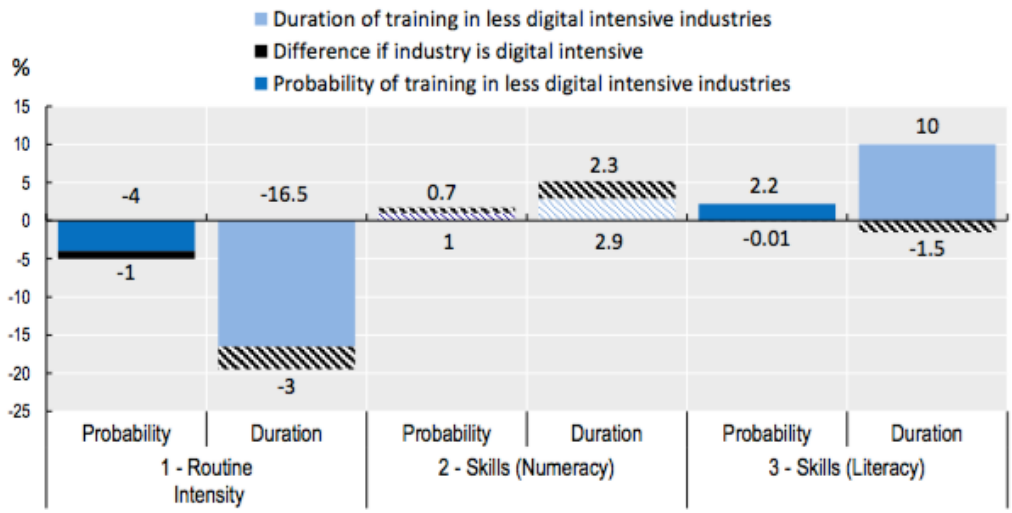


Figure 20: How is training associated with skills and routine task intensity? Digital intensive vs less digital intensive industries, Source: OECD calculations based on PIAAC data, November 2017.

In the digital age, the role of gender in the training environment becomes an important factor. Women and men vary in pace and duration of training. On average, across the 31 OECD countries, the proportion of women participating in training is higher than that of men who participate in training, but this difference is not statistically significant or reversible when training is "only" or "mostly during working hours" or when workers engage only in on-the-job training. Similarly, women in the PIAAC report share longer hours of training (as a proportion of total hours worked) than men, but this difference is five times lower when training is "only" or "mostly during working hours." These differences are linked, among other factors, to the proportion of women and men employed in industries and professions that are more intensive in training, or to the different tendency of men and women to work for some time. The figure below shows selected results from an analysis examining whether the likelihood and duration of training are related to the gender of the worker.

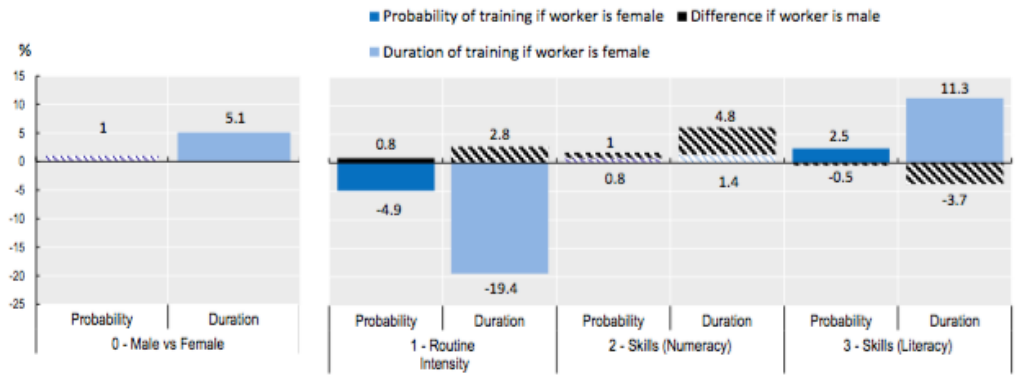


Figure 21: How is training associated with skills and routine task intensity? Men and women. Source: OECD calculations based on PIAAC data, November 2017.

CHAPTER 8: Digital skills mapping and assessment – A review

The European Commission considers the development of digital competence a strategic action to spread the more active digital participation of citizens. Hence, “the enhancing digital literacy, skills and inclusion” is one of the seven pillars of the Digital Agenda for Europe (DAE) in the Europe 2020 Strategy.

To help more people acquire a set of basic skills needed for a European Digital Single Market, the European Commission is reviewing the basic skills framework in 2017, and digital skills are part of the eight core skills, while the "Agenda" of New Skills for Europe "was adopted by the European Commission in 2016, redefines digital skills as equals to reading and arithmetic skills and, therefore, as a path to employability and prosperity. The European Commission showed that "women represent 60% of new graduates, but their employment rate is still lower than that of men and women, and men tend to work in different sectors. Inclusive labor markets should be based on the skills and talents of everyone, including low-skilled groups and other vulnerable groups. "In 2013, the European Commission reported that the equal participation of women in the ICT sector, as a quick achievement to address the growing skills and employment gap in Europe, would contribute each year to the European economy with an amount of € 9 billion.

The Skills Agenda for Europe makes practical recommendations to introduce new training paths for adults (especially those with low qualifications), promote digital skills and improve cooperation between the social partners within each economic sector to address skill shortages.

Box 7: Strengthening the foundation: Basic Skills

To improve the employment opportunities of low-skilled adults in Europe, Member States should put in place pathways for upskilling via a Skills Guarantee established in co-operation with social partners and education and training providers, as well as local, regional and national authorities. Upskilling should be open to people both in-work and out of work. Low-skilled adults should be helped to improve their literacy, numeracy and digital skills and – where possible – develop a wider set of skills leading to an upper secondary education qualification or equivalent.

The Commission proposes that a Skills Guarantee be established (see ref. doc COM(2016) 382) to provide:

- ✓ a skills assessment, enabling low-qualified adults to identify their existing skills and their upskilling needs;
- ✓ a learning offer, responding to the specific needs of individuals and of local labour markets;
- ✓ opportunities to have their skills validated and recognized.

Source: A NEW SKILLS AGENDA FOR EUROPE Working together to strengthen human capital, employability and competitiveness COM/2016/0381 final

The labour market is increasingly affected by the use of digital technologies. Digital skills form part of the "ICE Triangle"by promoting innovation, competitiveness and employability.

Types	Purpose
ICT generic skills	To perform everyday work, such as work with word processors and access websites.
ICT specialist skills	To program, develop applications, and manage networks
ICT complementary skills	To perform multiple and aggregated tasks, such as processing complex information, communicate with others, solve problems, and manage a team.

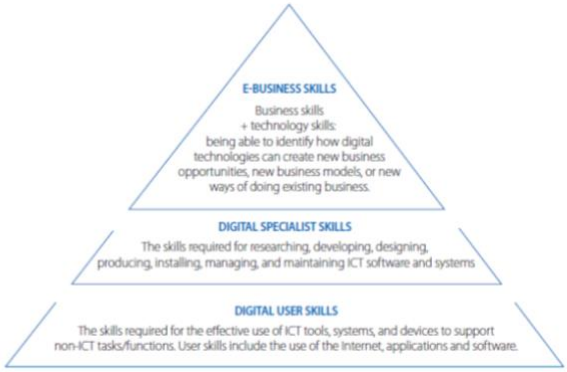


Figure 21: Frameworks for ICT Skills, *Source: (World Bank), Preparing ICT Skills for Digital Economy - 2018*

General population statistics

While digital technology plays an increasingly important role in our lives, and political systems are mobilizing to make the most of its leverage effect on innovation and economic growth, **56% of adults lack digital skills**, according to the Organization for Economic Cooperation and Development (OECD).

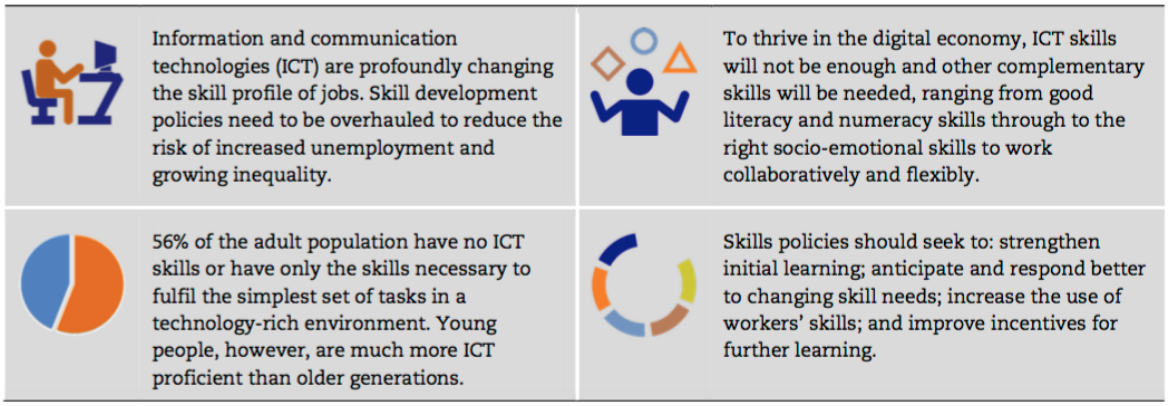


Figure 22 : Younger people are better prepared for the digital working environment than older people, Source: (OECD), *Skills for a Digital World- 2016*

Adult skills are further identified through socio-economic factors, especially the level of educational attainment, indicating a link between inequality in education and levels of digital skills. Analysis of characteristics of better performing countries reveals that other factors indirectly affect digital skills development by laying the foundations for an enabling environment: quality

of infrastructure, level of corporate transformation to digitalization, and quality of digital content.

All countries surveyed in the 2015 PIAAC survey showed a close correlation between adult education levels and their digital skills. The PIAAC study reveals an average difference of 61 points between the computer knowledge estimated by an adult aged between 25 and 65 and graduated from higher education and from an adult in the same age group whose level of education is below the secondary level. With regard to the potential relationship between digital skills and income, a link was noted between high salaries and better digital skills. On the other hand, workers who use their skills in intensive data processing in the workplace tend to have higher incomes, even after controlling the level of education and the type of work.

An interesting observation of the 2015 PIAAC study is that when applying for a job, digital skills with regard to qualifications become more important with age.

In the European Union, digital skills have been identified as the fourth major skill in the European framework for teaching and lifelong learning. According to the DESI report of 2018 [5], the value added of the ICT sector amounted to 632 billion euros in 2015. Information and communication technology services accounted for 92% of the total value added of the ICT sector. With regard to human capital, in 2017, 81% of Europeans used the Internet at least weekly and about 72% per day or nearly, for comparison, respectively, by 79% and 71% of the previous year. In relative terms, men use the Internet more than women (at least weekly: 82% vs. 79%, daily or almost 74% vs. 71%), although the difference decreases (at least weekly: 5 pages. 2017) 81% of EU citizens access the Internet at least once a week and 72% do so every day. There is still a gender ga
p but it has shrunk.

Especially in the area of digital skills, in 2017, 43% of the EU population had an insufficient level of digital skills. 17% did not have anything, since they did not use the Internet or did not. According to the Digital Skills Index, a composite indicator based on the Digital Competency Framework for Citizens, 17% of the EU population did not have digital skills in 2017, mainly because they rarely used the Internet or did so. This represents an improvement (ie, a decrease) of 2 pp. Compared to 2016. The proportion of EU citizens without basic digital skills, in turn, was reduced by 1 pp. (At 43%). However, these figures pose a serious risk of digital exclusion in the context of rapid digitization. A relatively larger number of men have at least basic digital skills (60% and 55%, respectively).

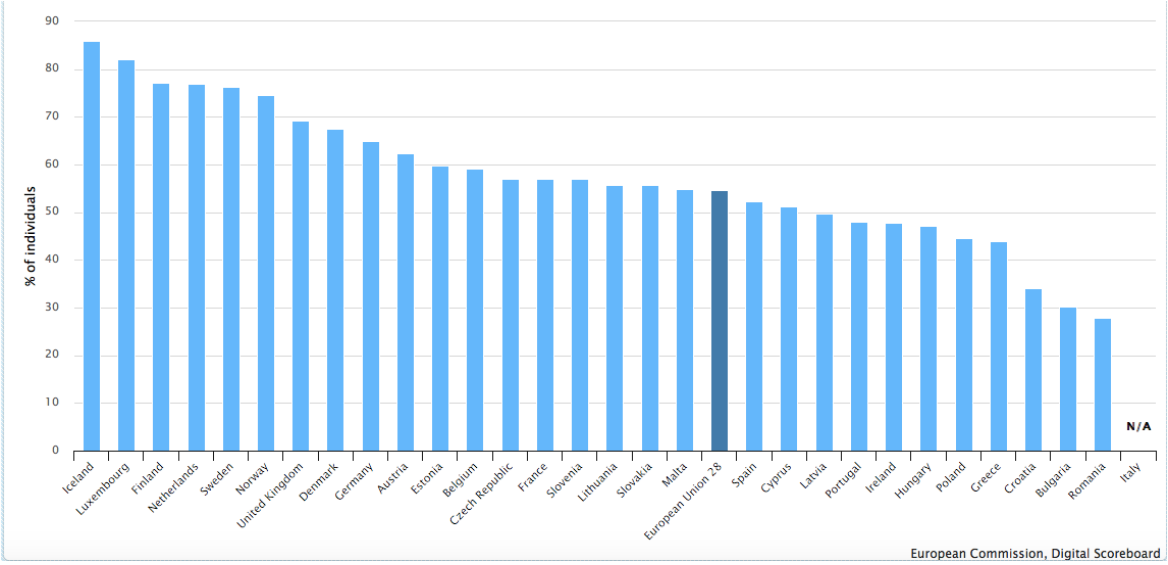


Figure 23: Indicator: Individuals with basic or above basic digital skills, Females, 16 to 74 years old – Year 2017

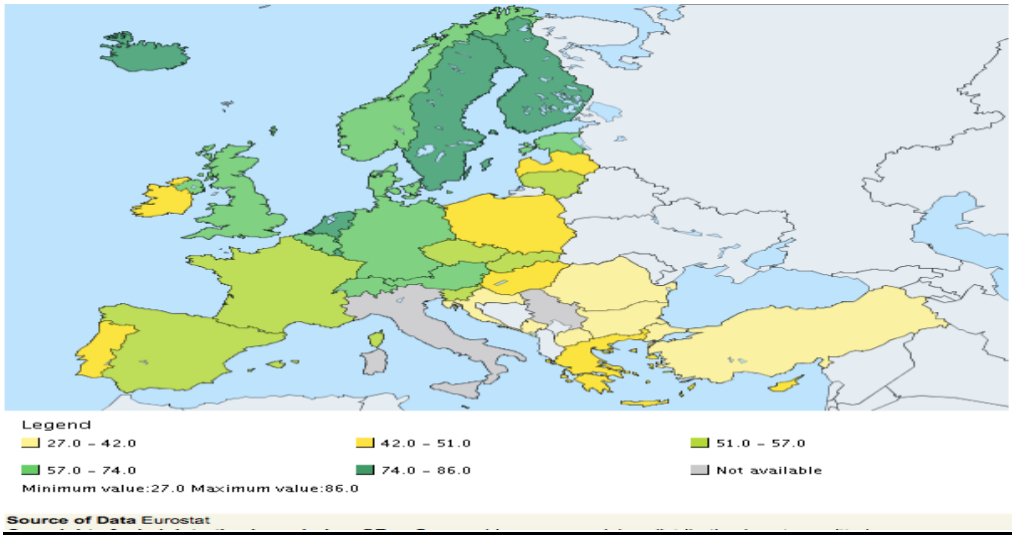


Figure 24: Individuals who have basic or above basic overall digital skills by gender. Females % of individuals aged 16-74

The share of the EU's active labour force (employed and unemployed) that can be considered to have no digital skills (essentially because they do not use the internet or do so only seldom) went from 11 % in 2016 to 10 % in 2017.

Figure 25: Digital skills of the EU labour force, 2017 (% individuals, by skills level)

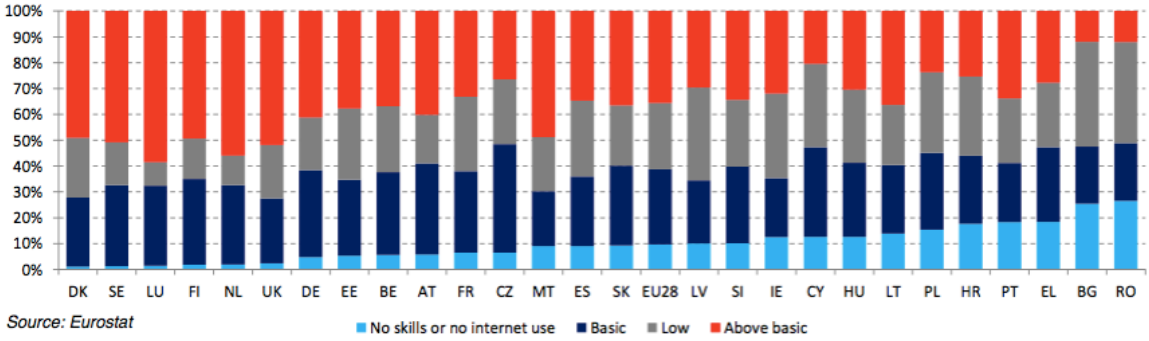


Figure 26: Figure 26: Digital skills of the EU labour force, 2017 (% individuals, by skills level)

These alarming findings indicate a mismatch in the demand and supply of skills required for the digitalization of the economy. This situation poses a great challenge in terms of unemployment: 24 million Europeans are currently

unemployed, but it is estimated that 820,000 digital jobs will be vacant by 2020 due to skill shortages. The development of digital skills among adults could, therefore, encourage professional integration for the unemployed.

According to Eurostat data, companies in all countries reported difficulties in hiring ICT specialists. During 2016, 8% of EU companies recruited or attempted to recruit ICT specialists and 4% reported having hard-to-fill vacancies for jobs that required relevant ICT skills. In total, 48% of companies that recruited or attempted to recruit ICT specialists in 2016 reported difficulties in filling vacancies.

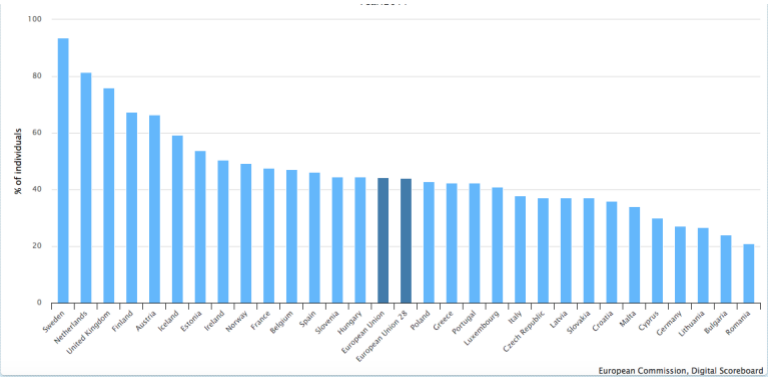


Figure 27: Figure 27: Workers who judge their current ICT skills sufficient for changing job within a year – Year 2011

Analyzing the relevant data reveals a correlation between penetration of technology into citizens' lives and strong digital skills levels. Infrastructure therefore appears to be one "activating" factor in high digital skills. Another significant factor is the use of digital technology in businesses. In all of the countries, the rate of corporate absorption of new technologies is above average. It can be concluded that working in highly-digitized environments has a positive impact on digital skills levels.

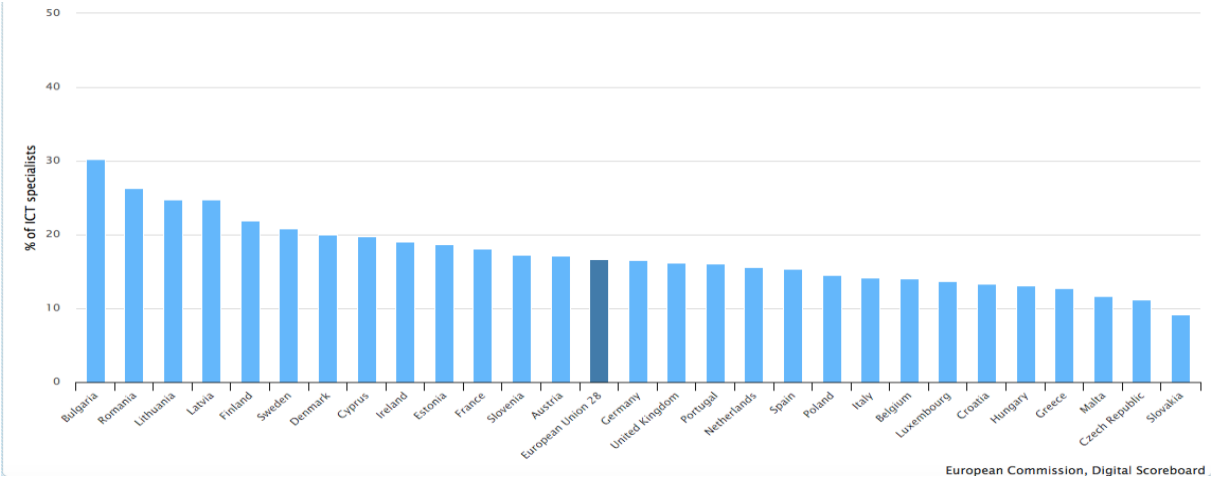
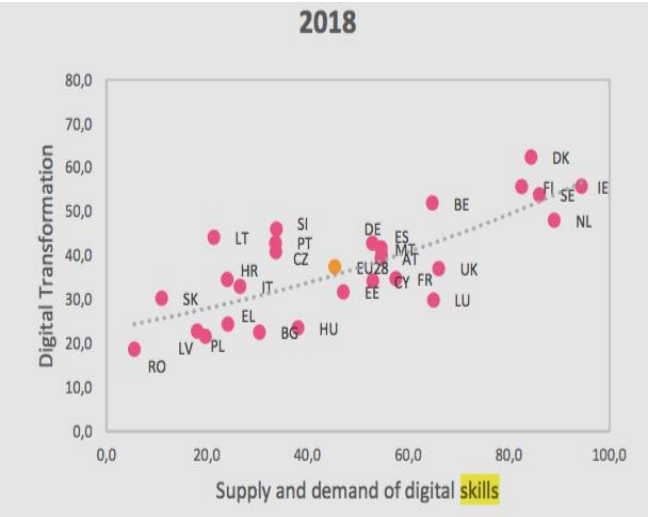


Figure 28: Indicator: Persons Employed with ICT Specialist Skills (broad measure), Females, 16 to 74 years old- Year 2017

According to the Digital Transformation Report recently published for 2018 [6], there is a positive impact of digital skills on the integration of digital technology. The figure below shows the positive correlation between the level of supply and demand of digital skills and performance in terms of the integration of digital and relevant technology and the supply and demand of digital skills for European countries. The Member States with the highest performance in terms of digital skills are also the best in terms of digital technology integration, and the same applies to low-performing countries.



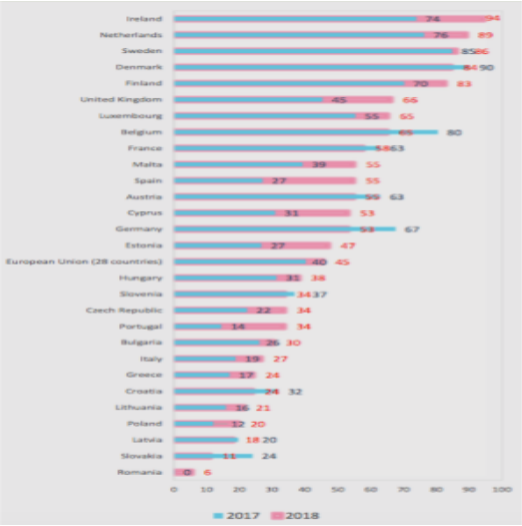


Figure 29 : Supply and demand of digital skills and Supply and demand of digital skills for MS, *Source: EC- Digital Transformation Scoreboard (2018)*

A similar to EC approach, OECD surveyed the digital skills mismuch including also new emerging technologies such as Blockchain and AI.

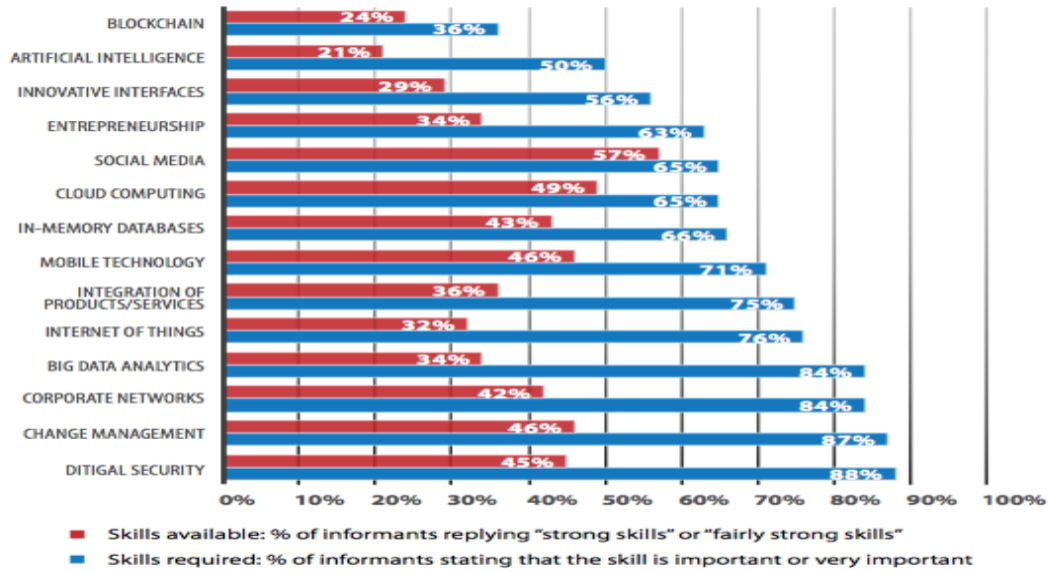


Figure 30: The mismatch in demand and supply for different digital skills

Source: OECD- Digital Skills for Transformation survey

The impact of digitalization on work practices has increased awareness among companies of the need for relevant skills to ensure their digital transformation according to another relevant study. The DT and TUM, Skills for Digital Transformation: Research Report 2017 aimed at information technology executives and human resources executives, conclude that: "the lack of digital skills continues to be one of the main barriers to digital transformation"

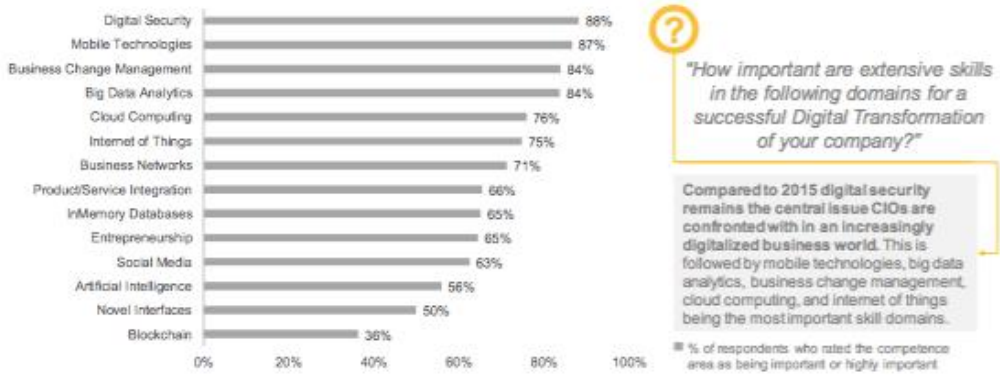


Figure 31: Skills needed for digital transformation

Source: DT and TUM, Skills for Digital Transformation: Research Report 2017.

The skill gap is also reflected in the respondents overall assessment of their personnel's skills with 64% of the respondents reporting "rather disagree" or "strongly disagree" with the statement. It can be concluded that the digital skill gap has not closed yet (see next Figure)

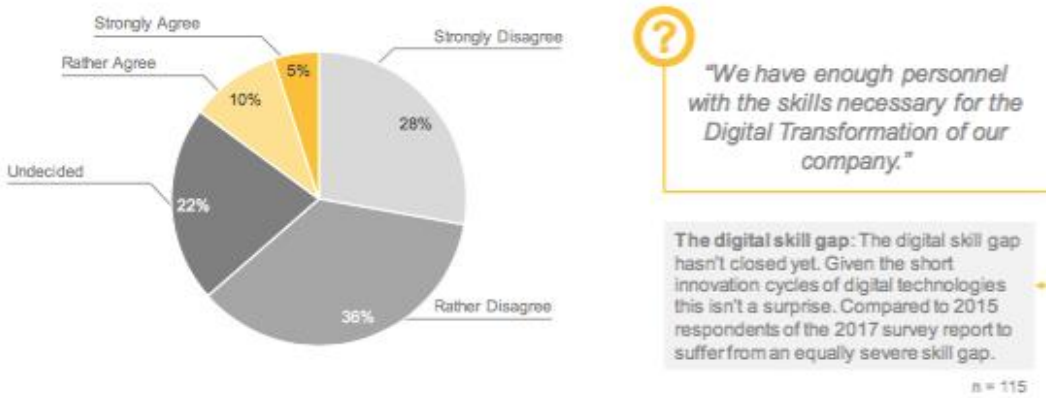
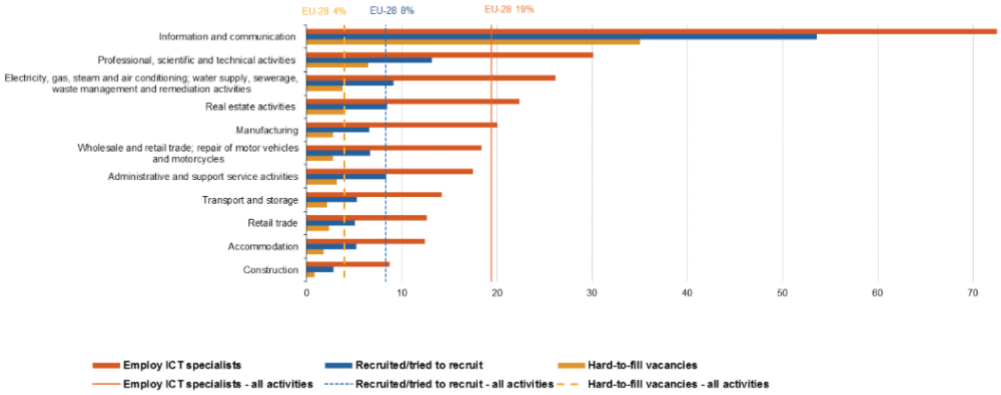


Figure 32 Figure 32: Overall skill gap, Source: DT and TUM, Skills for Digital Transformation: Research Report 2017.

The digitization of businesses generally gives rise to internal employee training programs. These aim to maintain their employability by giving them generic skills enabling them to use ICT in their daily work. That internal skills growth goes along with the recruitment of new staff with more specialized digital skills such as programming, Web Development and Network Management.
European Schoolnet and DIGITALEUROPE clearly stated in the e-Skills Manifesto 2016 "the following resources and actions must be supported at EU level:

- reduce the risk of further digital exclusion of the 286 million women in Europe;
- close the digital skills gap that affects women in Europe;
- Maximize the opportunities presented by involving Europe's women to design, build and lead the digital transformation of Europe. "

In line with the statistics of enterprises employing ICT specialists, the sector of information and communication dominated the proportion of EU companies that recruit such specialists (54%)



Source: Eurostat (isoc_ske_itspen2) and (isoc_ske_itrcrn2)

Figure 33: Enterprises employing, recruiting and having hard-to-fill vacancies for ICT specialists, by economic activity, EU-28, 2017 (% enterprises)

The main findings of OECD reports on the empowerment of women in the digital age indicate:

1. Today, around the world, there are 250 million fewer women than men online. In developed countries, women face an aspect of the digital gender divide and the regular low representation of ICT functions. For example, women around the world are less likely to occupy a leading position in the mobile industry by 20%.
2. ***The gender gap in science, technology, engineering and mathematics (STEM) is growing with age***. Girls 15 years of age are twice as likely to apply for a career as an engineer, a scientist or an architect, and four times as likely to be children as health professionals. Thus, it is not surprising that today women account for only 20% of higher education graduates in ICT.
3. ***Software development still seems (mostly) a club dominated by men***. In the last five years, nearly 90% of download packages for one of the most widely used open source software packages, "Massive Data", have been created by men. This is particularly worrisome, given the growing importance of analyzes of the "huge data" of the digital economy and the potential consequences of unintended bias because of this important role for women.
4. ***However, the morals of women have finally begun to emerge, with a promise to reduce a historic gap***. While nearly 80% of all patents filed in major IP offices

worldwide still come from men's teams, in the last two decades, the number of patents with at least one woman in the inventors' team has increased faster than the average. This is particularly the case of ICT-related patents, suggesting that women are gaining more and more credit for their creativity and innovation.

5. ***New projects and venture capital investments refer to gender-based social-cultural bias in capital financing***: for the time being, men have established 90 per cent of start-up companies seeking to invest in venture capital. New companies owned by women receive 23% less money and are less likely to have a 30% positive exit, i.e. an initial public offering or IPO, compared to companies owned by men. However, it is possible to move forward: venture capital firms with at least one partner more than double the investment in a company with a woman in the management team, three times the investment potential of CEOs (CEO).
6. ***Women at work today: Digital skills generate higher returns in the labor market***. While women seem less gifted with some of the skills needed to grow in the digital age, such as numeracy, science, technology, engineering, and quantitative mathematics, there is a chance to emerge: women who perform more intensive ICT tasks get 12 percent more. Increase the salary of men.
7. ***Digital tools can be part of the solution and can provide "leapfrog" opportunities for women's economic empowerment***. The use of women's digital platforms provides greater access to markets, knowledge and more flexible business agreements. This can lead to higher female employment rates on platforms than in traditional industries: In the United States, the proportion of female drivers is higher in Ober (14%) than traditional taxis (8%). In addition, mobile money, a way to make financial transactions from SIM to SIM using mobile phones without the need for a formal bank account, proves to be a powerful source of coverage for 2 billion people without an account. Official Finance
8. ***Bridging the gender divide is not out of our reach, but we need to accelerate progress.*** The commitment of the G20 ministers responsible for the digital economy last year in Düsseldorf to promote digital inclusion between the genders and the package designed to address the root causes of this division are important steps in the right direction. What depends on the future of women depends on what politics does today.

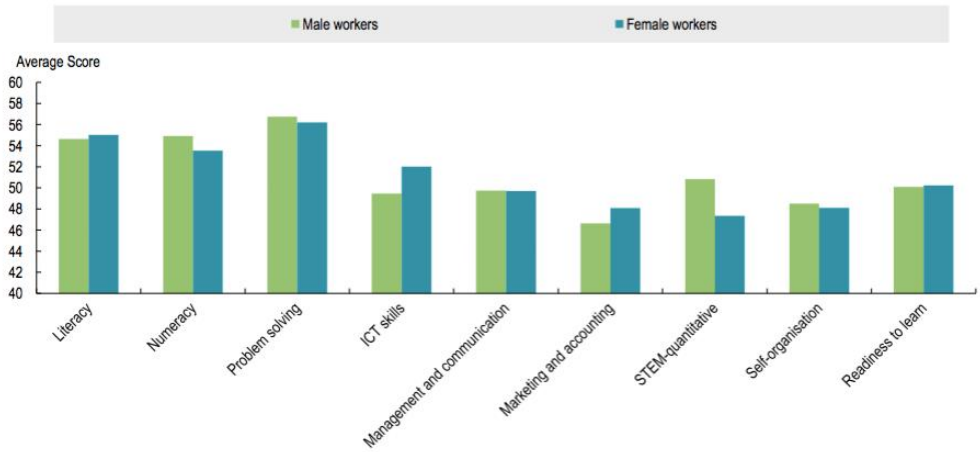


Figure 34: Figure 34 : Average skill levels for male and female workers, 31 OECD countries and partner economies, Source*: OECD (2017c),* Towards the implementation of the G20 Roadmap for digitalization: Skills, business dynamics and competition

At the G20 Digital Economy Ministerial Conference in Düsseldorf from April 6 to 7, 2017, the G20 members agreed on a prospective work plan for the G20 on digital transformation and jointly adopted "A Roadmap for Digitalization: Policies for a digital future ". The relevant report offers evidence on the extent to which skill returns differ by gender. In particular, it shows the extent to which labor market returns for women and men differ and whether wage gaps change (or not) when skills are taken into account. Additional ideas can be obtained by seeing if labor markets reward skills differently in the case of workers. The following figure presents selected estimates of wage returns to skills by gender in 31 countries. Therefore, the evidence presented is not driven by the occupation or sector in which the surveyed workers are employed, nor by the differences in the age or education profiles of the men and women in the sample.

The following graph shows that for most skills, salary returns do not differ between men and women. However, while men have higher returns on management and communication skills, the returns to ICT skills and readiness to learn are greater for women. This suggests that women may find themselves

better in a digital world, which increasingly demands more ICT skills and is willing to reward them proportionately more.

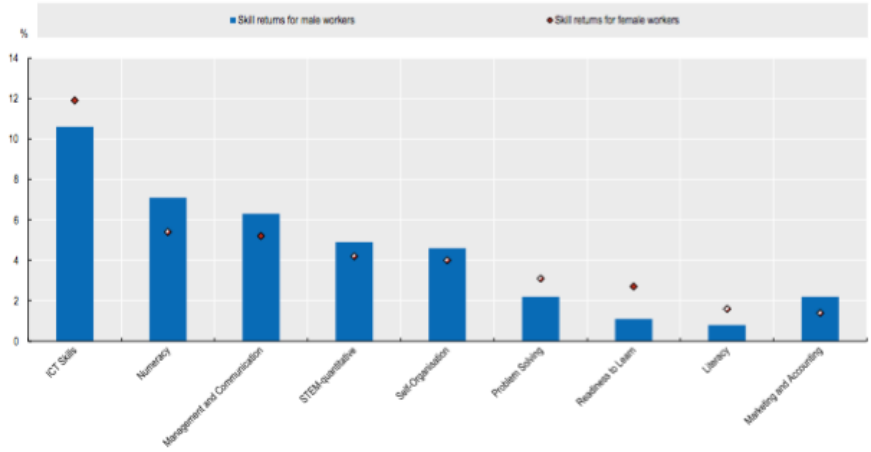


Figure 35: Labour market returns to skills by gender across 31 OECD countries and partner economies, Source: OECD calculations based on PIAAC

Box 8: United Kingdom: raising digital skill levels through partnerships

The Digital Skills Partnership was established for public, private and charity sector bodies in England to develop and deliver training that improves the digital skills of individuals and organizations as a whole.

Demand for skilled workers in the digital sector is growing in the UK. The UK Department for Digital, Culture, Media and Sport has subsequently set up the Digital Skills Partnership to work on implementing the UK digital strategy.

A multitude of digital skills training exist in the UK, so it is sometimes unclear to prospective learners and organizations which courses are best suited to their needs. An important part of the partnership's work is to develop tools that can help identify digital skills needs through local partnerships and support more nationally coherent skills provision. The partnership is also tasked with predicting future digital skills needs in new and emerging markets.

The first two local digital skills partnerships had started operations by the summer of 2018 as pilot projects covering the Lancashire and the Heart of the South West regions. Education and training providers can now collaborate within these local digital skills partnerships to avoid duplication of efforts and ensure training provision meets local needs.

The partnership aims to raise digital skill levels of both adults and young people through basic digital training for beginners to advanced skills linked to specialist jobs. Skills provision is offered at three levels. Essential digital skills introduce adults and children to basic activities, such as turning on a computer and accessing services on the internet. General digital skills may be taught as part of the curriculum in schools, through workplace training or to adults who need to manage online accounts. Specialist digital skills refer to coding, artificial intelligence, cybersecurity and digital marketing among others. These more advanced skills may be learned in schools, colleges and universities, but also through non-formal learning activities in clubs or in the workplace, and are often related to specific job roles.

Employer engagement is vital to the success of the partnership, and businesses have been involved from the start. Strategic input and insights from key businesses ensure skills provision matches the demands of local employers and contribute to growing the local

economy. Business links are being made through local enterprise partnerships.

It is further the remit of the partnership to enable small businesses and charities to raise the skill levels of their workforce. The partnership also aims to bring industry and other partners together to update teachers on the digital skills and knowledge they need to teach.

Source: Cedefop (2018)

In addition, UNESCO's recent report (2018) states that in order to achieve the best conditions for the development of digital skills, public authorities must make efforts in two areas:

1. *Policies that create a support framework, and*
2. *Sectoral policies for basic and continuous education.*

To ensure that these policies are as relevant as possible, they must be designed through cooperation between governments, educational and training institutions and enterprises. However, this research has focused so far on operational skills related to technological and cognitive access to the digital domain. By the way, they represent only basic skills. According to UNESCO, the new digital divide goes beyond physical, physical and technical access: it recognizes a growing gap between people who can find, manage and disseminate information and knowledge through technological tools in an innovative way. Effective, and people who cannot.

Mapping the Digital Skills

Digital competence is the set of knowledge, skills, attitudes (including skills, strategies, values and awareness) required when using ICTs and digital media to perform tasks; problem solving; transfer; information management for collaboration creating and sharing content; building knowledge in an effective,

efficient, appropriate, critical, creative, independent, flexible and ethical manner And reflective of work, entertainment, participation, learning, socialization, consumption and empowerment.

Most frameworks rely on skill development and the ability to use a specific set of tools and / or applications. As described in the previous definition, skills are only part of the learning areas that are included in digital efficiency; the ability to use specific tools or applications is just one of the many areas of competence that users must develop to operate in a digital environment.

Digital competencies are one of the eight main competencies for lifelong learning, which were approved by the European Parliament and the European Council in 2006. The innovative perspective of these recommendations is to expand the definition of digital competencies in two main directions:

1. *Basic skills (knowledge-related), and*
2. *Soft skills (linked to attitudes and skills).*

In 2005, Jane Davidson undertook a systematic study on the need to revise and publish "specific assessment methodologies" in the area of experimental social research interest. According to her, to assess the digital competence, specifically to formulate the evaluation conclusions about the competition, it is necessary to integrate a set of empirical evidence with definitions of quality and value. This is possible through methodologies aimed at qualifying digital competence. For them, Davidson explains how the evaluation model is evaluated

Table 8: A Specific Methodology to Evaluate Digital Competences: The Rubric

Criteria	Analysis levels	Indicators

Identification of visual, voiced, lexical etc codes present in the text	Expressive	Identification of communicative codes inside the text: verbal, sign, film language... .
Media genre identification and analysis.	2.Thematic/ figurative	Identification of genre syntactic rules. Identification of genre semantic fields. Connection of textual elements to the genre type: **Balance** (balanced distribution of optical weights) **Proportion** (adapting the picture to the background) **Progressiveness** (composing objects in a continuous way, without optical breeches Unity (coherence between the chosen objects) **Emphasis** (spectacular spelling of the object)
Identification and analysis of the author's narrative style and of the space-time construction of a text	3. Discourse level	Identification of the mechanisms that create the author's discourse Identification of the editing technique Filming style Special effects
	4.Semio-narrative	Semio-narrative
	5.Cultural context	
	6. Ideological	
	7. Communicative context	Equivalence degree between the textual product and the transmission container

As already mentioned, digital skills are developed along a continuous chain and are constantly updated in line with changes in technology. Digital skills frameworks play a critical role in capturing a range of skills and changes,

allowing policy makers and digital talent providers to ensure that their training curricula and programs remain relevant and current. Many international organizations and agencies have developed digital skills frameworks.

Digital skills take their place in a broader framework, known as 21st Century Skills. According to the World Economic Forum, twenty-first century skills consist of three "pillars": basic skills, competencies and qualifications of personalities, as shown in the chart below. Sometimes 21st century skills are called "skills.". As shown here, digital skills (referred to in the graph as "ICT literacy") are included in the constituent category, underscoring the great importance of communication between digital skills and other skills and personal qualities, all within the framework of a general lifelong learning system.

Figure 36: The 21st Century Skills Framework, *Source: World Economic Forum*

DigComp 2.0: The Digital Competence Framework for Citizens

In the 2013, DIGCOM project of the European Commission, critical efficiency is compatible with the digital dimension of information efficiency. Its components are:

(A) Search, search and filter information: to access and search information online, identify reliable resources, navigate resources online, and develop personal information strategies;
(B) Evaluation information: to collect, process, understand and evaluate information in a critical manner;
(C) Store and retrieve information by manipulating and organizing information and content to facilitate retrieval.
Ferrari (2012) [10] Digital competence is a combination of information skills, communication skills, content creation skills, security skills and problem solving skills. However, their definitions are technically oriented. Based on the number of devices used to communicate over the Internet. Content creation is the ability to produce content in different formats, environments and environments.

DigComp becomes Europe as a tool to improve citizens' digital efficiency, helps policymakers formulate policies that support digital competency development and plans education and training initiatives to improve the digital efficiency of specific target groups. DigComp also provides a common language on how to identify and describe key areas of digital capabilities and, therefore, provide a common signal at the European level.

In addition, DigComp has been implemented at the EU level, for example, to build a European-level indicator called "digital skills" used to monitor the economy and digital society. Another example is included in the CV Europass, which allows job seekers to evaluate their digital competency and include the rating in their Curriculum Vitaes.

Table 5: DigComp 2.0 - The Conceptual Reference Model

Competence areas Dimension 1	**Competences** Dimension 2
1. Information and data literacy	**1.1 Browsing, searching and filtering data, information and digital content**

	To articulate information needs, to search for data, information and content in digital environments, to access them and to navigate between them. To create and update personal search strategies. **1.2 Evaluating data, information and digital content** To analyse, compare and critically evaluate the credibility and reliability of sources of data, information and digital content. To analyse, interpret and critically evaluate the data, information and digital content. **1.3 Managing data, information and digital content** To organise, store and retrieve data, information and content in digital environments. To organise and process them in a structured environment.
2. Communication and collaboration	**2.1 Interacting through digital technologies** To interact through a variety of digital technologies and to understand appropriate digital communication means for a given context. **2.2 Sharing through digital technologies** To share data, information and digital content with others through appropriate digital technologies. To act as an intermediary, to know about referencing and attribution practices. **2.3 Engaging in citizenship through digital technologies** To participate in society through the use of public and private digital services. To seek opportunities for self-empowerment and for participatory citizenship through appropriate digital technologies. **2.4 Collaborating through digital technologies** To use digital tools and technologies for collaborative processes, and for co-construction and co-creation of resources and knowledge. **2.5 Netiquette**

	To be aware of behavioural norms and know-how while using digital technologies and interacting in digital environments. To adapt communication strategies to the specific audience and to be aware of cultural and generational diversity in digital environments. **2.6 Managing digital identity** To create and manage one or multiple digital identities, to be able to protect one's own reputation, to deal with the data that one produces through several digital tools, environments and services.

3. Digital content creation	**3.1 Developing digital content** To create and edit digital content in different formats, to express oneself through digital means. **3.2 Integrating and re-elaborating digital content** To modify, refine, improve and integrate information and content into an existing body of knowledge to create new, original and relevant content and knowledge. **3.3 Copyright and licences** To understand how copyright and licences apply to data, information and digital content. **3.4 Programming** To plan and develop a sequence of understandable instructions for a computing system to solve a given problem or perform a specific task.
4. Safety	**4.1 Protecting devices** To protect devices and digital content, and to understand risks and threats in digital environments. To know about safety and security measures and to have due regard to reliability and privacy. **4.2 Protecting personal data and privacy** To protect personal data and privacy in digital environments. To understand how to use and share personally identifiable

	information while being able to protect oneself and others from damages. To understand that digital services use a "Privacy policy" to inform how personal data is used. **4.3 Protecting health and well-being** To be able to avoid health-risks and threats to physical and psychological well-being while using digital technologies. To be able to protect oneself and others from possible dangers in digital environments (e.g. cyber bullying). To be aware of digital technologies for social well- being and social inclusion. **4.4 Protecting the environment** To be aware of the environmental impact of digital technologies and their use.
5. Problem solving	**5.1 Solving technical problems** To identify technical problems when operating devices and using digital environments, and to solve them (from trouble-shooting to solving more complex problems). **5.2 Identifying needs and technological responses** To assess needs and to identify, evaluate, select and use digital tools and possible technological responses to solve them. To adjust and customise digital environments to personal needs (e.g. accessibility). **5.3 Creatively using digital technologies** To use digital tools and technologies to create knowledge and to innovate processes and products. To engage individually and collectively in cognitive processing to understand and resolve conceptual problems and problem situations in digital environments. **5.4 Identifying digital competence gaps** To understand where one's own digital competence needs to be improved or updated. To be able to support others with their digital competence development. To seek opportunities for self-development and to keep up-to-date with the digital evolution.

Since its inception, the DigComp framework has been well received and adopted by various stakeholders. This versatile instrument is used for various purposes. In this section, and as illustrated in the Figure below, there is a classification of three different uses that the framework can have in the context of education, training and employment as follows:

1) Formulation of policies and support.
2) Educational planning for education, training and employment.
3) Evaluation and certification.

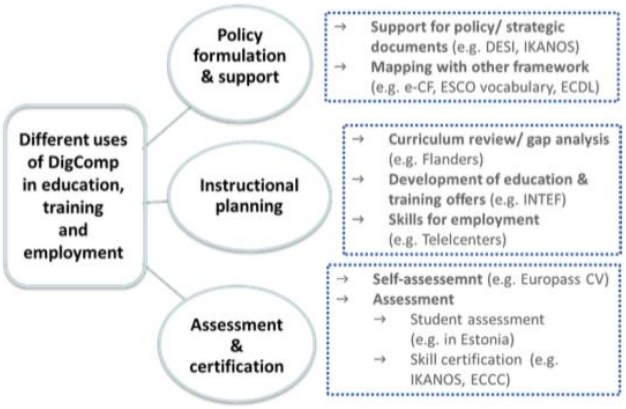


Figure 37: Figure 37: Different uses require different types of implementations, Source: Vuorikari et al. (2016) -DigComp 2.0 The digital competence framework.

The European e-Competence Framework (e-CF)

The European e-Competence Framework (e-CF) provides a reference of 40 competences as applied at the Information and Communication Technology (ICT) workplace, using a common language for competences, skills, knowledge and proficiency levels that can be understood across Europe.

The European e-Competence Framework (e-CF) version 3.0 supports a growing user community across Europe and beyond. Published by CEN in 2014 as a CEN Workshop Agreement (CWA) and transferred in 2016 to the European Standard EN 16234-1, the e-CF provides an international tool which can be deployed by a broad range of individuals and organizations.

In order to maintain the general relevance, availability, quality and scope of stakeholders within the framework of European electronic competence, TC 428 of the CEN began an update activity in e-CF. The next version of EN 16234-1 will be published next year. The systematic collection and consideration of information from multiple ICT stakeholders on the current e-CF usage and emerging emerging business trends are essential components of this process. According to CEN description [11], e-CF is structured in four dimensions, the European e-Competence Framework reflects different levels of business and human resources (HR) planning requirements, including job proficiency guidelines.

- Dimension 1 reflects five areas of e-efficiency, derived from ICT business processes: planning, construction, implementation, empowerment and management.
- Dimension 2 defines a set of e-competencies for each region, with reference definitions of 40 different efficiencies in total.
- Dimension 3 sets efficiency levels (e-1 to e-5) for each electronic efficiency, which conforms to Levels 3 to 8 under the European Qualifications Framework (EQF).
- Dimension 4 provides examples of knowledge and skills related to specific e-competencies identified in dimension 2.

The European E-competency Framework provides a common language for describing the competencies of ICT professionals and is designed to meet the needs of other companies and institutions. E-CF 3.0 provides clear definitions and good guidance to support decision-making regarding the selection and appointment of candidates, as well as the training and evaluation of ICT professionals. Allows the identification of the skills and competencies that may be necessary for the successful performance of tasks and the fulfillment of ICT-related responsibilities in the public and private sectors.

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Table 6: The e-Competence Framework Overview

European e-Competence Framework 3.0 overview

Dimension 1 5 e-CF areas (A – E)	Dimension 2 40 e-Competences identified	Dimension 3 e-Competence proficiency levels e-1 to e-5, related to EQF levels 3–8				
		e-1	e-2	e-3	e-4	e-5
A. PLAN	A.1. IS and Business Strategy Alignment				■	■
	A.2. Service Level Management			■	■	
	A.3. Business Plan Development			■	■	■
	A.4. Product/Service Planning		■	■	■	
	A.5. Architecture Design			■	■	■
	A.6. Application Design	■	■	■		
	A.7. Technology Trend Monitoring				■	■
	A.8. Sustainable Development			■	■	
	A.9. Innovating				■	■
B. BUILD	B.1. Application Development	■	■	■		
	B.2. Component Integration		■	■	■	
	B.3. Testing	■	■	■	■	
	B.4. Solution Deployment	■	■	■		
	B.5. Documentation Production	■	■	■		
	B.6. Systems Engineering			■	■	
C. RUN	C.1. User Support	■	■	■		
	C.2. Change Support		■	■		
	C.3. Service Delivery	■	■	■		
	C.4. Problem Management		■	■	■	
D. ENABLE	D.1. Information Security Strategy Development				■	■
	D.2. ICT Quality Strategy Development				■	■
	D.3. Education and Training Provision		■	■		
	D.4. Purchasing		■	■	■	
	D.5. Sales Proposal Development		■	■		
	D.6. Channel Management			■	■	
	D.7. Sales Management			■	■	■
	D.8. Contract Management		■	■	■	
	D.9. Personnel Development		■	■	■	
	D.10. Information and Knowledge Management			■	■	■
	D.11. Needs Identification			■	■	■
	D.12. Digital Marketing		■	■	■	
E. MANAGE	E.1. Forecast Development			■	■	
	E.2. Project and Portfolio Management		■	■	■	■
	E.3. Risk Management		■	■	■	
	E.4. Relationship Management			■	■	
	E.5. Process Improvement			■	■	
	E.6. ICT Quality Management		■	■	■	
	E.7. Business Change Management			■	■	■
	E.8. Information Security Management		■	■	■	
	E.9. IS Governance				■	■

The e-CF defines levels from the companies' viewpoint. However, as explained in the relevant documentation it also provides a link to the EQF and its associated learning levels.

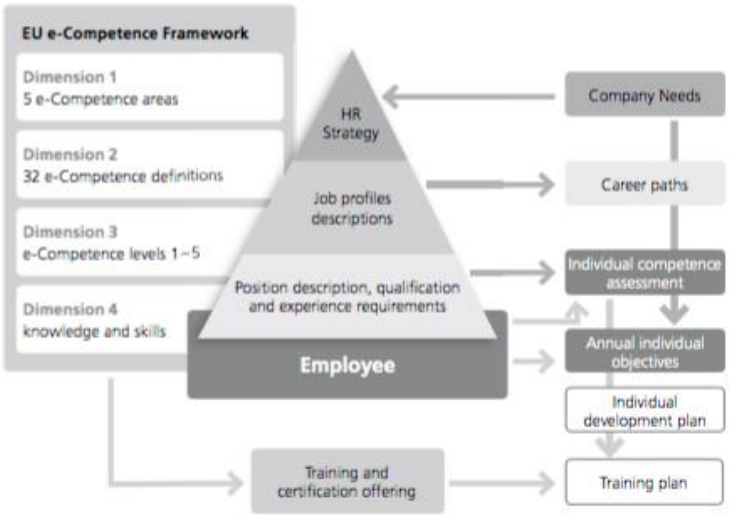


Figure 38:Figure 38: The e-CF 4 Dimensions implementation into companies, Source: Building the e-CF. Methodology documentation. CWA 16234:2014 Part 3

The Digital Competences in Europass.

Founded in 2005, Europass supports students and employees so that their skills and knowledge are better understood throughout Europe through registration tools and make their skills and qualifications transparent (see Section 2 for a full description). Although its primary objective is of increasing importance, some of its current tools need to be adapted to meet the challenges posed by the expectations and needs of today's students and developed labor markets. In order to address the shortcomings, the current structure of Europass has become a simpler, goal-oriented and modern service, while maintaining its original goal of comparing and transparency in skills and qualifications to improve the geographical and professional mobility of students and workers. One of the interviews with the department is digital skills as part of the Passports Section European Commission. The efficiency level has been classified in a four-level format (see figure below).

Table 7:Digital competences - Self-assessment grid, Source: © European Union, 2015 | http://europass.cedefop.europa.eu

	Basic User	Independent user	Proficient user
Information processing	I can look for information online using a search engine. I know not all online information is reliable. I can save or store files or content (e.g. text, pictures, music, videos, web pages) and retrieve them once saved or stored.	I can use different search engines to find information. I use some filters when searching (e.g. searching only images, videos, maps). I compare different sources to assess the reliability of the information I find. I classify the information in a methodical way using files and folders to locate these easier. I do backups of information or files I have stored.	I can use advanced search strategies (e.g. using search operators) to find reliable information on the internet. I can use web feeds (like RSS) to be updated with content I am interested in. I can assess the validity and credibility of information using a range of criteria. I am aware of new advances in information search, storage and retrieval. I can save information found on the internet in different formats. I can use cloud information storage services.
Communication	I can communicate with others using mobile phone, Voice over IP (e.g. Skype) e-mail or chat – using basic features (e.g. voice messaging, SMS, send and receive e-mails, text exchange). I can share files and content using simple tools. I know I can use digital technologies to interact with services (as governments, banks, hospitals). I am aware of social networking sites and online collaboration tools. I am aware that when using digital tools, certain communication rules apply (e.g. when commenting, sharing personal information).	I can use advanced features of several communication tools (e.g. using Voice over IP and sharing files). I can use collaboration tools and contribute to e.g. shared documents/files someone else has created. I can use some features of online services (e.g. public services, e-banking, online shopping). I pass on or share knowledge with others online (e.g. through social networking tools or in online communities). I am aware of and use the rules of online communication ("netiquette").	I actively use a wide range of communication tools (e-mail, chat, SMS, instant messaging, blogs, micro-blogs, social networks) for online communication. I can create and manage content with collaboration tools (e.g. electronic calendars, project management systems, online proofing, online spreadsheets). I actively participate in online spaces and use several online services (e.g. public services, e-banking, online shopping). I can use advanced features of communication tools (e.g. video conferencing, data sharing, application sharing).
Content creation	I can produce simple digital content (e.g. text, tables, images, audio files) in at least one format using digital tools. I can make basic editing to content produced by others. I know that content can be covered by copyright. I can apply and modify simple functions and settings of software and applications that I use (e.g. change default settings).	I can produce complex digital content in different formats (e.g. text, tables, images, audio files). I can use tools/editors for creating web page or blog using templates (e.g. WordPress). I can apply basic formatting (e.g. insert footnotes, charts, tables) to the content I or others have produced. I know how to reference and reuse content covered by copyright. I know the basics of one programming language.	I can produce or modify complex, multimedia content in different formats, using a variety of digital platforms, tools and environments. I can create a website using a programming language. I can use advanced formatting functions of different tools (e.g. mail merge, merging documents of different formats, using advanced formulas, macros). I know how to apply licences and copyrights. I can use several programming languages. I know how to design, create and modify databases with a computer tool.
Safety	I can take basic steps to protect my devices (e.g. using anti-viruses and passwords). I know that not all online information is reliable. I am aware that my credentials (username and password) can be stolen. I know I should not reveal private information online. I know that using digital technology too extensively can affect my health. I take basic measures to save energy.	I have installed security programmes on the device(s) that I use to access the Internet (e.g. antivirus, firewall). I run these programmes on a regular basis and I update them regularly. I use different passwords to access equipment, devices and digital services and I modify them on a periodic basis. I can identify the websites or e-mail messages which might be used to scam. I can identify a phishing e-mail. I can shape my online digital identity and keep track of my digital footprint. I understand the health risks associated with the use of digital technology (e.g. ergonomy, risk of addiction). I understand the positive and negative impact of technology on the environment.	I frequently check the security configuration and systems of my devices and/or of the applications I use. I know how to react if my computer is infected by a virus. I can configure or modify the firewall and security settings of my digital devices. I know how to encrypt e-mails or files. I can apply filters to spam e-mails. To avoid health problems (physical and psychological), I make reasonable use of information and communication technology. I have an informed stance on the impact of digital technologies on everyday life, online consumption, and the environment.
Problem solving	I can find support and assistance when a technical problem occurs or when using a new device, program or application. I know how to solve some routine problems (e.g. close program, re-start computer, re-install/update program, check internet connection). I know that digital tools can help me in solving problems. I am also aware that they have their limitations. When confronted with a technological or non-technological problem, I can use the digital tools I know to solve it. I am aware that I need to update my digital skills regularly.	I can solve most of the more frequent problems that arise when using digital technologies. I can use digital technologies to solve (non-technical) problems. I can select a digital tool that suits my needs and assess its effectiveness. I can solve technological problems by exploring the settings and options of programmes or tools. I regularly update my digital skills. I am aware of my limits and try to fill my gaps.	I can solve almost all problems that arise when using digital technology. I can choose the right tool, device, application, software or service to solve (non-technical) problems. I am aware of new technological developments. I understand how new tools work. I frequently update my digital skills.

One of the most interesting impacts are the online statistics based on the statistics of all the Europass CVs sent. The European Survey on Competencies and Employment (ESJS) is a cutting-edge survey of adult employees (aged 24 to 65) conducted in the 28 Member States of the European Union. The survey focused on gathering information on matching the skills of adult workers with the skill needs of their jobs. The recently published ESJS [12] shows that approximately 85% of all jobs in the EU need at least one level of basic digital skills. It is visible, even to the untrained eye, that immature technological advances, such as machine learning, big data analysis, the Internet of things and advanced robotics, along with restructuring in global value chains, are reshaping the world of work as we move forward.

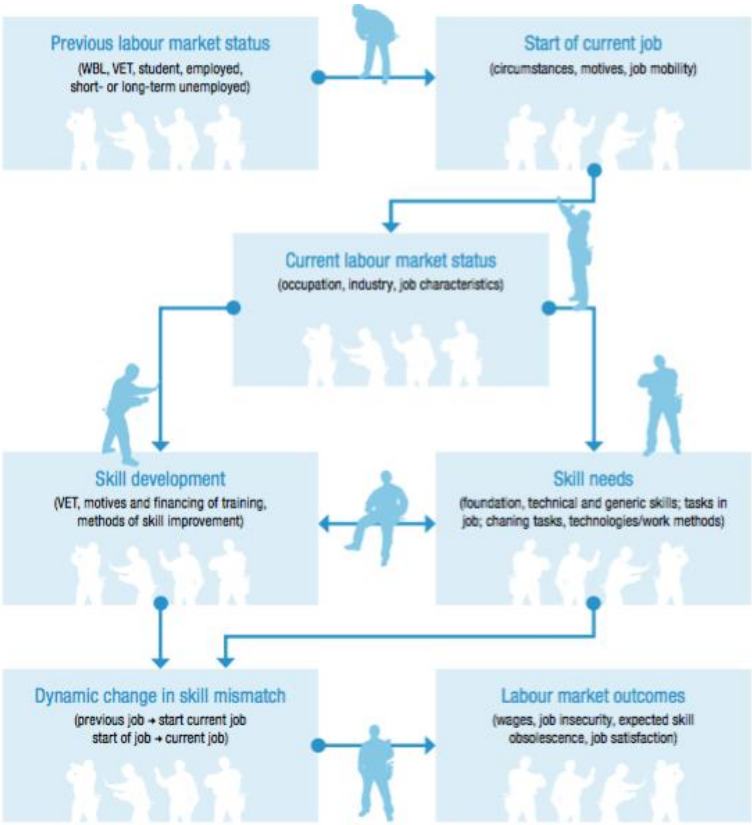


Figure 39: Source: © European Union, 2015 | http://europass.cedefop.europa.eu, Source: Cedefop - European skills and jobs survey

« *In Austria, we have a well- established tertiary system that produces highly competent innovators. However, we are facing an increasing lack of competent and qualified workers who could maximise the potential of these innovations* ».

Box 9: Margarete Schramböck- Federal Ministry of Digital and Economic Affairs

She places cooperation in a broad perspective: 'To run a successful dual system, all bodies representing the education system, at federal,

regional and local levels, as well as those from the economy, have to work closely together. The task
of my ministry is to modernize occupational profiles so that they best meet the needs of the economy. Our aim is to develop targeted and modern profiles that should be swiftly implemented. That means that all responsible ministries, social partners and companies have to cooperate in a dynamic, yet non- bureaucratic way.'
Ms Schramböck outlines what Europe needs to be a leader in digital skills: 'VET is a key area in making Europe for the digital transformation, and it must work on two levels. First, new occupational pro les must be implemented, incorporating current trends in digitalization. For example, online retailing is still increasing, so the need for high-qualified e-commerce traders, online marketing experts or app-developers is increasing too. Second, existing occupational profiles have to be modernized and enriched with new technological approaches. It will be our task to combine both strands in a European digital skills program for all education levels.

Source: *Cedefop: Skillset and match – September 2018 issue 14*

Measuring Digital Skills mismatch

In all countries, addressing skills mismatch and skill shortages is a major challenge for labor markets and training policies in the context of rapid and substantial changes in skill needs. In light of this challenge, the OECD has embarked on an ambitious program of work on how to achieve better alignment or better provision of skills and demand for skills, with a focus on:

- understand how countries collect and use information about skill needs;
- investigate profitable training and labor market policies to address mismatch and skill shortages;
- study the incentives of training providers and participants to respond to changing skill needs;

- establish a database of skills needs indicators.

This work is based on the OECD's extensive work program in the area of skills, including the OECD Skills Strategy and its national monitoring strategies, the Adult Skills Survey (PIAAC) and its rich analyzes in the areas of skills mismatch, education and professional training and work-based learning.

The proposed survey approach is based on a two-tier structure consisting of core and supplementary indicators within 11 thematic modules. Core indicators represent statistical information deemed essential to monitor relevant dimensions in usage, i.e. access to the internet, frequency and intensity of usage and the type of activities performed, together with elements regarding the uptake of e- commerce, the use of e-government services, individuals' IT skills, measures in place to protect security and privacy and related incidents. Supplementary indicators are meant to provide more in-depth information on these phenomena, including individuals' satisfaction and perception of obstacles.

Skill mismatch is based mainly on the commercial aspect where the relevant Module: ICT Skills comprised the demand and employment of skilled ICT workers, including unmet needs and perceived motivations to hire ICT professionals and relevant ICT skills for individuals, such as computer level Internet skills. Complementary questions about the ICT skills acquisition channels.

Figure 40: The OECD Model Survey on ICT Usage by Businesses: 2nd revision Definitions

ICT specialists are employees for whom ICT is the main job. For example, to develop, operate or maintain ICT systems or applications.

ICT related functions encompass a wide variety of activities within the enterprise. ICTs are not the main job, but a tool.

H1.	**Employment of ICT specialists** (% of enterprises)	In survey implementation, this indicator might be translated into a binary filter question or joined to H2
H2.	**ICT specialists** (% of persons employed)	Data might be collected as number of persons employed or percentage
H3.	**ICT training provided to persons employed** (% of enterprises, by type of training offered)	It is useful to distinguish specialists' training from other ICT related training
H4.	**Recruitment of ICT specialists** (% of enterprises which offered positions)	Filled and non-filled vacancies should be distinguished (% of enterprises *recruiting* and searching but *not recruiting*)
H5.	**Difficulties in recruitment of ICT specialists** (% of enterprises experiencing difficulties)	In survey implementation this indicator might be translated into a binary question or joined to H6.
H6.	**Difficulties in recruitment of ICT specialists** (% relevance of each reason)	Reasons for hard to fill vacancies might include lack of ICT skills by applicants: (a) technical, (b) managerial (e.g. ICT project, ICT contract or ICT security managers), or (c) related to ICT business integration, as well as (d) salary requests too high
H7.	**ICT functions performed in-house or by external specialists** (% of enterprises relying mainly on internal or external resources, by function)	Functions considered might include: – Maintenance of ICT infrastructure (servers, computers, printers, networks, etc.) – Service and support for software – Development of e-business systems (e.g. ERP, CRM. databases) – Maintenance of e-business systems

		– Development of web solutions (e.g. websites, e-commerce) – Maintenance of web solutions – Security and data protection (e.g. testing and software) – Development of ICT architecture (i.e. planning and organising of IT assets, their interoperability, etc.)
H8.	**Use of foreign suppliers for ICT functions** (% of enterprises)	The use of foreign suppliers might regard any function requiring ICT specialists. The indicator might further distinguish external suppliers from foreign affiliates of the enterprise.

Figure 41: The OECD Model Survey on ICT Access and Usage by Households and Individuals: 2nd revision

Definitions:

Formal education refers to institutionalized learning activities that lead to a learning achievement that can be positioned in the National Framework of Qualifications (NFQ). The NFQ recognizes learning activities constituted of structured hierarchical programs with chronological succession of levels and grades, admission requirements and formal registration.

Non-formal education refers to institutionalized learning activities, which are not part of the NFQ. It includes structured activities which either do not lead to any qualification or lead to qualifications that are not included in the NFQ.

Informal learning activities are not institutionalized. They can take place almost anywhere (within the family, with friends, at work) and include learning by doing or self-studying via books, cd-roms, online courses, wikis etc.

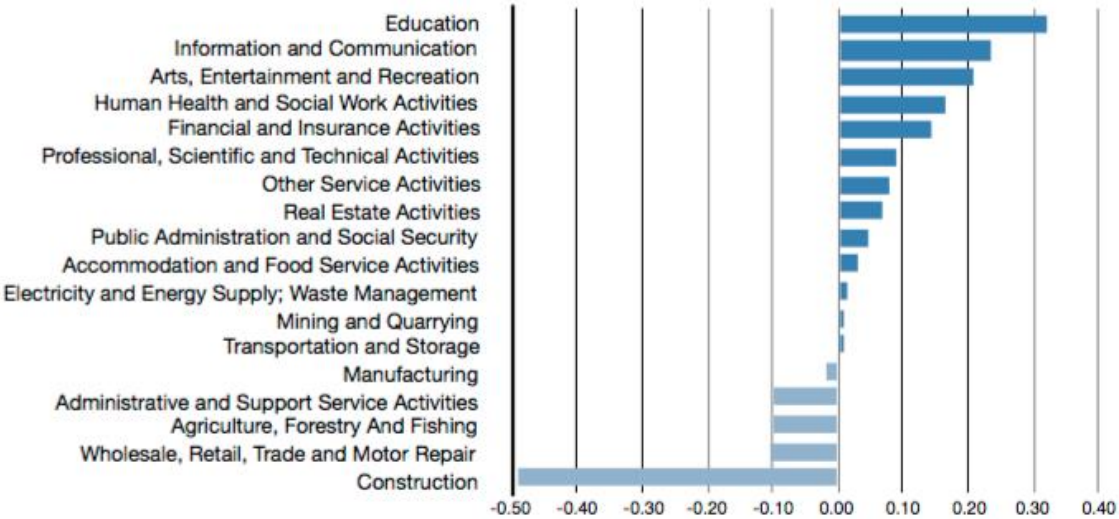
H1.	**Ability to perform selected ICT tasks** (% of capable individuals, by task)	Population: All individuals. Tasks include the following: 1. Using word-processing software 2. Using basic arithmetic formulas in a spreadsheet 3. Using spreadsheet advanced functions to organize and analyze data, such sorting, filtering, using formulas, creating charts 4. Using software for electronic presentations (slides) 5. Sendinge-mails with attached files(document, picture, video) 6. Posting messages (e.g. to chat rooms, newsgroups or forums) 7. Transferring files (e.g. digital camera, mobile phone, m-player) 8. Finding, downloading and installing software from the Internet 9. Modifying or verifying the configuration of software applications 10. Modifying the security settings of Internet browsers 11. Computer programming using a specialized language 12. Creating a web page 13. Installing or replacing an operating system
H2.	**Means of acquiring ICT skills** (% relevance of each mean)	Population: Individuals with ICT skills of any type. Means refer to: Formal education; Non-formal education; Informal learning.
H3.	**Ability to address basic needs to work, communicate, keep security and privacy**	Population: Individuals with ICT skills of any type. This indicator portrays individual self-assessed ability (sufficient or insufficient) with respect to the following needs:

	(% of individuals w/sufficient ability, by need)	a. Taking up a new job/change job within a year; b. Communicate with relatives, friends, colleagues over the Internet; c. Protecting personal data (e.g. by means of strong passwords); d. Protecting a computer from virus or other computer infection.

The relevant Estonian Country note for October 2018 reveals that: 6 out of 10 jobs facing skills shortage are in occupations requiring high skills. Demand for medium skills is also robust (40% of jobs in shortage) and in line with the OECD average.

The Education as well as the Information and Communication sectors are facing the largest occupational shortages in Estonia.

Figure 42: Sector indicators



Box 10: Measuring qualification, skill and field-of-study mismatch

Skill mismatch arises when workers have a level of skills that is higher or lower than that required by their job. If their skill level is higher than that required by their job, workers are classified as over-skilled; if the opposite is true, they are classified as under skilled (Krahn and Lowe, 1998). Skill mismatch in the OECD Survey of Adult Skills is calculated by defining a range of skill levels that are appropriate for the job, based on the skill levels of individuals who self-report being well-matched. Individuals with skill levels outside this range are said to be skill-mismatched (see Pellizzari and Fichen, 2013).

Qualification mismatch arises when workers have an educational attainment that is higher or lower than that required by their job. If their education level is higher than that required by their job, workers are classified as over-qualified; if the opposite is true, they are classified as underqualified. Generally, the required qualification level is obtained by looking at the average or most common qualification level of individuals working in a specific occupation. In the OECD Survey of Adult Skills, workers are asked what would be the usual qualifications, if any, "that someone would need to get (their) type of job if applying today". The answer to this question is used as each worker's qualification requirement and compared to their actual qualification to identify mismatch. While biased by individual perceptions and period or cohort effects, self-reported qualification requirements along these lines have the advantage of being job-specific rather than assuming that all jobs with the same occupational code require the same level of qualification.

Field-of-study mismatch arises when workers are employed in a different field from what they have been specialized in. The matching of occupations and fields of study generally follows a normative

approach, in which occupations are linked to fields of study based on what educational specialization is deemed to be appropriate for the jobs in that occupation (Wolbers, 2013; Montt, 2015). Workers who are not employed in an occupation that is considered a good match for their field are counted as mismatched.

Source: *OECD - 2017 - Getting skills right skills for jobs indicators.*

The OCED database as well Eurostat database (Eurostat self-assessment survey) are used for the statistical analysis of digital skills gap. For example, European Skills Index Out of the full list of skills considered, three in particular were considered most important for the Index – communication skills gap, problem-solving skills gap, and ICT skills gap. These indicators were considered most important to include given their anticipated importance as skill requirements in the economy.

High computer skills indicator represents in (%) the share of 16-74-year olds able to carry out 5 or 6 out of the 6 tasks described in the survey. Digital competences defined as required for employability and active participation in society. The figure below presents the structure of the European Skills Index.

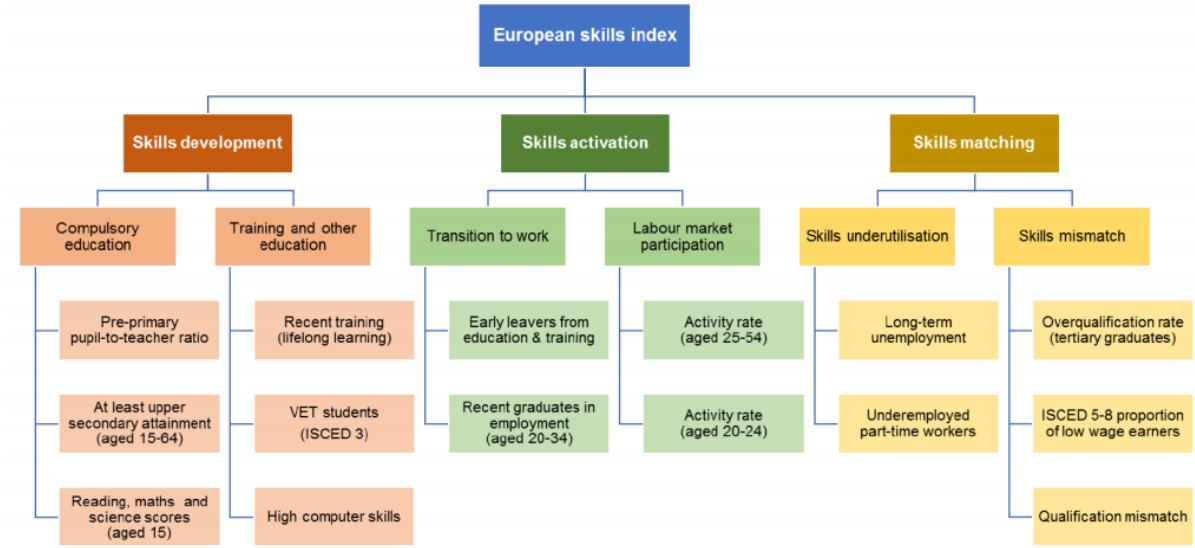


Figure 43:European Skills Index structure, Source: European Skills Index (2018), Cedefop

Defining Jobs Profiles in the ICT Sector.

One of the most important parts of e-CF is 30 professional ICT professionals who provide a general set of typical functions performed by ICT professionals in any organization covering all business operations of ICTs. As a complement to CF-e, the periodic profiles of ICT professionals in Europe contribute to a common European reference language for developing, planning and managing the needs of ICT professionals from a long-term perspective. The extent and maturity of the ICT profession in general.

The role of ICT profiles in Europe is to provide users with a user structure and tools to design, identify and synthesize the various activities necessary to support the organization's digital strategy. They are less detailed and less specific than job descriptions and offer a simple but flexible starting point. It also represents a common view of multiple European stakeholders and provides a common reference tool for language and communication to support mutual understanding, for example. Between countries and stakeholders, as well as within organizations, such as between human

resources departments and information and communication technology. Although the focus is on the efficiency and professional performance of ICTs, the ultimate goal is to influence the ability of organizations to benefit from ICT for better performance.

With regard to the number of levels, based on the experience of employers, five levels of efficiency are commonly applied to support the development of career and manpower. The following structure of the employer is provided.

Table 8: A typical employer structure and a proposal for related EQF comparison

e-Competence Level	e-Competence Level descriptions	Generic Job Description	Typical Tasks
5	Overall accountability and responsibility; recognized inside and outside the organization for innovative solutions and for shaping the future using outstanding leading edge thinking and knowledge.	Principal	IS strategy or program management
4	Extensive scope of responsibilities deploying specialised integration capability in complex environments; full responsibility for strategic development of staff working in unfamiliar and unpredictable situations.	Lead Professional or Senior	IS strategy/holistic solutions

		Manager	
3	Respected for innovative methods and use of initiative in specific technical or business areas; providing leadership and taking responsibility for team performances and development in unpredictable environments.	Senior Professional or Manager	Concepts/Basic principles
2	Operates with capability and independence in specified boundaries and may supervise others in this environment; conceptual and abstract model building using creative thinking; uses theoretical knowledge and practical skills to solve complex problems within a predictable and sometimes unpredictable context.	Professional	Consulting
1	Able to apply knowledge and skills to solve straight forward problems; responsible for own actions; operating in a stable environment.	Associate	Support/Service

By integrating the competencies of the e-CF (EN 16234-1) as an essential element in profile description, e_CF also provides 30 images of the technical roles of ICT as a general set of model roles played by professionals. Information and communication technology in any organization, covering the process.

As an integral part of CF, the periodic profiles of European ICT professionals contribute to a common European reference language for developing, planning and managing the needs of ICT professionals from a long-term perspective and the maturity of the ICT profession.

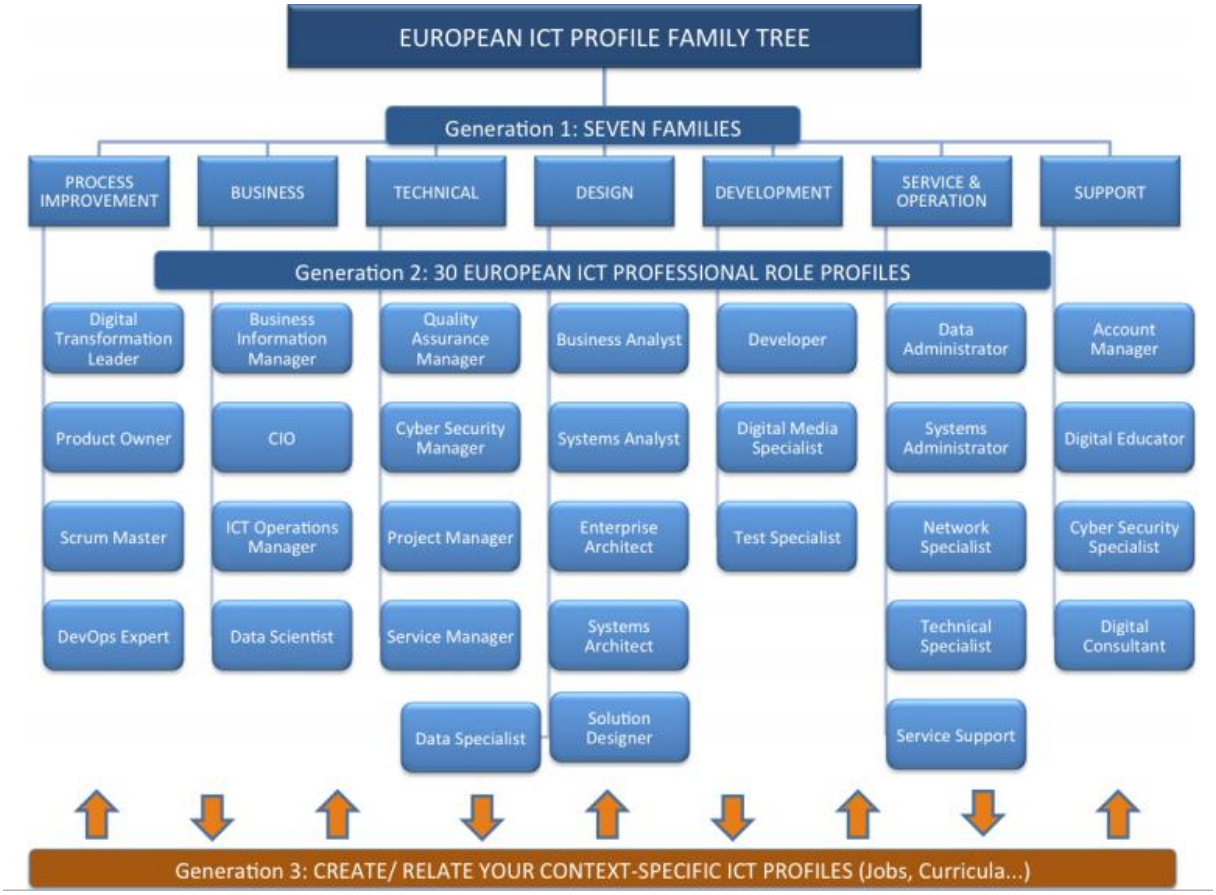


Figure 44: Figure 44: European ICT Professional Role Profiles version 2: 30 profiles, Source: *European ICT professionals role profiles – Part 1: 30 ICT profiles*

CHAPTER 9: Future Trends

Employability Trends

Expected job creation in different sectors and Industries

Different sectors, sub-sectors and cross-cutting sectors are of interest for future job creation affecting employability. Based on Future of work, 2017 (ILO) the expected trends are as follows:

Agriculture

Agriculture is considered as a potential sector for future job creation through, among other policies, the development of food value chains and the "modernization" of production including artificial intelligence developments expecting to boost agricultural productivity. The possibility of "urban farmers" reintroducing local agriculture in urban areas in the near future is expecting to also have a positive impact.

Natural resources

Natural water and energy resources, including coal and diamonds, are considered as a possible job-creating sector in certain countries. The discovery of oil, gas and other mineral resources, if they can be used sustainably could increase job creation in the extractive industries.

Services sector

A major shift from production to the services sector is evident in many countries among other reasons due to the growing digitalization and interconnectedness between man and machine. The Global Outsourcing Services enabled through online platforms have a high growth potential as well as low-skilled work, although for different reasons.

The care economy

Due to shift in values such as ethical responsibilities in certain countries, it is expected that employment around this cross cutting economic sector to increase. Care services have also the potential to be a source of job creation for women.

The green economy

The greening of the economy to preserve the environment, can result in both job destruction and creation. For example, climate change, through the demands it imposes on the nature of jobs could lead to job creation. On the other hand, changes in production and technology could result in demands for fewer, but better qualified workers in green jobs.

Sectors linked to the knowledge economy

There are different approaches regarding how technological progress will influence jobs in sectors linked to the knowledge economy. The optimists believe that there is potential to increase jobs especially if these are connected to skills in the broader ICT sector. They also believe that new jobs will be created to substitute others that will be destroyed. However, IT education to increase employment opportunities, increased investment in IT infrastructure, the provision of integrated employment support services in IT and the development of an IT culture are considered as important prerequisites. The pessimists believe that technological advances have the potential to destroy more jobs than the ones that will be created.

Table 76 shows how employability, in certain industries, is expected to be affected in the near future, according to data aggregated from Future of Jobs, 2016.

Table 9: Expected employment trends in job families

Industries	Trend
Architecture and Engineering	++
3D printing	++
robotics	++
Internet of Things	++
Computer and Mathematical	++
Big Data analytics	++
data visualization	++
Manufacturing and Production	-
additive manufacturing	-
3D printing	-
robotics	+
Installation and maintenance	+
Green Jobs	+
Internet of Things	-
Sales and Related	0
Internet of Things	-
online shopping	++
Big Data	++
Office and Administrative	- -
mobile internet	- -
cloud technology	- -
Big Data analytics	- -
Internet of Things	- -

It is evident that employment trends are differently distributed within job families, thus, although in Manufacturing and Production roles a decline is expected, robotics point to potential increases in labour and could be considered as a key driving factor. What could also be inferred is the importance of certain technologies for specific industries showing possible employability paths for skilled personnel, even when overall these technologies affect negatively the employment. In other words, these could also show the direction of substitution in job roles.

Overall, job destruction vs creation is an ongoing debate not only because technology is constantly evolving imposing new demands, but also because of the different perspectives influencing assessment. Digital Scoreboard 2018 findings show that the adoption of digital technologies doesn't seem to lead

to job destruction. On the contrary, job creation rate rose from 10% last year to 21%, while the rate of employee numbers remaining stable or increasing rose from 54% to 66%. But these results do point towards a shift in existing job definitions and the emergence of new skill sets which require continuous up/reskilling to meet the needs of evolving digital economy.

According to Future of Jobs, 2016 "*there is a strong gender dimension to expected employment changes whereby, notably, gender gaps appear to be more pronounced within both high growth and declining job families. For example, women make up low numbers in the fast-growing STEM job families, pointing, on current trends, to a deteriorating gender gap over time; but also, low numbers within job families such as Manufacturing and Production or Construction and Extraction, where expected job losses will disproportionately affect men. However, female employment is also concentrated in low-growth or declining job families such as Sales, Business and Financial Operations and Office and Administrative, indicating, if our respondents' expectations come to pass, a possible reversal of some of the gains made in workplace gender parity over the past decade".*

Technologies that lead digital transformation

Seven seem to be the major technologies which are currently affecting or expected to affect EU business and job creation (from: Innovation for the Earth, 2017):

Cloud technology, including big data: Enables the delivery of computer applications and services over the internet reducing storage and computer power needs. Big data enabled by cloud allows predictive relationships to form, underpinning optimisation.

Virtual and Augmented Reality: Computer-generated simulation of a three-dimensional image overlaid to the physical world (AR) or a complete environment (VR).

Artificial Intelligence: Software algorithms that are capable of performing tasks that normally require human intelligence, e.g. visual perception, speech recognition and decision-making.

Robots: Electro-mechanical machines or virtual agents that automate, augment, or assist human activities, autonomously or according to set instructions.

Blockchain: Distributed electronic ledger that uses software algorithms to record and confirm transactions with reliability and anonymity

3D printing: Additive manufacturing techniques used to create three dimensional objects based on 'printing' successive layers of materials

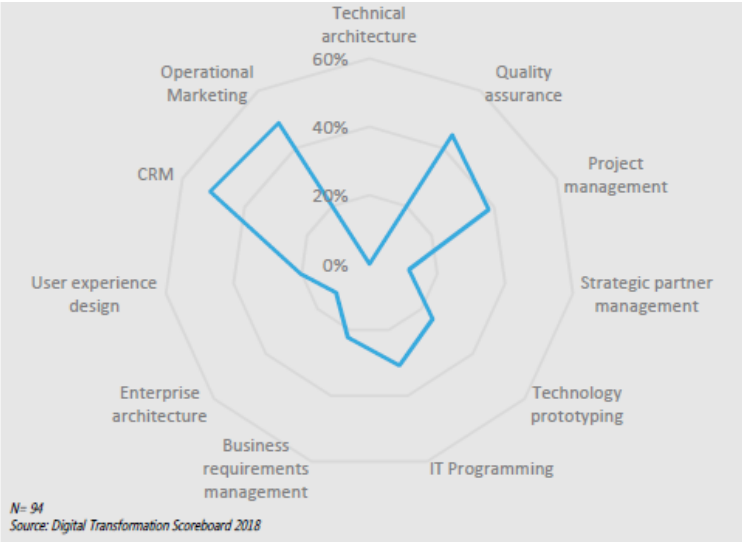
Internet of Things: Network of objects embedded with sensors, software, network connectivity and computer capability, that can collect and exchange data over the internet and enable smart solutions.

There are differences in the adoption of key digital technologies among companies in EU indicating the different needs and priorities in each industry. For example, the need for robotic and automated machinery is higher in the food sector than in the construction sector due to the nature of the production processes in the industry. Indicative examples of digital technologies adoption by companies are provided by the latest Digital Scoreboard Report based on a survey on food and construction industries. Thus, social media technologies are reported as being adopted by more than 30% of the sample firms, big data and data analytics, cloud technology and the Internet of things are adopted by at least 20% of the sample firms, cybersecurity solutions are adopted by 14%

of companies, while artificial intelligence and 3D printing seem to be the two technologies with the lowest adaptation level, measured at 5% in the survey.

The main business functions affected by digital technologies, are shown in Figure below.

Figure 45: Business functions affected by technologies



Source: Digital Scoreboard, 2018.

It seems that the most affected business functions were considered to be the operational marketing and CRM, quality assurance, project management, and IT programming, ranging from 31% to 51% of respondents, while the least-affected business functions were prototyping, enterprise architecture, user-experience design, and strategic partner management.

Looking more closely at the results and mainly at the goals companies are trying to achieve using the digital technologies, we could identify the emphasis placed on certain business functions, which consequently could lead to the identification of areas with growth potential regarding the creation of jobs, (see Table below).

Table 10: Digital technologies and accompanying goals

Technologies	Goals	Functions affected
Social Media	Brand development Engagement and communication with customers	CRM, operational marketing
Cloud technologies	Engagement with customers Improve product development Improve sales	CRM, operational marketing, quality assur and project management
IoT	Engagement with customers Introduce new product, Improve product design Improve sales	CRM, business requirements management, project management and quality assurance
Cyber security	Engagement with customers Data privacy	Operational marketing, CRM, project management and quality assurance
Robotics	Improve design and production processes Increase productivity, Improve quality	Quality assurance, CRM, technology prototyping
Big data	Efficient business management Engage with customers Improve sales	Operational marketing, CRM, project management, and quality assurance
3D	Improve design and production processes Increase productivity, Engage with customers	Project management, technology protot and CRM.
AI	Engage with customers Increase competitiveness, Deployment of new products	Project management, technology protot and CRM.

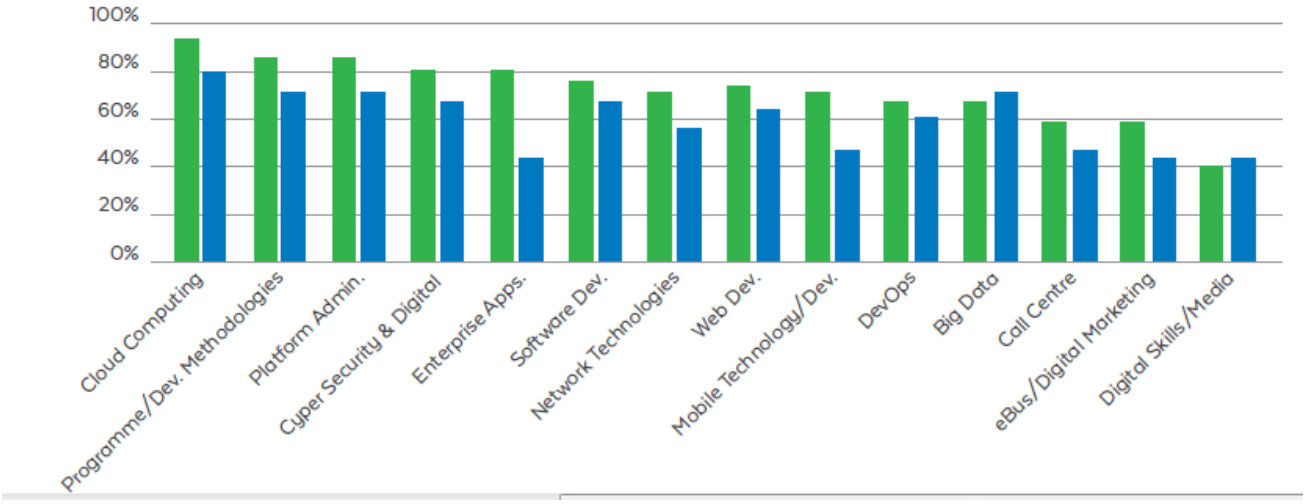
It is evident, analyzing the findings from the above survey, that the major goal in adopting ICTs is customer engagement as there seems to be more prominent the need to engage with customers than to improve production processes, which is indicative for other industries too. Customer engagement is the means by which a company creates a relationship with its customer base to foster brand loyalty and awareness, going beyond the realm of traditional sales. In an increasingly networked society in which customers can interact easily with other customers and firms through social networks, customer engagement is considered as a behavioral manifestation toward the brand or firm that goes beyond transactions and blurs even further the boundaries between firms and customers.

This trend could possible influence the emergence of new applications to further facilitate communication and engagement as well as hint to possible new job roles.

Adapting the labour force to skills requirements

Evidence from a recent survey in ICT-intensive enterprises in Ireland (FIT, 2018) shows a strong skills demand across all ICT disciplines from both corporate and SMEs, (see Figure below)

Figure 46: Company Demand per Discipline: Corporate V SMEs (%).



Source: FIT ICT Skills Audit 2018, green=corporate, blue=SMEs

An interesting finding of this audit is that it shows significant levels of demand for people at entry, competent and 'experts' level, correcting the misconception that ICT skills gap exist only at the top level. In addition, it demonstrates that although ICT companies continue to demand deeper technical skills, they also place greater emphasis, comparing to previous surveys, on soft, social and transversal skills, to enable wider applications of emerging technologies.

So, although firms and industries draw on different skill mixes at different times depending on the stage and type of innovation, industry structure and business strategies, many skills seem to be relevant across the innovation spectrum.

In the "New Skills Now" taxonomy in order to *futureproof workforce development for a rapidly changing economy*, six skills families have been identified: Learn to Earn, Build Tech Know-How, Apply We'Q, Create and Solve, Cultivate a Growth Mindset and Specialize for Work, see fig XX. The six New Skills Now families consist of the cognitive abilities, aptitudes and dispositions needed to stay relevant and thrive in the fast-evolving digital economy, as well as specialized knowledge or craft skills for a specific market, industry or setting[39].

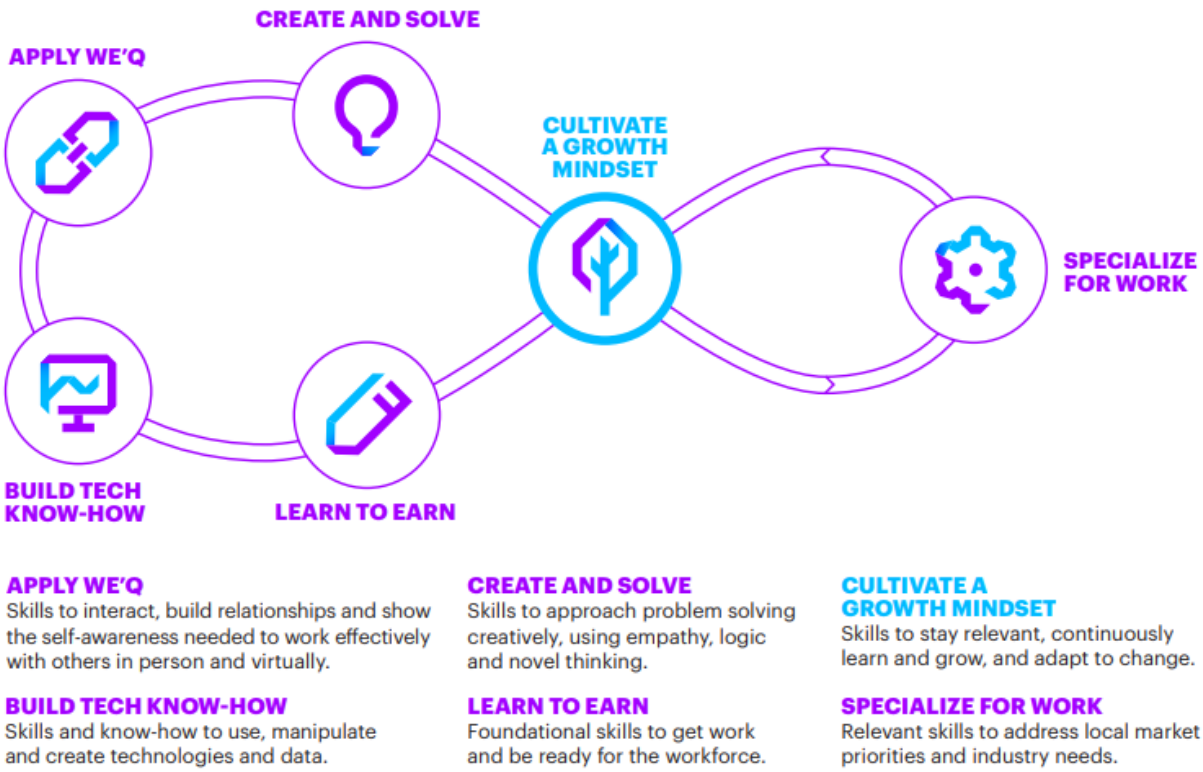
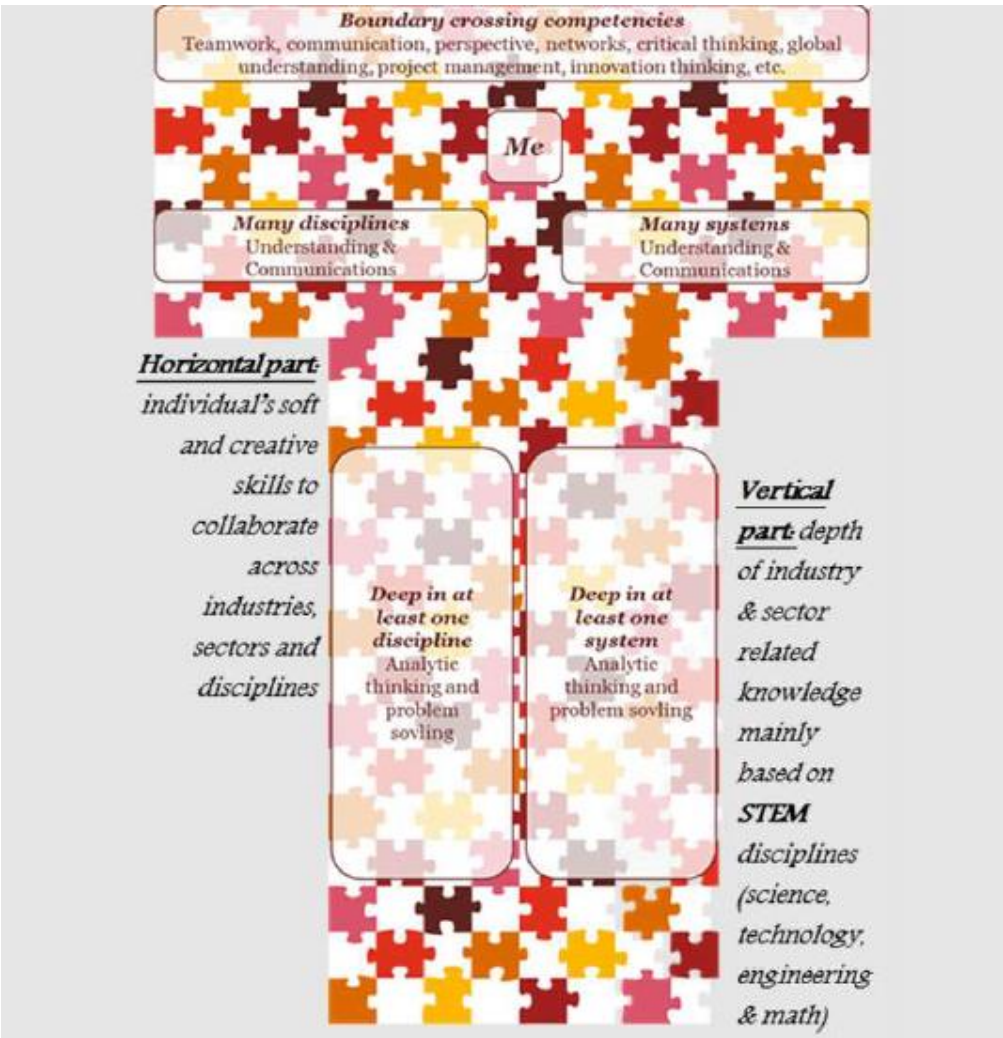


Figure 47: The New Skills Now taxonomy, *Source: New Skills New- Inclusion in the Digital Economy, Accenture 2017*

[39] *New Skills New- Inclusion in the Digital Economy, Accenture (2017)*

Another approach to integrate the different skills requirements is the T-shaped skills model[40], fig 49. *In order to adapt to the change caused by digital transformation, the worker of tomorrow must have leadership and entrepreneurship skills combined with research and innovation skills. This will encompass a range of skills, from technical, academic, sectoral and digital skills to softer skills like problem solving, creative and design thinking, communication, emotional intelligence, multicultural openness, leadership, managerial and interaction skills.*

Figure 48: The T-shaped model of demand for skills



[40] The Digital Transformation Scoreboard, 2018

Source: The Digital Transformation Scoreboard, 2018.

All these efforts just signify the complexity of jobs and the consequent breadth of skills needed for sustainable employability in the labour market today. The rapid evolution of technology and the changes in tasks and roles, have necessitate the ability to understand and appreciate developments in a range of ICT fields and to work across them, as overspecialization denotes lack of the much-appreciated flexibility. In addition, employers also require not only a broad array of tech skills, but also people's skills and creativity coupled with a deep understanding of business development to drive innovation.

For this reason, tech practitioners can no longer rely on the deepening skills acquired through initial formal education. They should adapt and take on additional ICT skills sets to a greater or lesser extent as the tech-driven transformation evolves. At the same time, transversal competencies, which cannot be fully mastered in the classroom, but require effective application through hands-on learning, are increasingly in demand.

This has led to a "learning how to learn" imperative as an integral part of the job, so that people (both low-skilled and high-skilled) and businesses become more agile and are able to anticipate new jobs, including those that will be created as a result of the development of digitalization and artificial intelligence.

CHAPTER 10: Suggestions for Digital Occupations Profiles

Based on the research findings presented in the previous sections regarding skills shortages and future employability trends, specific digital occupation profiles for the target population are identified in order to develop, through appropriate training, those digital competences which will facilitate their insertion to labour market. These profiles were evaluated by the consortium partners and during the field research study.

Target population characteristics

The project focuses on young women 19 to 29 years old in seven Partner countries: Latvia, Spain, Greece, Malta, Lithuania, Ireland and Romania. The project addresses two categories of young women: NEETs and educated but unemployed women. The target population includes also young women with disabilities (visually impaired).

Selection process for profile development

For the development of the profiles the e-Competence Framework was used as well as the findings from the desk research review. The e-Competence Framework and the European ICT Profiles CWA provide a generic, but also a consistent framework to define digital occupation profiles. The original, 30 profiles have been updated in content, based upon the target group characteristics.

A consistency cross-check was carried out, once all Profiles were fully updated based on the professional level. The criterion was that the needed competences should be Level 1, Level 2 & Level 3 taken into consideration the education level of the target group and the expected duration of the training.

The outcome of this process defined 10 ICT Professional Role Profiles with full descriptions and are presented in the following Table. Dark coloring signifies higher level of proficiency, and these profiles are considered as more suitable for young graduates, while light colored profiles are considered more suitable for young women with lower educational background.

Table 11: The 10 proposed digital profiles for the target group.

Role Profile	e-Competences (from e-CF)	Job Profile
Service Support Role	C.1. User Support - L.2 C.2. Change Support - L.2 C.3. Service Delivery - L.1 C.4. Problem Management - L.2	Summary Statement: Provides remote or onsite diagnosis or guidance to internal or external clients with technical issues. To provide user support and troubleshoot ICT problems and issues. The primary objective is to enable users to maximize their productivity through efficient and secure use of ICT equipment or software applications.
Systems Administrator Role	B.2. Systems Integration - L.2 B.3. Testing - L.2 C.2. Change Support - L.3 C.4. Problem Management - L.2 E.8. Information Security Management - L.2	Summary Statement: Administers ICT System components to meet service requirements. Installs software, configures and upgrades ICT systems. Administers day-to-day operations to satisfy continuity of service, recovery, security and performance needs.
Technical Specialist Role	C.2. Change Support - L.3 C.3. Service Delivery - L.2 C.4. Problem Management - L.3 E.3. Risk Management - L.2 E.6. ICT Quality Management - L.2	Summary Statement. Maintains and repairs hardware, software and service applications. To effectively maintain customer hardware/software. Responsible for delivering timely and effective repairs to ensure optimal system performance and superior customer satisfaction.
Digital Media Specialist Role	A.6. Application Design - L.2 B.1. Design and Develop. - L.3 B.3. Testing - L.2 B.4. Solution Deployment - L.3	Summary Statement: Integrates digital technology components for internal and external communication purposes.

	D.12. Digital Marketing – L.1	Designs and codes social media applications and websites. Makes recommendations on Application Programming Interface (API) and supports efficiency through appropriate content management systems.
Developer Role	B.1. Design and Develop. - L.3 B.2. Systems Integration - L.2 B.3. Testing - L.2 B.5. Documentation Production - L.3 C.4. Problem Management - L.3	Summary Statement: Designs and/or codes components to meet solution specifications. Ensures building and implementing of ICT applications. Contributes to low- level design. Writes code to ensure optimum efficiency and functionality and user experience.
Test Specialist Role	B.2. Component Integration - L.3 B.3. Testing - L.3 B.4. Solution Deployment - L.2 B.5. Documentation Production - L.3 E.3. Risk Management - L.2	Summary Statement: Designs and performs testing plans. Ensures delivered or existing products, applications or services comply with technical and user needs and specifications. For existing systems, applications, innovations and changes; diagnoses failure of products or services to meet specification.
Digital Consultant Role	A7. Technology watching - L.5 A3. Business Plan Development - L.4 A4. Product or Project Planning - L.3 E3. Risk Management - L.3 E7. Business Change Management - L.4-5	Summary Statement: Supports understanding of how digital technologies add value to a business. Maintains a technology watch to inform stakeholders of existing and emerging technologies and their potential to add business value. Supports the identification of needs and solutions for achieving business and IS strategic goals.
Information Security Specialist Role	C.2 Change Support - L.3 C.3 Service Delivery - L.3 D.9 Personnel Development - L.3 D.10. Information and Knowledge Management - L.3	Summary Statement: Ensures the implementation of the organisation's information security policy by the secure and appropriate use of ICT resources. Defines, proposes and implements necessary information security technique and practices in compliance with information security standards and procedures. Contributes to security practices, awareness and

	E.8 Information Security Management - L.3-4	compliance by providing advice, support, information and training.
Network Specialist Role	A.6. Application Design - L.3	Summary Statement: Ensures the alignment of the network, including telecommunication and/or computer infrastructure to meet the organisation's communication needs. Manages and operates a networked information system, solving problems and faults to ensure defined service levels. Monitors and improves network performances and security.
	B.2. Component Integration - L.3	
	B.4. Solution Deployment - L.3	
	C.4. Problem Management - L.3	
	E.8. Information Security Management - L.3	
Database Administrator Role	B.1. Design and Develop. - L.3	Summary Statement: Designs, implements, or monitors and maintains data sets, structured (databases) and unstructured (big data). Administer and monitor data management systems and ensures design, consistency, quality and security.
	B.2. System integration - L.3	
	C.2. Change Support - L.3	
	D.10. Information and Knowledge management - L.3	
	E.8. Information Security Management - L.3	

Full description of the selected ICT Professional Role Profiles can be also found in the ANNEX 2.

Due to the increased importance of soft skills, these should also be considered in the development of the profiles. Thus, the profiles could be as follows:

Table 12: Additional proposed digital profiles for the target group.

Learning to learn attitude		User Support - L.2

Collaboration skills Communication skills Business knowledge Problem solving Empathy	**Service Support** Non tertiary education	Change Support - L.2 Service Delivery - L.1 Problem Management - L.2

Learning to learn attitude Collaboration skills Communication skills Business knowledge Problem solving	**Systems Administrator** Non tertiary education	Systems Integration - L.2 Testing - L.2 Change Support - L.3 Problem Management - L.2 Information Security Management

Learning to learn attitude Collaboration skills Communication skills Business knowledge Creativity Innovation thinking	**Digital Media Specialist Role** Non tertiary education	Application Design - L.2 B.1. Design and Develop. - L.3 B.3. Testing - L.2 B.4. Solution Deployment - L.3 D.12. Digital Marketing

Learning to learn attitude Collaboration skills Communication skills Business knowledge Global thinking Problem solving	**Technical Specialist** Non tertiary education	Change Support - L.3 Service Delivery - L.2 Problem Management - L.3 Risk Management - L.2 ICT Quality Management - L.2

Learning to learn attitude Collaboration skills Communication skills Business knowledge Creativity Problem solving	**Developer** Tertiary education optional	Design and Develop. - L.3 Systems Integration - L.2 Testing - L.2 Documentation Production - L.3 Problem Management - L.3

Learning to learn attitude Collaboration skills Communication skills Business knowledge Problem solving Analytical thinking	**Test Specialist** Tertiary education optional	Component Integration - L.3 Testing - L.3 Solution Deployment - L.2 Documentation Production - L.3 Risk Management - L.2

Learning to learn attitude Collaboration skills Communication skills Business knowledge Problem solving	**Network Specialist** Tertiary education optional	Application Design - L.3 Component Integration - L.3 Solution Deployment - L.3 Problem Management - L.3 Information Security Management - L.3

Learning to learn attitude Collaboration skills Communication skills Business knowledge Problem solving	**Database Administrator** Tertiary education optional	Design and Develop. - L.3 System integration - L.3 Change Support - L.3 Information and Knowledge management - L.3 Information Security Management - L.3

Learning to learn attitude Collaboration skills Communication skills Business knowledge Critical thinking Global understanding Problem solving	**Information Security** Tertiary education	Change Support - L.3 Service Delivery - L.3 Personnel Development - L.3 Information and Knowledge Management - L.3 Information Security Management - L.3-4

Learning to learn attitude Collaboration skills Communication skills		Technology watching - L.5 Business Plan Development - L.4

Business knowledge Situation Awareness Innovation skills Critical thinking Global understanding Leadership/persuasion	**Digital Consultant** Tertiary education, preferably Business School Graduate	Product or Project Planning - L.3 Risk Management - L.3 Business Change Management L.4-5

Special note for SMEs

Taking into consideration that because of constant changes in technologies we are always in a transition state, there might be room to consider jobs more attuned or necessitated because of this "intermediate state" in order to facilitate the harnessing of technological breakthroughs. These could be middle level jobs oriented towards the utilization of digital business applications, distinct from the job of the Digital Consultant who aims for more integrated digital transformation. In Digital Scoreboard 2018, the words of an entrepreneur are reported that are quite revealing. "We cannot say we have a digital strategy. We have a strong vision and we know where we want to go. We are just using the tools that are available to reach our objectives".

It is mentioned in the literature that businesses and especially SMEs should be more aware of digital development opportunities (Future of work, ILO), but given the fact that the majority of SME managers do not possess the necessary skills or the time to scout for digital development opportunities, these might lead to new job opportunities regarding technology consultant roles: Taking into consideration that millennials are technology savvy, although not always digital savvy, there might be an opportunity to use this tendency in young people and couple it with basic business knowledge to enable them make calculated suggestions of how SMEs could benefit from specific technologies. Closely linked to these roles is a situation awareness skill. The term means the up-to-the-minute cognizance or awareness required to move about, operate equipment, or maintain a system and it includes the perception of the elements in the environment within a volume of time and space, the

comprehension of their meaning, and the projection of their status in the near future.

It includes three hierarchical phases and primary components (Endsley, 1995):

- Level 1 Situation Awareness—perception of the elements in the environment. This is the identification of the key elements or "events" that, in combination, serve to define the situation. This level tags key elements of the situation semantically for higher levels of abstraction in subsequent processing.
- Level 2 Situation Awareness—comprehension of the current situation. This is the combination of level 1 events into a comprehensive holistic pattern, or tactical situation. This level serves to define the current status in operationally relevant terms in support of rapid decision making and action.
- Level 3 Situation Awareness—projection of future status. This is the projection of the current situation into the future in an attempt to predict the evolution of the tactical situation. This level supports short-term planning and option evaluation when time permits.
- Another possible job role could be that of the facilitator with the main task to support the introduction of technologies to SMEs. Considering that it entails changes not only in the technical level, but also in the cultural level (attitudes and reaction to change) women with more aptitude for people skills coupled with transition state management skills could constitute adequate candidates.

Chapter 11: Concluding Comments

In the IT industry, diversity is an issue. It seems that, despite the efforts to end the deliberate exclusion of women from the workplace, misconceptions and cultural beliefs still persist that lead to unconscious biases in the ICT sector, which in turn affect career prospects. The discrepancies in overall male-to-female pay rates is also one of the reasons that make the sector unattractive for women. Lack of female representation on company boards affects young women willingness to pursue a career in a historically male dominated field by depriving them of role models and limiting their aspirations for growth which young women seem to pursue. Young women seem also to value workplace experiences, such as support from the management and job satisfaction when weighing work options.

But, discriminatory practices against women by decision makers most commonly include recommending a male candidate rather than a female one for a job position affecting recruitment prospects and career advancement. Key infrastructure, a holistic approach starting at the top and long-term commitment is needed to support gender diversity on behalf of the companies, while learnability and excellence, on the behalf of the women, can equalize opportunities. One way to achieve this is by equipping young women with job-ready, transferable digital skills that employers are seeking and support them to be the best.

Digitalization offers growth opportunities for people and businesses alike. But for firms to get the full productivity gains from ICT, business processes should be redesigned around the use of the new technologies. So far, ICT skills shortages, poor matching of workers to jobs and low managerial quality limit digital technology adoption and therefore the rate of diffusion. The positive role of firm's leadership in ICT adoption indicates that beyond subsidies or governmental programs that promote ICT adoption, it is also necessary to engage the main SMEs decision makers to this effort. Qualified firm management can facilitate digital adoption through initiating and guiding the

adoption process. In addition, SMEs that are planning to invest in ICT are also much more likely to provide training and development to their staff and managers. This also accentuates the importance of better involvement of employers in skills development programs to ensure that training programs are well aligned with the skills needed by the local labor market. Due to the generally slow pace of formal educational institutions to adapt to the changes brought about by the technology, non-formal education can play a critical role in providing young people with further opportunities to improve and / or adapt their digital skills to job-market needs.

PART B

CHAPTER 12: Baseline Report

Whilst gender imbalance in ICT is a worldwide phenomenon, we can observe discrepancies when comparing the situation in different nations. This is, in large, a result of different industrial structures, job markets and societal norms, Thus, it is necessary to break down the figures per country, in order to make comparisons and draw the necessary conclusions. In the Annex, a more detailed presentation, per country, is presented on the labor market, the economic sectors as well as the differing circumstances and dynamics leading to different results concerning digital growth.

The worldwide ICT market is forecast to grow by a Compound annual growth rate of 3% in the period from 2016 to 2021, with a strong growth market for emerging technologies sitting beneath this figure. The key trend that is driving the implementation of these technologies is digital transformation. Digital transformation has been a strong theme in both business and IT over the past five years — and often is a term mistakenly used for almost any kind of new technology adoption. True digital transformation is the transformation of a business, underpinned and enabled by digital technology, guided by two key principles: one is that the adoption of technology must be about transforming the business and not about the technology itself, and the other is that true digital business transformation is an ongoing process that requires cultural change. In each country, differing circumstances and dynamics lead to different results concerning digital growth and thus, it is useful to examine the individual profiles of different countries

Socio-economic environment

Unemployment rates NEET

In partner countries, unemployment of young people varies significantly ranging from 10,1% in Malta to 26,8% in Greece. The EU-28 percentage is 16,5%, almost double of the percentage of youth unemployment in USA (8,5%). As shown in the following figure and table, in 3 out of the 7 partner

countries, unemployment rates are higher than the already high EU average: in Spain, Greece and Romania.

Figure 49: NEETs unemployment in EU

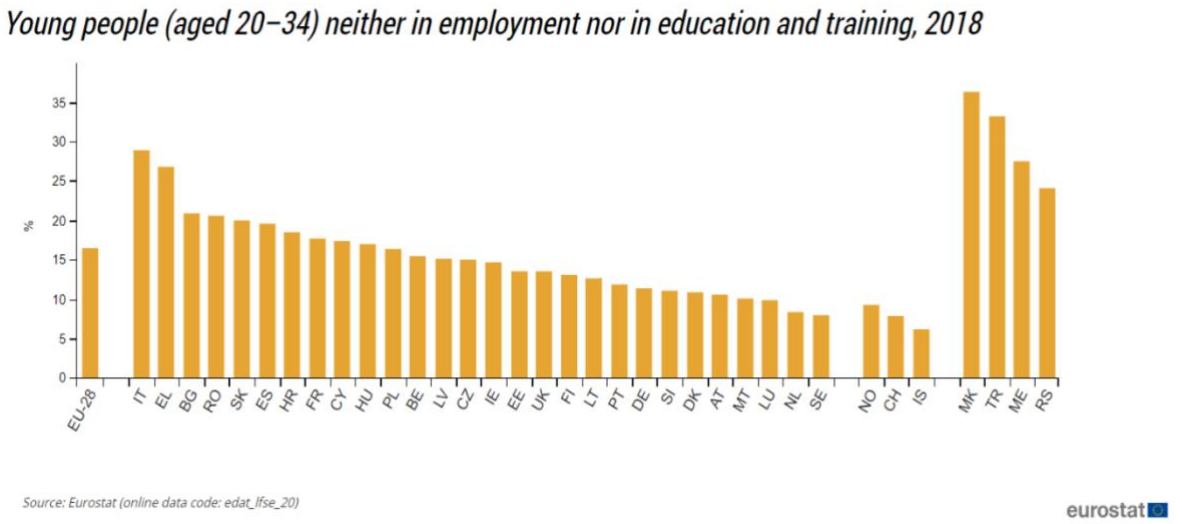


Table 13: Youth unemployment (20-34)

COUNTRY	NEETs Unemployment %
EU-28	16,5
LT	15,2
ES	19,6
GR	26,8
MT	10,1
LT	12,7
IE	14,7
RO	20,6

Partner country specific data are shown in the table below, where available, regarding the age groups that this project is focusing.

Table 14: Unemployment rates NEET (15-29) age groups, (*: not available)

Unemployment rates NEET (15-29) age groups

	15-29		15-19		20-24		25-29	
COUNTRY	**Women**	**Men**	**Women**	**Men**	**Women**	**Men**	**Women**	**Men**
Latvia	8,4%	4,8%	6,5%	5%	8,7%	7,2%	12,8%	4,6%
Spain	17,1%	15,7%	7,6%	8,7%	18,1%	19%	24,8%	19,4%
Greece	*	*	4	4,6	14	12,7	13,5	12,4
Malta	11,1%	12,7%	4,6%	5,7%	12,1%	13%	9,8%	12,4%
Lithuania	*	*	*	*	*	*	*	*
Ireland	*	*	*	*	*	*	*	*
Romania	5,9%	8,1%	5,6%	7,4%	6,4%	8,2%	4,9%	6,05%

In some of the partner countries women's unemployment percentages are higher than those of men (in Latvia and Greece – except the 15-19 age group) and in others men's unemployment percentages are higher (Malta nad Romania) , while in Spain the results are mixed: in the 15-29 and 24-29 age groups, women's unemployment is higher; in the rest, men's unemployment is higher.

Employment rates (men- women, 15-64)

Recent statistics reveal that despite the continued reduction in the employment gap, the overall employment rate is still higher for men than for women in 2018 in all EU Member States. The EU employment rate for men of working age was 79 % in 2018, exceeding that of women (67,4 %).

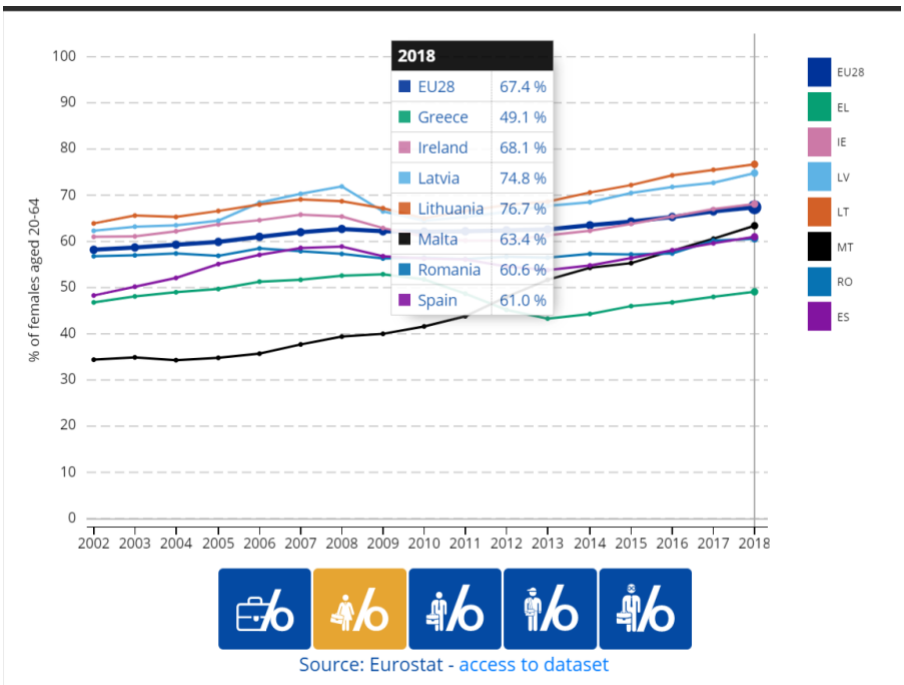


Figure 50:Women's employment rates in EU

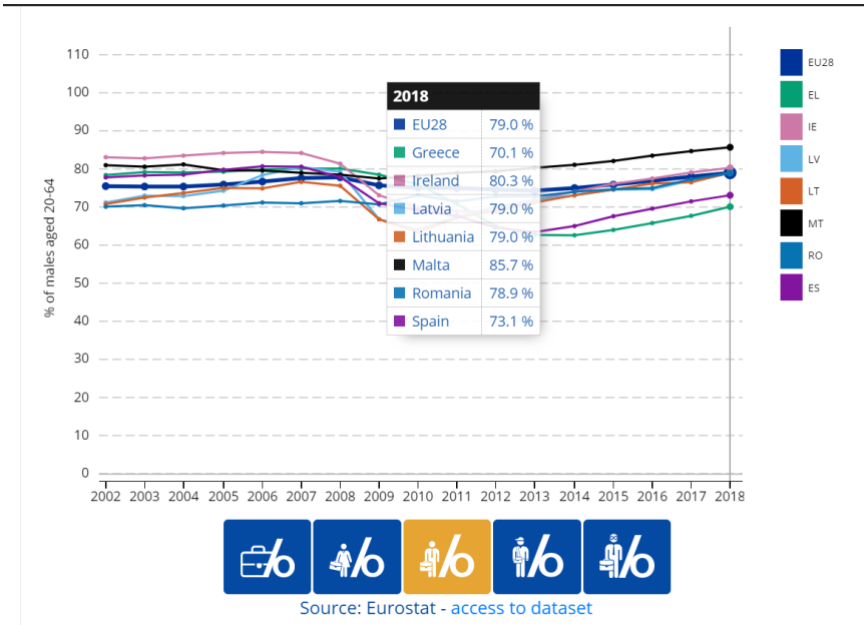


Figure 51:Men's employment rates in EU

These percentages are shown also in the following Table.

Employment rates

Country	Age	Female	Male	Total
Latvia		74,8	79	76,8
Spain		61	73,1	67
Greece		49,1	70,1	59,5
Malta		63,4	85,7	75
Lithuania		76,7	79	77,8
Ireland		68,1	80	74,1
Romania		60,6	78,9	69,9
EU-28		67,4	79	73,2

Structure and Intensity of the Industrial Sector

In Latvia, the vast majority of enterprise population is comprised by micro-firms (163.909 enterprises). Large firms comprise a tiny fraction of the enterprise population, compared to every other EU country. The majority of employees are concentrated in the Services Industry, followed by the Trade Industry and are employed by micro/small firms, in every sector.

Spain's business structure consists of small business units, and eight out of every 10 companies in Spain has two or fewer employees.

The largest percentage of small enterprises is in the services sector, especially trade. Large companies ARE concentrated in the industrial sector, many of which are international players in sectors related to infrastructure development, renewable energy, tourism, banking, insurance, the textile industry, health technology, aeronautics, the agri-food sector and the car industry.

In **Greece**, the vast majority of enterprise population is comprised by micro-firms. Micro-firms and small firms employ the majority of employees.

The biggest sectors of economic activity in Greece, both in terms of enterprise population and number of employees are Retail, trade and repair of vehicles, Tourism, Accommodation and food service activities and professional, technical and scientific activities.

In **Malta**, the vast majority of enterprise population is comprised by micro-firms (88% of the enterprise population) and small firms (8%).

Major market sectors include: Information Communications Technology (ICT), oil and gas, infrastructure, construction, information handling, pharmaceuticals, medical equipment, automotive components, light engineering, alternative and renewable energy, research & development, franchising, security, environmental waste technology, and agriculture technology including medical marijuana production.

In **Lithuania**, the biggest share of the whole market is occupied by small companies employing 0 to 4 employees (61.6%). Big companies account for only 0.1% of the total businesses.

The biggest share of companies is in the wholesale and retail trade sector (almost 30% of the whole market). The 2nd place is taken by companies in the scientific and technical sector. The smallest amount of companies is seen in the agricultural sector (2.8%) and administrative activities sector (3.8%

In **Ireland**, Small and Medium Sized Enterprises (SMEs) represent 52.1% of Ireland's GDP20 and employ 65% of the private sector employees. The Top 50 industrial enterprises in Ireland represented over 71% of the overall NSV with a value of €81.2 billion. This highlights that the Manufacturing sector in Ireland is heavily reliant on a very small number of enterprises.

In **Romania**, the vast majority of enterprises (88.5%) are considered "Micro-Firms", but the majority of employees work in large firms (33,6%), while Micro-Firms employ 23.1% of persons. At the same time, large firms contribute 47.2% of Added Value, while Micro-Firms contribute 17.9% of AV respectively.

Industries with Growth Potential

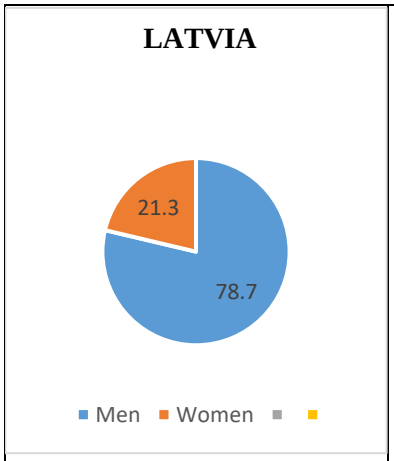
In the following table sectors in which partner countries have a competitive advantage are presented.

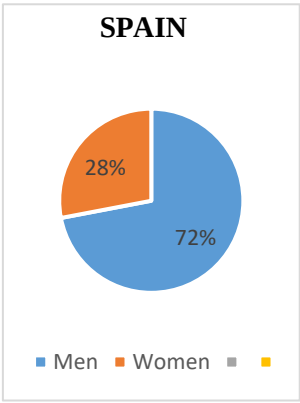
Latvia	Spain	Greece	Malta	Lithuania	Ireland	Romania
Woodworkin g	Tourism	Tourism	Tourism	ICT	Pharmace utical	Constructio n
Metalworking and mechanical engineering	Real Estate	Energy	Healthca re services	Robotics	Food	Manufactur ing
Transport and storage	Food and cuisine	Life Sciences	Financial Services	Games	Chemicals	Car manufactur ing
Food processing	Aeronautics	Food Agricultur	Online Gaming	Financial technolo gies	ICT	High technology
Green techno logy	Environmen t and Water treatment	Logistics	Insuranc e			Steel industry
Health care	Renewable energy	ICT	ICT			Information technology
Life sciences	Logstics					
Food processing	Biotechnolo gy					

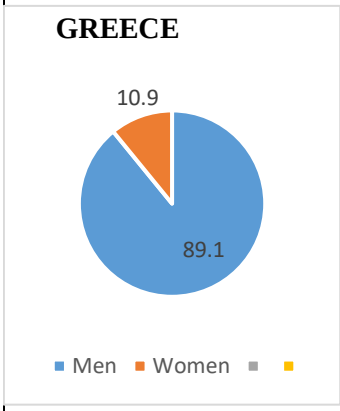
	Pharmaceutical and Health Sciences					
	ICT					

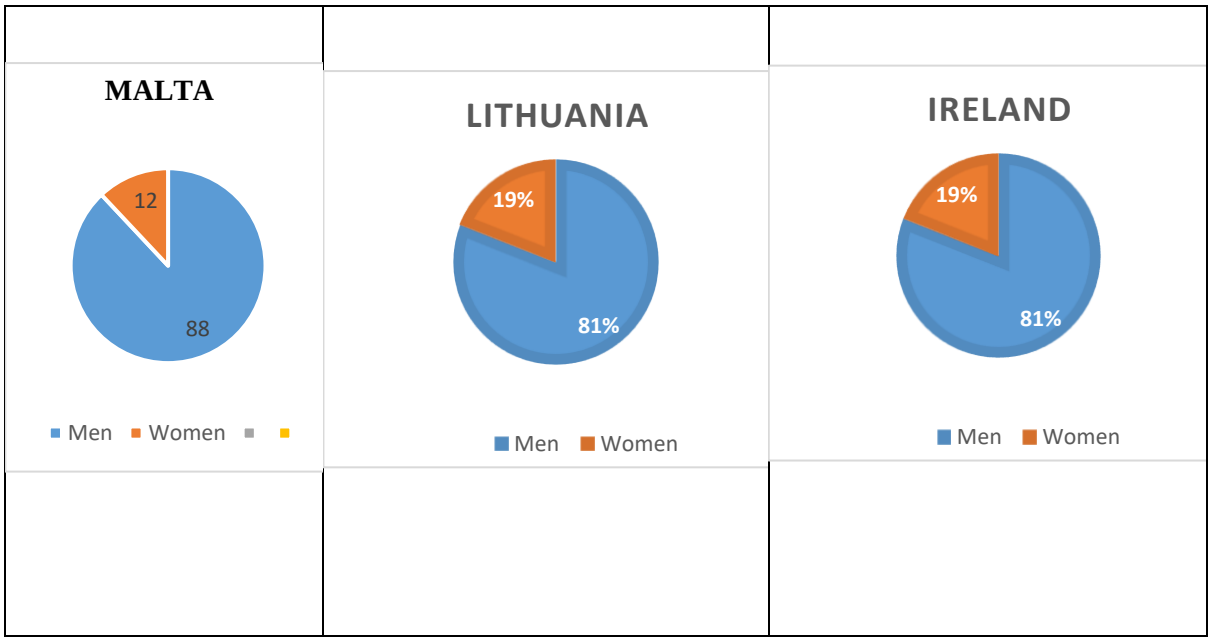
Women participation in ICT sector 2018

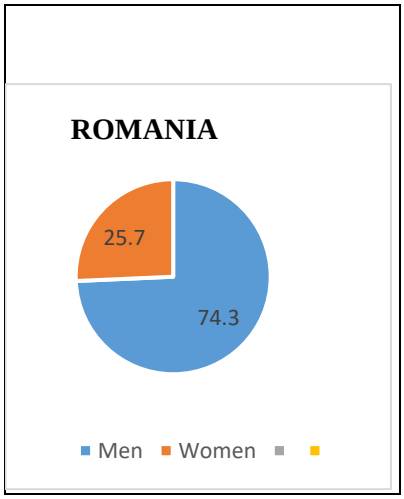
Overall, women's participation in the ICT sector in the partner countries ranges from 10,9 percent in Greece to 28% in Spain, as shown in the following figures.








MALTA
12
88
Men
Women
LITHUANIA
19%
81%
Men
Women
IRELAND
19%
81%
Men
Women


ROMANIA
25.7
74.3
Men
Women

Digital skills

Supply and demand of digital skills

In **Latvia**, in the area of supply and demand of digital skills, there are weaknesses that need to be addressed, in order to catch up with the leading EU nations. The challenge is to fight the mismatch between supply and demand in ICT, and encourage young professionals in Latvia to study ICT, as well as attract talented ICT professionals from across the globe, in order to build a competitive market.

In **Spain**, the area of supply and demand of digital skills reveals a remarkable improvement. Spain acknowledges that increasing the number of ICT specialists and promoting the role of the education system in the advancement of digital skills is a challenge that the country faces. Analysis of the public consultation has identified several key challenges, such as: digital inclusion, re-training of the workforce for a digital environment, digital skills training and digital entrepreneurship. A high degree of skills mismatches in companies' workforces limit their capacity to innovate and capitalize from innovation. Increasing the number of Spanish ICT specialists but also reskilling seem necessary.

In **Greece**, 23% of individuals in Greece have been found to have low and 24% have basic digital skills compared to EU28 average (26%). Similarly, 22% of individuals in Greece (from 16% in 2015) had above basic digital skills compared to 31% of individuals in the EU28 (2017). Thus, training, upskilling and re-skilling is necessary for the workforce to take advantage of technology for enhanced productivity and economic growth.

Malta, performs strongly in ICT start-ups, entrepreneurial culture and digital infrastructure, but there is still room for improvement in the dimension of the supply and demand of digital skills. For instance, recent data shows that the innovation output could be further increased, as well as the number of employees with portable devices provided by their companies. SMEs in Malta

and across the EU cited the availability of skilled staff or experienced managers as the most pressing problem.

Overall, **Lithuania** is performing well in fields related to digital development, but Lithuania shows low performance in the supply and demand of digital skills can be seen as its main point of improvement. To a large extent, this performance is caused by employees' low ICT and IT skills. In addition, relatively few enterprises employ ICT specialists.

Although **Ireland**'s strong performance in the field of the supply and demand of digital skills is backed by the country's high innovation output, still technical skills are difficult to find. In many cases the difficulty is because the skill being sought are in very new disciplines and therefore are in short supply. Examples are artificial intelligence, machine learning and, even more recent, blockchain and robotics.

In **Romania**, there is a particular need for improving the digital skills of its workforce, as it is difficult for enterprises to find employees with suitable ICT skills. Moreover, the number of enterprises recruiting ICT specialists is under the EU average. Overall, further efforts are needed in the supply and demand of digital skills, as the data shows that professionals have a rather low level of digital skills.

CHAPTER 13: Concluding Comments

Despite the improvements, over the last years, in women employment and digital development shown in certain countries of the consortium, challenges still persist and more needs to be done for skills development and use, especially for vulnerable groups such as women and NEETs in order to ensure better job prospects for themselves and economic growth for the society.

In all countries there are sectors which have a growth potential, and economies seem to have regained strength after the crisis faced by many of them. However, shortages in skills as well as professional, technical and scientific occupations are persisting despite the efforts so far. Taken into consideration the speed technological advancements proceed with, efforts should focus not only on the supply of skills currently in shortage, but on more proactive approaches to prepare the labor force for the things to come and ensure a constant supply of those resources necessary for thriving in a continuously changing, competitive world.

PART C

CHAPTER 14: Employers' survey

This study was conducted to investigate employers' attitudes and views on ICT technologies, diffusion of technologies, digital skills needs and digital jobs profiles considered as important as well as to collect data on female employees' skills and perceptions towards them.

The field research took place between December 2018 and April 2019 and included the gathering of the data as well as its interpretation and the writing of the analysis. When necessary, data from focus groups are used to supply the analysis.

Scope and approach of the survey

An online questionnaire (google docs and survey monkey) was sent to more than 400 selected companies in all piloting partner countries (Latvia, Spain, Greece, Malta, Lithuania, Ireland and Romania, (Annex 2). However, response rate was low, although the survey was advertised through partners' social media and promoted throughout personal and professional networks. The majority of respondents filled in the questionnaire after repeated requests and in some cases, it was necessary for partners to arrange telephone or face to face meetings. At the end, a total of 203 employers completed the survey.
The answers were codified by two researchers to define categories and analysed using SPSS.

Limitations

A key limitation of this survey was the fact that our survey required data, such as companies' demographics, that some respondents did not feel comfortable in providing or were not knowledgeable of and had to ask for the support of other company's members or provided rough estimates. Also, certain

respondents preferred to answer the survey anonymously, so analysis correlating the gender of the participants with input provided cannot be made. In addition, the format of the online survey did not yield as rich data as might have been afforded by semi-structured interviews, but time constraints on both sides did not allowed for such research designs.

Another limitation of the study is the fact that the sample was a sample of convenience, i.e. selected using non-probability sampling techniques and most of the participants were selected/invited because of their accessibility and proximity to the consortium partners. So, the data presented here can only be used to highlight tendencies and should be cross-checked with the findings from the desk report to yield explanations/interpretations.

Results

In the following sections survey questions are presented.

Demographics

Sample

A final total of 203 CEOs, business owners, heads of ICT units and HR managers responded to the survey. However, due to incomplete data, the analysis is based on 195 questionnaires and is presented in the following sections using descriptive statistics.

Tables 1, 2 and 3 below shows the respondents per participating country, company size and company type respectively.

Table 15: Number of respondents per country

Respondents		
Frequency		Percent
GREECE	30	14,77
IRELAND	28	13,79
LATVIA	34	16,74
LITHUANIA	30	14,77
MALTA	24	11,82
ROMANIA	27	13.30
SPAIN	30	14,77
Total	203	100.0

Table 16: Number of valid respondents per company type

Company type					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Private	153	78.5	78.5	78.5
	NGO	15	7.7	7.7	86.2
	Public	22	11.3	11.3	97.4
	Social Enterprise	5	2.6	2.6	100.0
	Total	195	100.0	100.0	

Table 17: Number of valid respondents per company size

Company size					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	0 to 9 employees	42	21.5	21.5	21.5
	10 to 99 employees	36	18.5	18.5	40.0
	20 to 49 employees	28	14.4	14.4	54.4
	50 to 249 employees	28	14.4	14.4	68.7
	250 to 499 employees	23	11.8	11.8	80.5
	500 or more employees	38	19.5	19.5	100.0
	Total	195	100.0	100.0	

Countries' samples are quite balanced ranging from 12% – 17% of the total responses and the majority of the respondents are from private companies, (78,5%). All company sizes are represented in the sample.

Regarding years of operation, 34% of the sample companies report 1-9 year of operation, 26% report 10-19 years of operation and 30% report 20-29 years of operation. Older companies, with more than 30 years of operation, account for less than 8% of the sample, (Table 18).

Table 18: Sample companies' years of operations

Years of operation					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	NR	3	1.5	1.5	1.5
	Between 1-9 years	66	33.8	33.8	35.4
	Between 10 to 19 years	51	26.2	26.2	61.5
	Between 20 to 29 years	60	30.8	30.8	92.3
	Between 30 to 39 years	8	4.1	4.1	96.4
	Between 40 to 49 years	7	3.6	3.6	100.0
	Total	195	100.0	100.0	

Most companies are service providers (54%), few are product developers (9%) and 37% report that they are both, Table 19.

Table 19: Main activity of sample companies

What is your company's main activity?					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Service Provider	106	54.4	54.4	54.4
	Product Developer	17	8.7	8.7	63.1
	Both	72	36.9	36.9	100.0
	Total	195	100.0	100.0	

The majority of the participating companies reported that they are facing strong competition, (above average: 41%, and high 25%), as shown in Table 20. Almost fifty-four percent (54%) of the companies' state that the business environment they are operating in, is quite complex (a "complex business environment" is characterized by a multitude of diverse, but interconnected factors and by rapid, unpredictable changes), Table 21.

Table 20: Competition sample companies face

How would you describe the competition your company is facing?					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Low	3	1.5	1.5	1.5
	Below Average	7	3.6	3.6	5.1
	Average	56	28.7	28.7	33.8
	Above Average	80	41.0	41.0	74.9
	High	49	25.1	25.1	100.0
	Total	195	100.0	100.0	

Table 21:Complexity of business environment

How would you describe the complexity in the environment of your company?					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	NR	32	16.4	16.4	16.4
	Low	2	1.0	1.0	17.4
	Below Average	6	3.1	3.1	20.5
	Average	52	26.7	26.7	47.2
	Above Average	54	27.7	27.7	74.9
	High	49	25.1	25.1	100.0
	Total	195	100.0	100.0	

The Table below (Table 22) shows the sectors sample companies belong to. The sector, in which almost one third of the sample companies belongs to (29,2%), is the ICT sector.

Table 22: Business sectors of sample companies

What is your company's main sector?					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Agriculture, forestry and fishing	7	3.6	3.6	3.6
	Extractive industries and Manufacturing industry	16	8.2	8.2	11.8
	Building	6	3.1	3.1	14.9
	Trade, accommodation and catering services	2	1.0	1.0	15.9
	Transportation and storage	9	4.6	4.6	20.5
	Information and communications	57	29.2	29.2	49.7
	Financial and insurance activities, Real Estate activities, scientific	13	6.7	6.7	56.4
	Public administration and defense; mandatory social security	9	4.6	4.6	61.0
	Education	21	10.8	10.8	71.8
	Health and social services activities	11	5.6	5.6	77.4
	Other services	44	22.6	22.6	100.0
	Total	195	100.0	100.0	

More than half of the respondents reported that above 70% of their employees, have a university degree, Table 23.

Table 23: Employees with university degrees

What percentage of your employees has a University degree?					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	NR	1	.5	.5	.5

	0%-9%	11	5.6	5.6	6.2
	10%-19%	13	6.7	6.7	12.8
	20%-29%	11	5.6	5.6	18.5
	30%-39%	11	5.6	5.6	24.1
	40%-49%	14	7.2	7.2	31.3
	50%-59%	11	5.6	5.6	36.9
	60%-69%	15	7.7	7.7	44.6
	70%-79%	31	15.9	15.9	60.5
	80%-89%	39	20.0	20.0	80.5
	90%-100%	38	19.5	19.5	100.0
	Total	195	100.0	100.0	

Attitudes / perceptions on technologies

Respondents were asked how useful they consider selected ICT technologies. On a 5-point Likert scale, where 1 was “Not at all” and 5 “Very Useful” all technologies were considered “Useful” to “Very Useful” with the exception of 3D printing, as shown in the figure below, (Figure 52, in percentages). The percentages given to mobile services, social media and cloud technologies were the highest ones (76%, 67% and 61% were reported as “Very Useful” respectively).

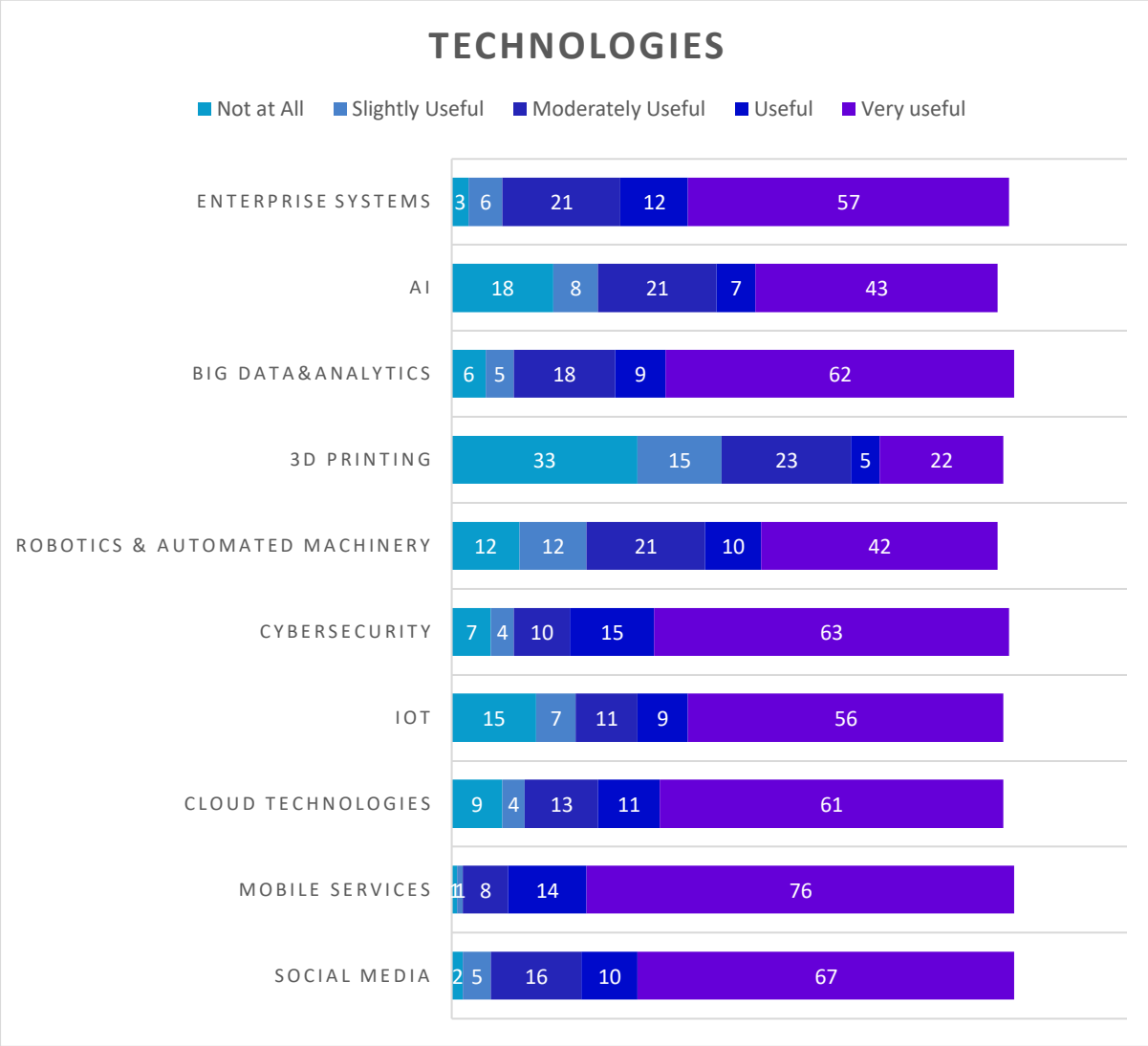


Figure 52: Respondents perceptions on the usefulness of technologies

IT adoption

Followingly, respondents were asked whether their firm uses any of the selected ICT technologies? More than 50% of the survey participants reported that their businesses use mobile services (66,2%), social media (60%) and cloud technologies (54,4%). Cyber security and enterprise

systems are being used by 44,1% and 40,5% of the businesses, respectively, (Figure 53). AI and robotics are the least used technologies in the sample (14,9% and 15,9% respectively).

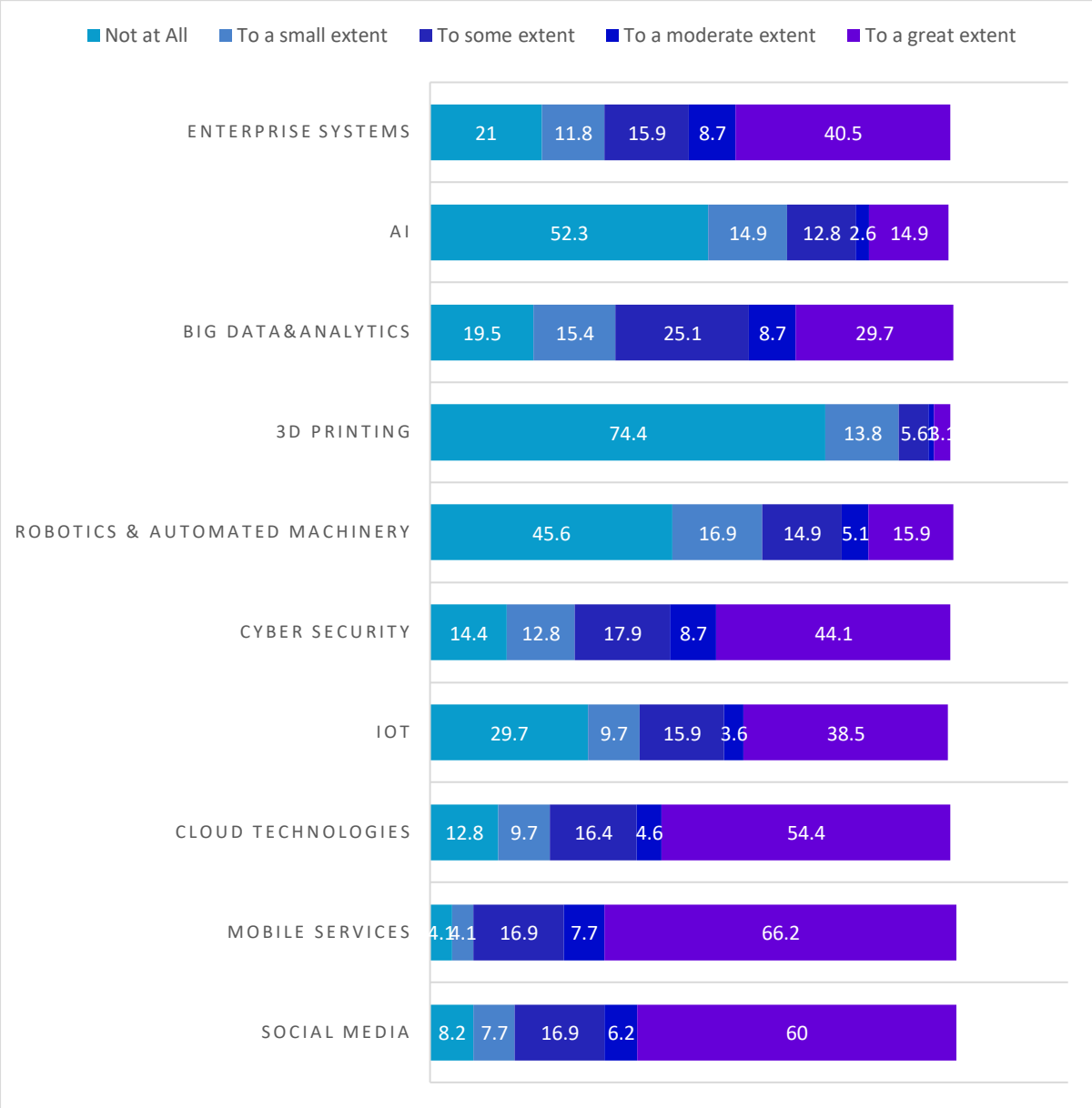


Figure 53:Use of technologies by businesses

Regarding whether the participating companies are planning to invest in any of the selected technologies, the answers are shown in Figure 54. It seems that with the exception of 3D printing for which only 7,2% of the sample reported

plans to invest in, for all other technologies, respondents stated that their companies are planning to invest giving percentages that range from 24,6% to 60%. The most popular technologies seem again to be cloud technologies (60%) and social media (50,8%), although almost half of the companies seem to be willing to invest in big data and analytics (48,7%), mobile services (48,2%), cyber security (47,7%) and enterprise systems (42,1%).

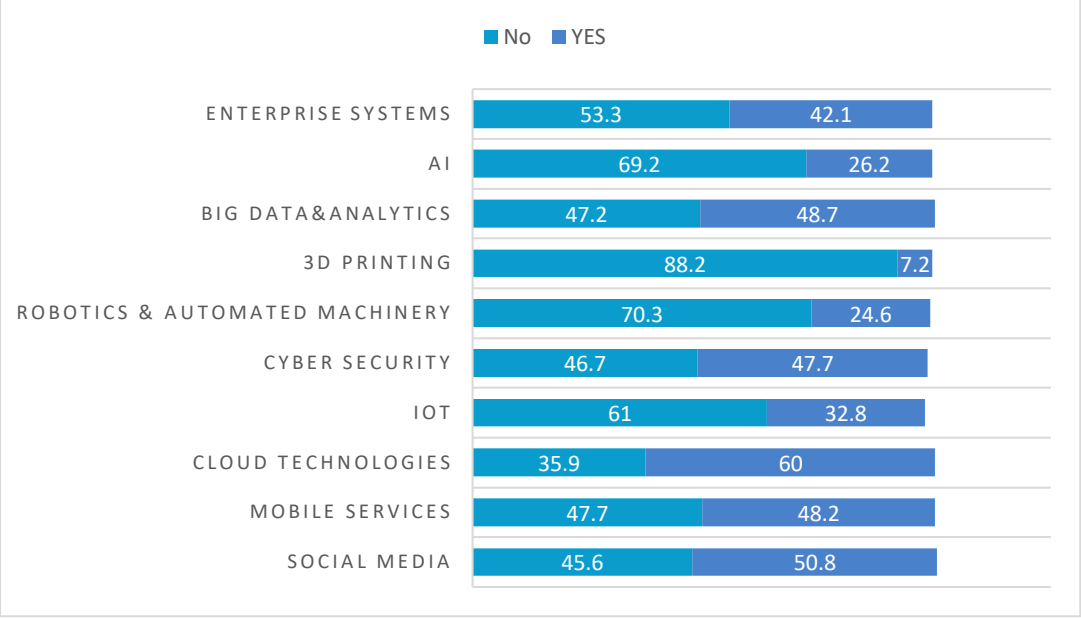


Figure 54: Companies planning to invest in technologies

The main reasons supplied for not using digital technologies is the cost (50,3%) followed by lack of IT professionals (31,8%), (Figure 55).

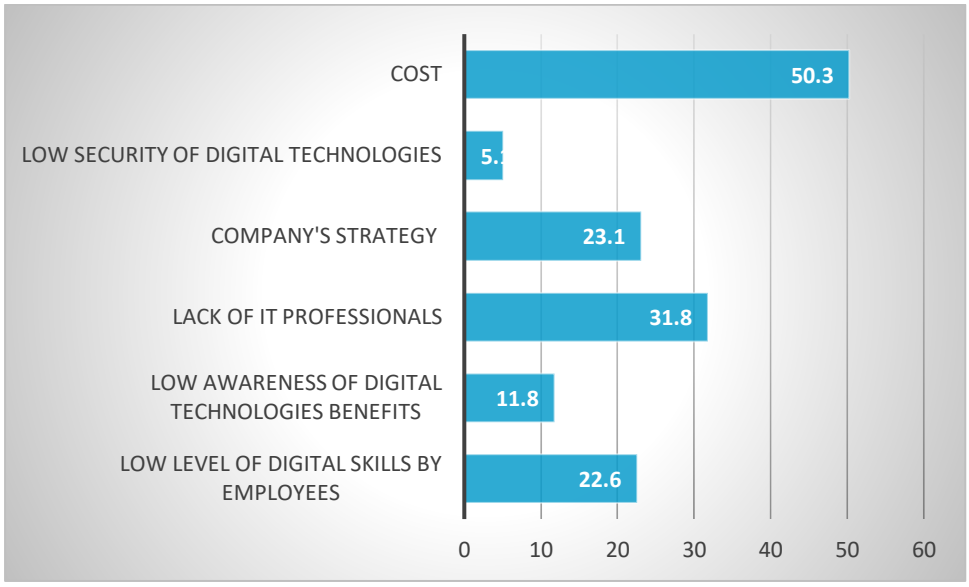
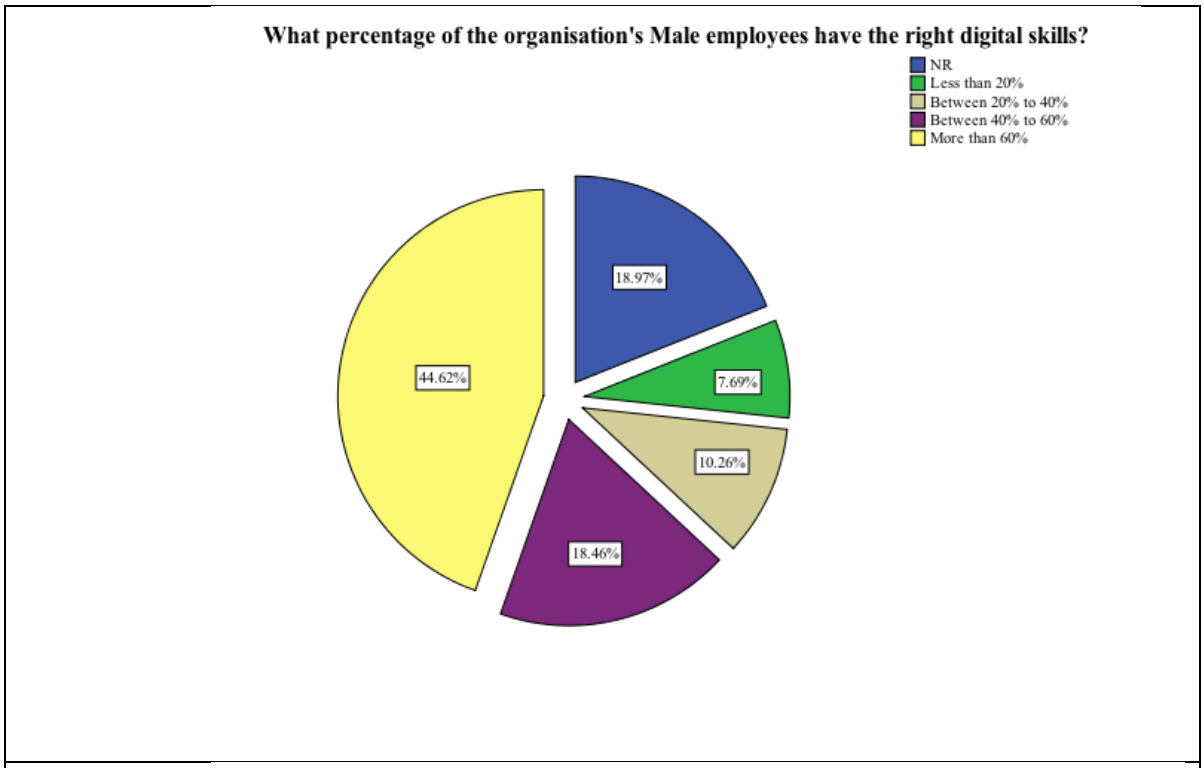


Figure 55: Reasons that prevent companies from using digital technologies

Skills shortages

Sample participants were asked on the digital skills, education and experience possessed by their employees, males and females. Their answers showed that in 44,6% of cases, respondents reported that more than 60% of their male employees have the right digital skills. For female employees, in 33,85% of the cases it was reported that more than 60% of their male employees have the right digital skills, (Figure 56).



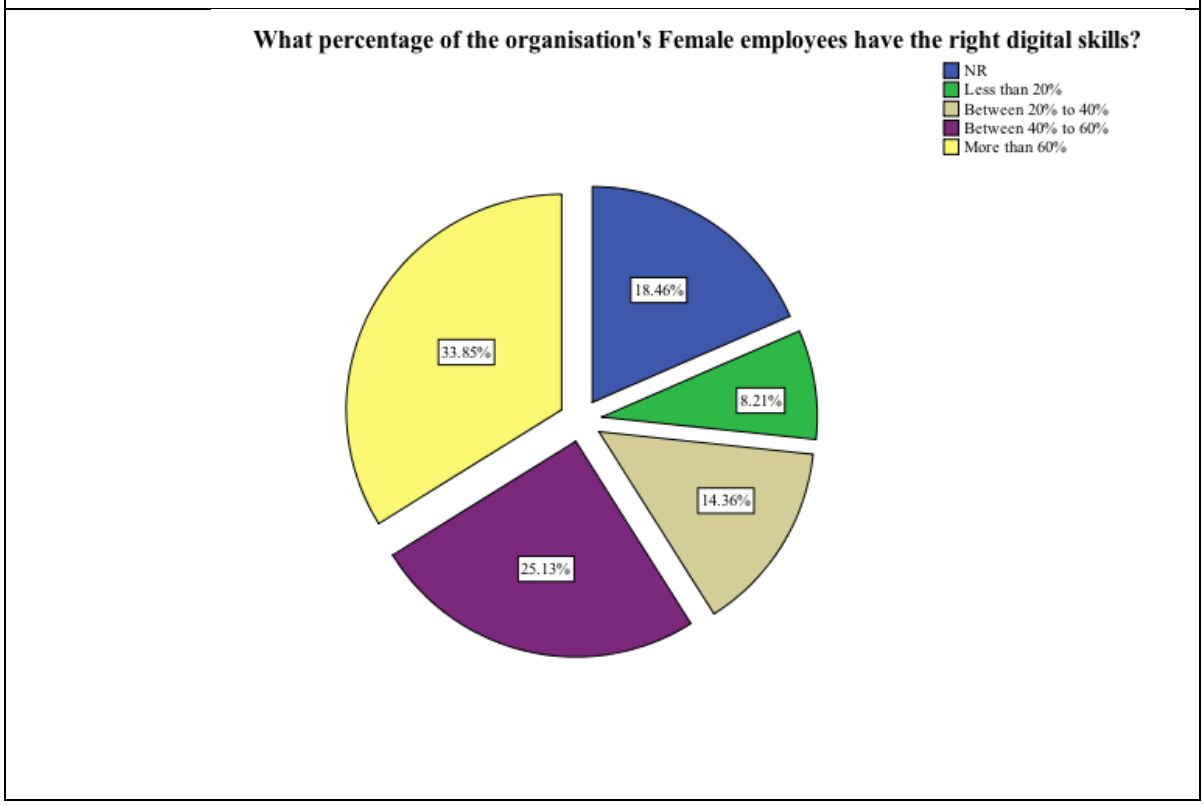
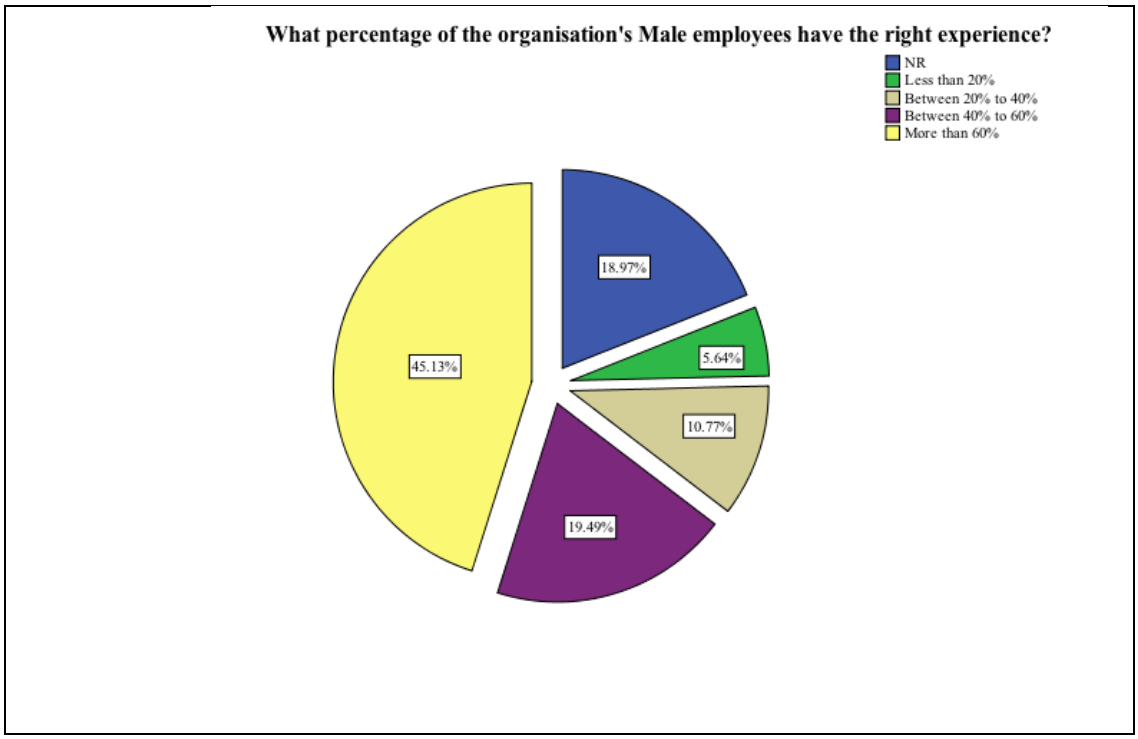


Figure 56: Percentages of male and female employees with the right digital skills

Regarding education, both genders seem to have quite high scores. Thus, in 45,13% of cases, respondents reported that more than 60% of their male employees have the right education. For female employees, in 43,08% of the cases it was reported that more than 60% of their female employees have the right education, Figure 57.



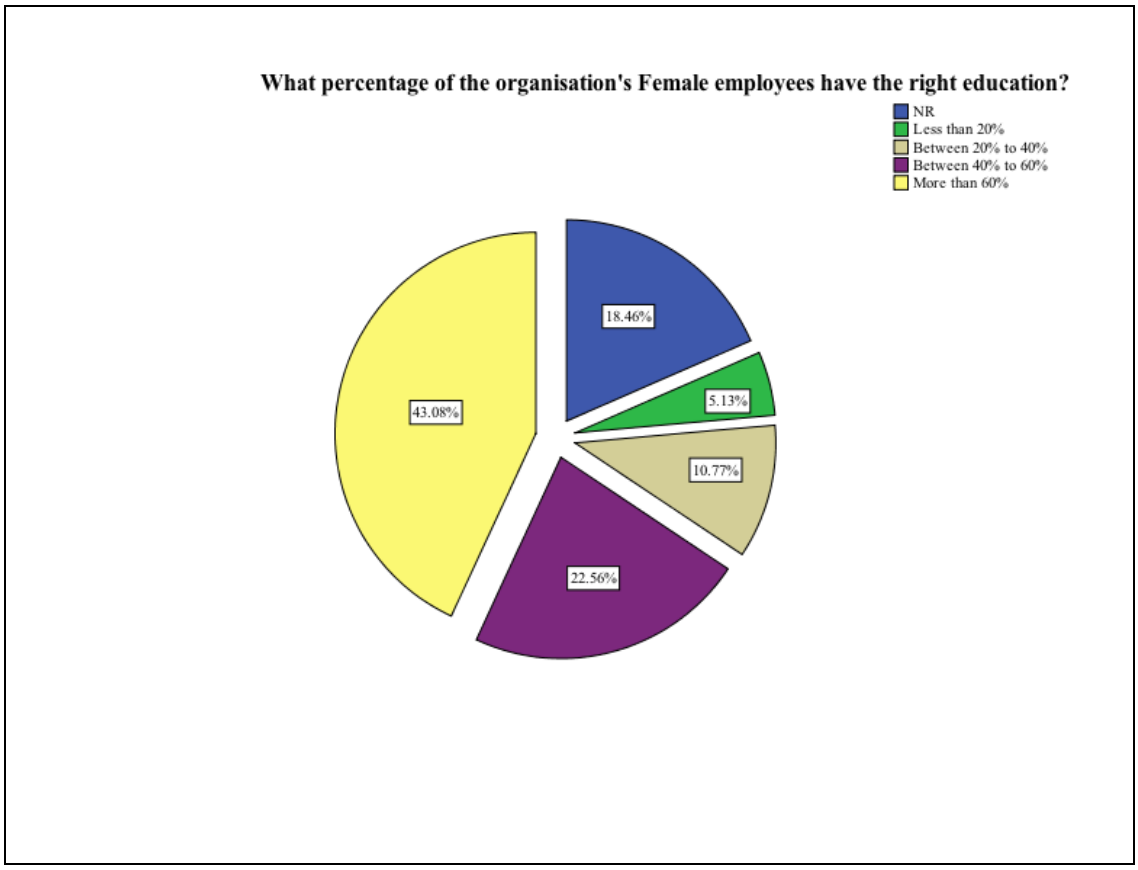
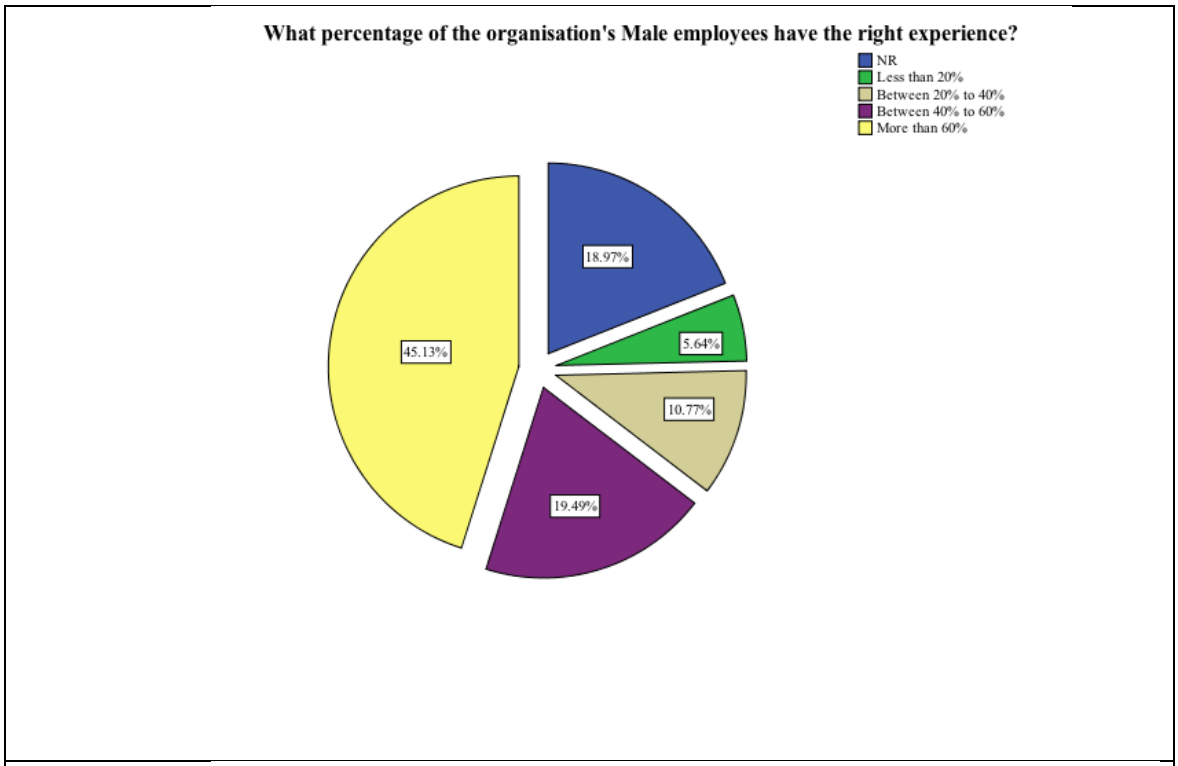


Figure 57: Percentages of male and female employees with the right education

When respondents were asked to provided answers regarding whether the male or female employees have the right job experience, the percentages showed a marked difference.



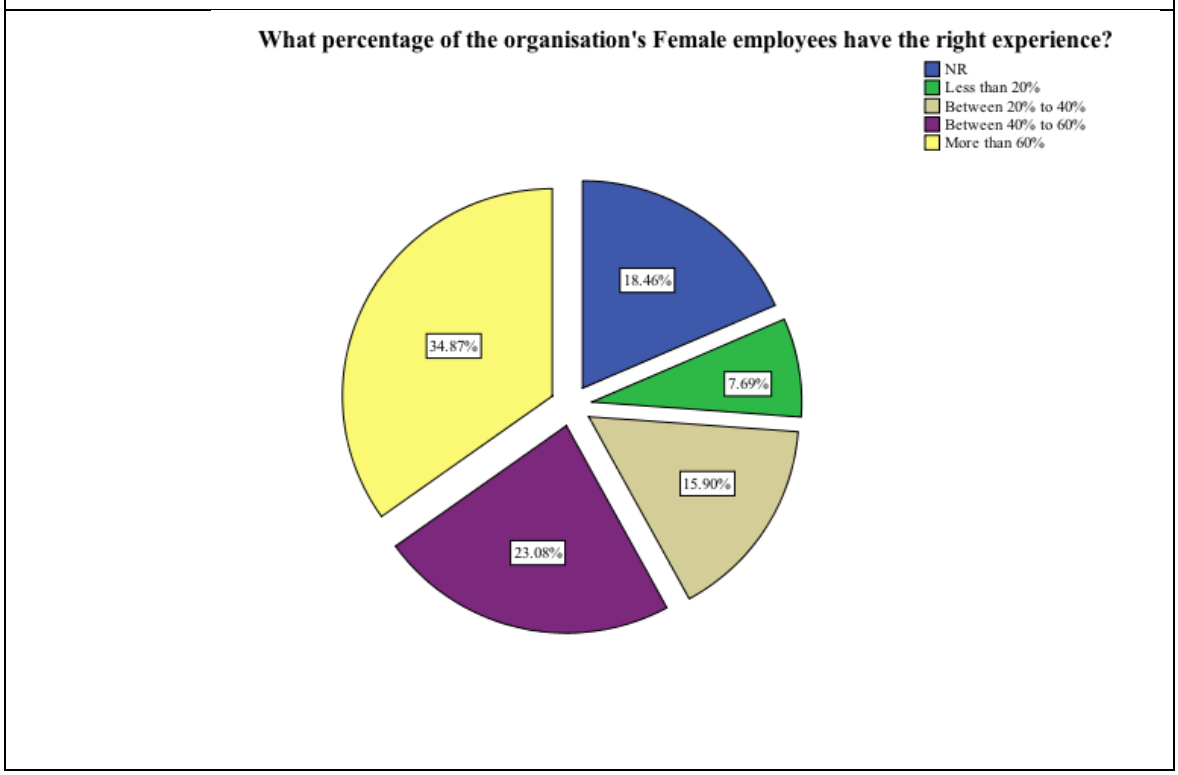


Figure 58:Percentages of male and female employees with the right experience

Thus, in 45% of the firms, respondents reported that more than 60% of their male employees have the right experience, while for female employees in only 35% of the firms it was reported that more than 60% of female employees have the right experience, Figure 58.

This finding is compatible with the literature presenting that women lag behind men in digital skills and experiences, which show that improving the digital skills can change the picture. Studies also demonstrate that the proportion of women in the EU who earn higher education qualifications, such as degrees, is higher (29 percent) among women than men (25.3 percent) which could provide an explanation for the findings of this survey, that women are high-achievers when it comes to education.

Recruiting

When respondents were asked during the last 1-2 years, how many job applicants had the right digital skills, the comparison revealed an almost 30% difference when top applicants were concerned: in 28% of the firms, respondents reported that more than 60% of their male applicants possessed the right digital skills, while for female employees, 20% of the firms reported the same high percentage, Figure 59.

APPLICANTS - SKILLS	Male	Female
Less than 20%	9.2	11.3
Between 20% to 40%	19.0	25.1
Between 40% to 60%	23.6	23.1
More than 60%	28.2	20.5

Figure 59: Job applicants with the right digital skills

When respondents were asked during the last 1-2 years, how many job applicants had the right education, the comparison revealed almost similar percentages for top applicants: in 32,3% of the firms, respondents reported that more than 60% of their male applicants possessed the right education, while for female employees 29% of the firms reported the same high percentage, Figure 60.

APPLICANTS - EDUCATION	Male	Female
Less than 20%	8.7	6.7
Between 20% to 40%	12.3	16.9
Between 40% to 60%	26.7	27.2
More than 60%	32.3	29.2

Figure 60: Job applicants with the right education

When respondents were asked during the last 1-2 years, how many job applicants had the right experience, the comparison showed again a marked difference: 25% of the firms reported high percentages for male applicants, while only 16% of the firms reported the same high percentage for the female applicants, Figure 61.

APPLICANTS - EXPERIENCE	Male	Female
Less than 20%	11.3	13.3
Between 20% to 40%	22.6	28.2
Between 40% to 60%	20.5	22.6
More than 60%	25.6	15.9

Figure 61: Job applicants with the right experience

Skills

The specific question (What ICT and soft skills do you think will be required in the next 5 years?) was open and the classification of responses was difficult as a very large number of skills, competences and attitudes was reported depending on the background of the respondent. For this reason, in the analysis it was also included feedback from the focus groups and stakeholders' interviews. Thus, the major categories developed included levels of competence, such as basic skills and advanced skills, ICT skills, and soft skills. In the Tables below, some of the field research participants' responses are included, to provide an idea of which skills employers and labour market experts believe are important.

Levels of competence

Basic Skills	Advanced Skills
▪ Security ▪ Data Analysis ▪ Working with Databases ▪ Stem talent ▪ Helpdesk ▪ Database analysis ▪ SQL and programming etc	▪ Information processing ▪ Software and product development principles, business and system process analysis, user experience, testing ▪ Organization and maintenance of IT Services and Infrastructure Management Processes ▪ Data Analysis ▪ Elaboration of on-line marketing plans ▪ Cybersecurity ▪ CRM management ▪ Data Analysis ▪ Transformation and adaptation capacity ▪ C++ and C# programming for video games etc

Type of skills

ICT Skills	Soft Skills
▪ Cloud ▪ Automation ▪ AI	▪ Communications and presentation skills. ▪ Communication for remote teams ▪ Sales skills ▪ Resilience ▪ Teamwork and Networking

▪ DATA Analytics ▪ Machine Learning, Computer Vision ▪ Programming and coding ▪ Software development ▪ cybersecurity etc	▪ Leadership and Mentorship ▪ Self-promotion ▪ People skills ▪ Problem solving, etc

All of the reported skills were considered important by the respondents and were provided by them, i.e., they were not selected by a drop-down list, so the above presented lists reveal better employers' views and needs.

Job profiles

The respondents were asked what job profiles they believed will be most in-demand the following 5 years. Their answers are shown in Figure 62. In order of priority, as the most demanded job profiles have been selected the following: Developer (48,7%), Digital Media Specialist (42,1%), Data Analyst (39,5%), Solution Designer (35,9%), CRM Platforms Manager (34,4%), Graphic Designer (31,3%), Service Support Role (28,7%), Systems Administrator (27,7%), Database Administrator (27,2%), and Test Specialist (17,4%).

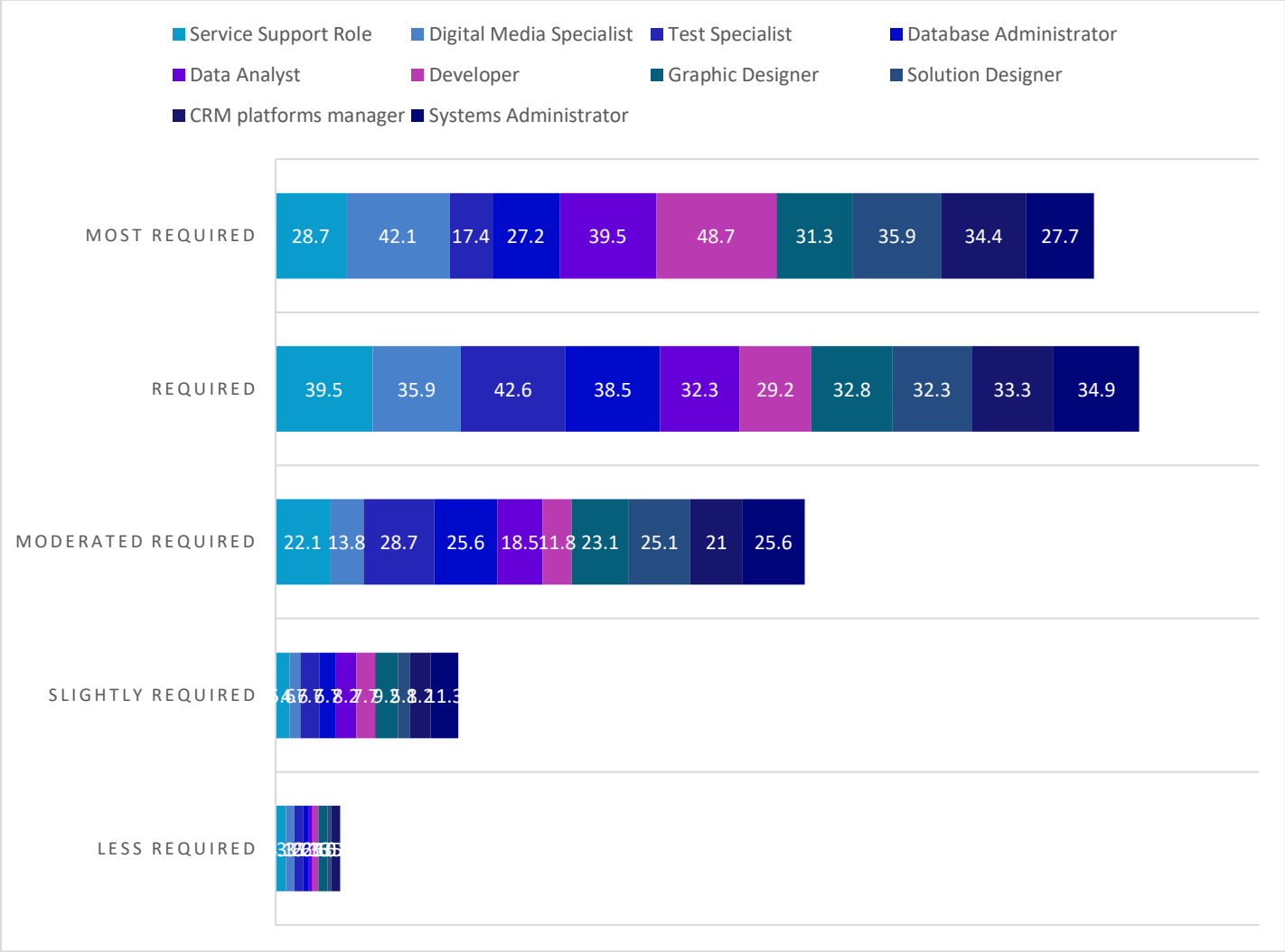


Figure 62: What job profiles are expected to be in-demand the following 5 years

Number and roles of female employees

Respondents were asked the percentage of women employees in their firm. Their answers followed the normal distribution: about one third of the sample reported that women constituted less than 30% of their employees, the other one third reported that more than 70% of their employees are women and the last one third reported percentages ranging from 30%-70%, Figure 63.

Percentage of women employees in the firms of the sample	
% of Firms	% of women employees
Between 0% to 9%	4.1
Between 10% to 19%	5.1
Between 20% to 29%	9.2
Between 30% to 39%	12.8
Between 40% to 49%	12.8
Between 50% to 59%	19.0
Between 60% to 69%	14.4
Between 70% to 79%	10.3
Between 80% to 89%	6.7
Between 90% to 100%	2.1
Between 90% to 100%	2.6
Total	100.0

Figure 63: Percentage of women employees in the firms of the sample

But, when participants were asked the percentage of women in digital/IT positions in their firms, 35,4% of the participants reported that less than 10% of the female employees occupy IT positions, 16,9% of the participants reported that only 10-19% of the female employees occupy such positions and 15,4% of the participants reported that women occupy less than 30% of the IT positions, Figure 64.

Percentage of women employees in IT positions in the firms of the sample	
% of Firms	% of women in IT positions
Between 0% to 9%	35.4
Between 10% to 19%	16.9
Between 20% to 29%	15.4
Between 30% to 39%	9.7
Between 40% to 49%	5.6
Between 50% to 59%	6.7
Between 60% to 69%	2.6
Between 70% to 79%	1.0
Between 90% to 100%	.5
Between 90% to 100%	2.1

Figure 64: percentage of women in IT positions in sample companies

These percentages mirror also the supply of women applicants for IT positions, as 56% of the sample participants stated that women applying for such positions are less than the 30% of all the applicants.

Percentage of women who apply for IT positions	
% of Firms	% of women applicants
Between 0% to 9%	23.6
Between 10% to 19%	14.4
Between 20% to 29%	17.9
Between 30% to 39%	9.2
Between 40% to 49%	6.7
Between 50% to 59%	6.2
Between 60% to 69%	2.6
Between 70% to 79%	1.0
Between 80% to 89%	3.1
Between 90% to 100%	1.5
Between 90% to 100%	1.0
Total	100.0

Figure 65: percentage of women applying for IT positions in sample companies

Important work aspect for women employees

Respondents were asked to provide their opinions regarding which is the most important aspect of the work for women employees. Remuneration and work organization, i.e. how work is structured, e.g. tele-working, were considered as the most important work aspects for women, while work flexibility, i.e. the ability to coordinate their work – schedules, was considered as less important, Figure 66.

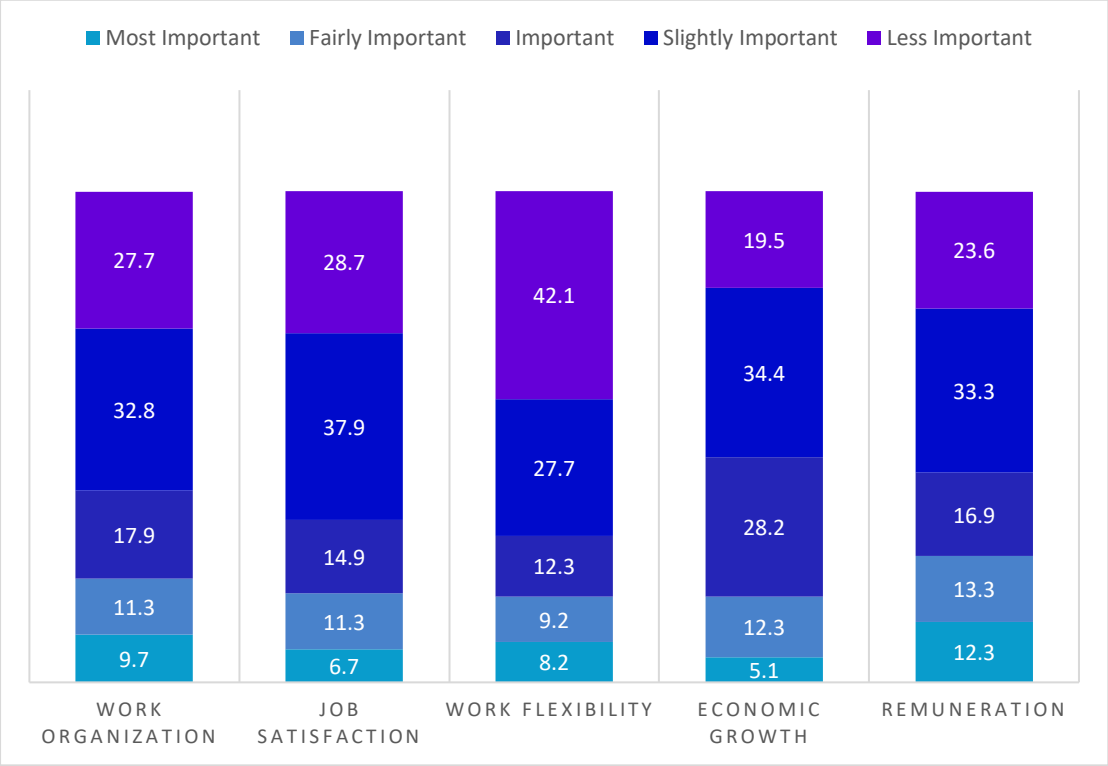


Figure 66: Sample perceptions on which work aspects women consider important

Usually, pay is considered to be valued more by male employees than female employees. It should be noted however, that this questions is not answered by women, but by employers showing their perceptions on women's workplace values.

In the question whether the company has policies for work-family reconciliation, sample responses showed that the majority of the companies (55,9%) has some kind of policies to support work-life balance, Figure 67. This reveals also that family support considerations have increasingly become part of enterprise policies.

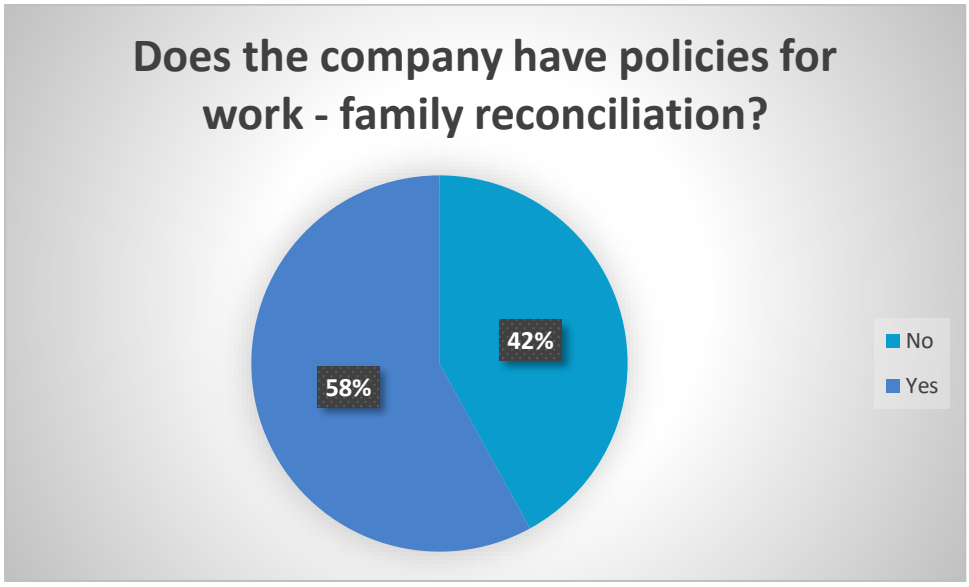


Figure 67: Companies with work - family reconciliation policies

Analysis of Variance

Following descriptive statistics, Analysis of Variance was used to evaluate the interrelationships between dependent and interdependent variables and detect any significant differences in the means between the population's samples.

The overall results of this study indicate that there are statistically significant differences on the following:

- Countries and investments in Cybersecurity solutions
- Countries and investments in Robotics and automated machinery
- Countries and investments in 3D printing
- Company's main activity and Test Specialist Role
- Company's main activity and Systems Administrator
- Company's main activity and percentage of women employees in the firm

More analytically, the analysis of variance (Table 24) revealed statistically significant differences between countries and the will expresses by businesses to invest in Cybersecurity solutions.

Table 24: ANOVA results- country and cybersecurity solutions

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	2.010	1	2.010	6.259	.013[b]
	Residual	63.585	198	.321		
	Total	65.595	199			

Table 25: ANOVA results- country and cybersecurity solutions

The Table below, summarizes the responses from the different national samples, showing that in Spain, Malta and Ireland the companies of the sample make plans to invest in cybersecurity in the following months.

Table 26: Companies willing to invest in cybersecurity

Does your company plan to invest in cybersecurity solutions?		
Country	No	Yes
LATVIA	19	8
SPAIN	11	19
GREECE	16	14
MALTA	9	15
LITHUANIA	18	12
IRELAND	6	18
ROMANIA	13	14

Although the sample size in each country is small, to allow for further statistical investigations, it seems that strong tendencies are observed in certain countries. However, further research is necessary before any conclusions can be reached.

The analysis of variance (below) revealed also statistically significant differences between countries and the will expresses by businesses to invest in robotics and automated machinery.

ANOVA[a] results: Table 27: Companies planning to invest in Robotics and automated machinery

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	2.067	1	2.067	8.722	.004[b]
	Residual	47.157	199	.237		
	Total	49.224	200			

a. Dependent Variable: In the following months, does your firm plan to invest in Robotics and automated machinery?
b. Predictors: (Constant), Country

The Table below, shows that in most of the partner countries, with the exception of Latvia and Greece were percentages were very small, about one third of the respondents stated their willingness to invest in robotics and automated machinery in the following months. Again, although the number of survey participants is very small, it seems that these technologies are starting to be appreciated by the companies.

Table 28: Companies willing to invest in robotics and automated machinery

Does your company plan to invest in Robotics and automated machinery?		
Country	No	Yes
LATVIA	24	3
SPAIN	19	11
GREECE	27	3
MALTA	16	8
LITHUANIA	20	10
IRELAND	18	7
ROMANIA	19	8

Table: 3D printing ANOVA[a] results

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	.366	1	.366	3.569	.060[b]
	Residual	20.391	199	.102		
	Total	20.756	200			

a. Dependent Variable: In the following months, does your firm plan to invest in 3D printing?
b. Predictors: (Constant), Country

Table 29, based on the ANOVA table above, shows that 3D printing is a very advanced technology that companies in partner countries are not familiar with and thus, very few respondents reported that they plan to invest in it, except in Malta where it seems that businesses are starting to find ways to apply it.

It seems that although many businesses have access to broadband networks, the diffusion of more advanced digital technologies such as 3D printing or Robotics differs across countries, a finding that is compatible with the literature (McKinsey Global Institute, 2018). So, more research is needed to understand the drivers of technology adoption.

Table 29: Companies willing to invest in 3D printing

Does your company plan to invest in 3D printing?		
Country	No	Yes
LATVIA	26	2
SPAIN	18	2
GREECE	28	2
MALTA	23	1
LITHUANIA	26	4
IRELAND	23	2
ROMANIA	26	1

The next two analysis of variance results relate to businesses type of activities. Thus, the analysis of company's main activity and Test Specialist job profile (Table 30) revealed a statistically significant difference for product developing companies. Companies that develop products, across the sample, seem to consider this job profile as more important.

Table 30: Company's main activity and Test Specialist job profile ANOVA results

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	5.995	1	5.995	5.302	.022[b]
	Residual	227.247	201	1.131		
	Total	233.241	202			

a. Dependent Variable: What job profiles do you believe will be most in-demand in the following 5 years? [Test Specialist Role (Ensures delivered or existing products, applications or services comply with technical and user needs and specifications)]
b. Predictors: (Constant), What is your company's main activity?

Table 31: Company's main activity and Systems Administrator job profile ANOVA results

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	3.719	1	3.719	3.835	.052[b]
	Residual	194.931	201	.970		
	Total	198.650	202			

a. Dependent Variable: What job profiles do you believe will be most in-demand in the following 5 years? [Systems Administrator (Installs software, configures and upgrades ICT systems)]
b. Predictors: (Constant), What is your company's main activity?

The analysis also revealed that ICT companies of the sample consider Systems Administrator job profile as more important than the rest of the companies. The job description of a Systems Administrator includes: installing and configuring software, hardware and networks, monitoring system performance and troubleshooting issues, while ensuring security and efficiency of IT infrastructure. It usually belongs to the ICT unit of a company, and can work in any type of industry, including the ICT.

Table 32: ANOVA results on service providers and % of women employees.

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	23.465	1	23.465	4.218	.041[b]
	Residual	1118.101	201	5.563		
	Total	1141.567	202			

a. Dependent Variable: What percentage of women employees are there in your firm? (please give only a percentage %)
b. Predictors: (Constant), What is your company's main activity?

It seems that services providing companies state that they have more women employees in their workforce, a trend that has also been observed in the literature. According to many studies female employment is highly corelated to the service sector, (World Bank Org).

CHAPTER 15: Concluding Remarks – Employers' Survey Summary

Adoption of Technologies

Technologies are reshaping our lives and the way we work. Employers have started to realize the benefits of ICT, but they need support on the available options and how best to use the technology. In our sample, although small, it is evident that companies are planning to invest not only in the most popular office automation technologies such as social media and cloud, but also in cybersecurity and in more advanced technologies, such as robotics. Except the cost, of major concern were the lack of IT professionals and the low skilled personnel. Thus, ICT experts among firms' staff or employees with specialized ICT skills can increase the probability of ICT adoption, which leads to the next point.

Digital skills

In order to promote the adoption and diffusion of the new technologies, it is necessary for companies to posses the necessary expertise which is especially hard for smaller firms, However, it is the micro and small firms that constitute the vast majority of enterprises in all partner countries. Greater understanding of the time and financial constrains that small business face and the provision of support could benefit all parties involved. But, because digitalization brings about changes in work organization and businesses processes, management education and the development of soft skills could also be helpful. Actually, most of the respondents, when asked, suggested technical and soft skills as necessary also for todays' marketplace.

Job profiles

Although some job profiles were evaluated by the majority of the survey participants as very important such as Developer, Digital Media Specialist and Data Analyst, there was found a connection between company's main activity and specific roles. Taking into consideration the different challenges and

opportunities that each country faces and the different levels of digital transformation, a more detailed analysis, not only of the local labor market, but also of the specific company environment might be appropriate.

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ANNEXES

ANNEX 1: DETAILED BASELINE REPORT

Part 1: Country profiles

LATVIA

1.1: General characteristics:

- Population: 1.95m.
- General employment rate: 70,1%
- Women: 68,4% in the workforce.

Employment rate			
Age	**Female**	**Male**	**Total**
15-64	68,4	71,9	70,1

1.2: NEET employment rates: Men and women, 2018 (15-29):

Unemployment rates NEET (15-29) age groups							
15-29		**15-19**		**20-24**		**25-29**	
women	**men**	**women**	**men**	**women**	**men**	**women**	**men**
8,4%	4,8%	6,5%	5%	8,7%	7,2%	12,8%	4,6%

- The majority of unemployed NEETs in Latvia are between the ages of 25 and 29.
- There is a higher percentage of female unemployment than of male, across all age groups

1.3: NEET employment rates per sector:

Employment per sector			
Sector	**Women**	**Men**	**Total**
Agriculture, forestry and fishing	4,2	9,6	6,9
Extractive industries and Manufacturing industry	11,4	21,2	16,2
Building	1,5	12,8	7,0
Trade, accommodation and catering services	22,3	13,6	18,0
Transportation and storage and Information and communications	6,9	17,4	12,1
Financial and insurance activities, Real State activities, scientific and administrative activities.	13,4	10,4	11,9
Public administration and defense; mandatory social security	7,2	6,9	7,0
Education	15,1	3,2	9,2
Health and social services activities	10,4	1,9	6,2
Other services	7,7	3,0	5,4

(Central Statistical Bureau of Latvia, 2017)

- The majority of men are employed in Extracting and Manufacturing, as well as Transportation/Storage and Information/Communication.
- The majority of women are employed in Trade, Accommodation and Catering services.
- The percentage of women employed in ICT is very low compared to that of their male counterparts.

2. Structure and Intensity of the Industrial Sector:

Firm Size Structure			
Type		**Count**	**Distribution**
Micro	1 to 9	163 909	93,7%
Small	10 to 49	9167	5,24%
Medium	50 to 249	1608	0,91%
Large	250 or more	235	0,13%

(Central Statistical Bureau of Latvia, 2017)

- The vast majority of enterprise population is comprised by micro-firms (163.909 enterprises).
- Large firms comprise a tiny fraction of the enterprise population, compared to every other EU country.

Industry structure (service, trade, manufacturing, etc):	
Indicators of structural business statistics by the number of employees, 2016:	**Persons employed:**
Total	**63 49 54**
0-19	279 500
20-49	8 48 01
50-249	13 76 87
250+	13 29 66
Manufacturing	**14 19 15**
0-19	33 900
20-49	2 33 82
50-249	5 00 00
250+	3 46 33
Construction	**6 34 49**
0-19	33 119
20-49	1 18 79
50-249	1 39 20
250+	45 31
Trade	**15 94 93**
0-19	44 998
20-49	1 89 57
50-249	2 85 43
250+	3 49 45
Services	**27 00 97**
0-19	135 433
20-49	3 05 83
50-249	4 52 24
250+	5 88 57

(Central Statistical Bureau of Latvia, 2017)

- The majority of employees are concentrated in the Services Industry, followed by the Trade Industry.
- The majority of the workforce is employed by micro/small firms, in every sector.

3. Industries with Growth Potential:

Target sectors where Latvia has a competitive advantage:
Woodworking
Metalworking and mechanical engineering
Transport and storage

Food processing
Green technology
Health care
Life sciences
Food processing

- The economic crisis proved that the Latvian economic model–mainly based on internal demand– was not sustainable. As a result, action was taken to support the transition towards a more sustainable economy focuses on exports, paired with increased attraction of capital. The aim of the policy is to be more competitive in both internal and external markets.

4. Job supply and demand:

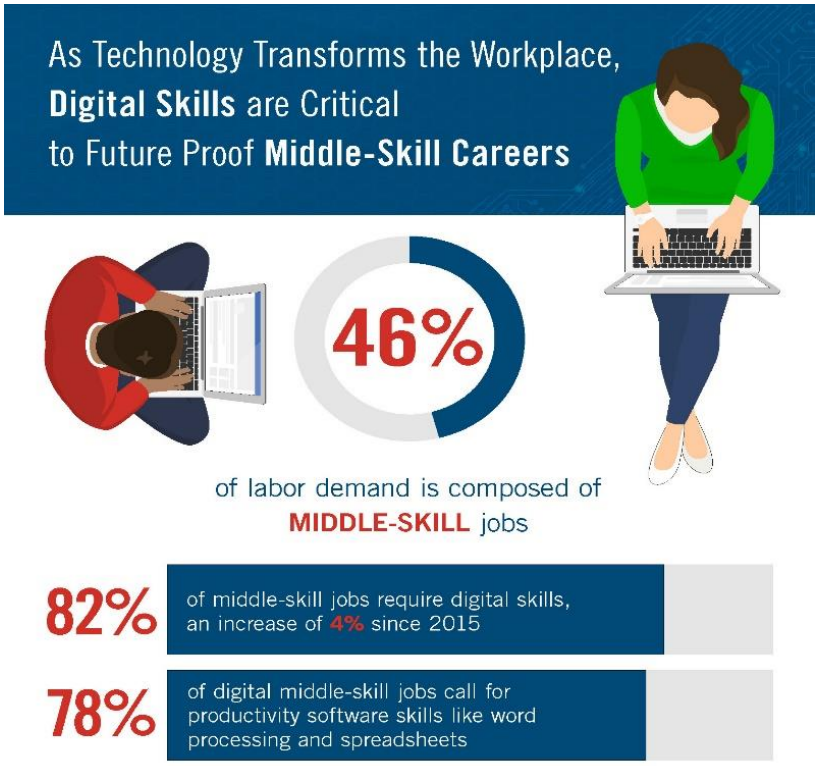
Sectors	Job vacancies, Thousand	Occupied posts, thousand	Job vacancy rate, %
Agriculture, forestry and fishing	0,4	22,8	1,8
Mining and quarrying	0,1	3,7	2,0
Manufacturing	3,5	113,5	3,0
Electricity, gas, steam and air conditioning supply	0,2	12,0	1,7
Water supply; sewerage, waste management and remediation activities	0,2	7,9	3,0
Construction	2,4	63,3	3,7
Wholesale and retail trade, repair of motor vehicles and motorcycles	4,6	146,2	3,1
Transportation and storage	2,2	76,5	2,9
Accommodation and food service activities	1,4	36,1	3,8
Information and communication	0,7	34,4	2,1
Financial and insurance activities	0,3	17,2	1,7
Real estate activities	0,4	28,1	1,4
Professional, scientific and technical activities	0,4	42,2	0,9

Administrative and support service activities	0,9	38,9	2,2
Public administration and defence; compulsory social security	3,4	64,2	5,1
Education	1,0	96,7	1,1
Human health and social work activities	1,9	67,8	2,7
Arts, entertainment and recreation	0,3	25,6	1,0
Other service activities	0,1	14,4	0,7
Total	**24,5**	**911,5**	**2,6**

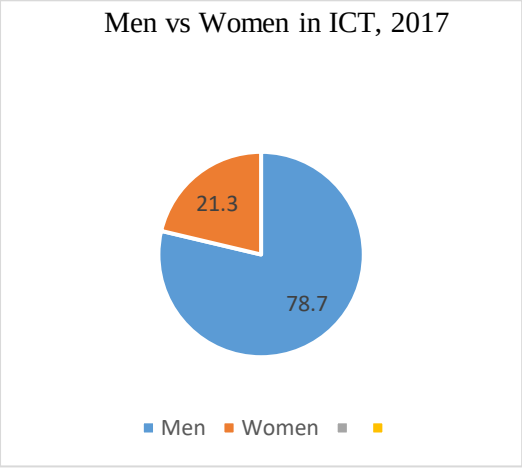
(Central Statistical Bureau of Latvia, 2017)

- The biggest job supply can be observed in Manufacturing, Wholesale and Retail/Trade, as well as Public Administration and Defence/compulsory Social Security

4.1: National report on skills sets in demand:



- Employers don't only require specific education and technical skills, but also knowledge of foreign languages, digital skills and previous experience.
- Communication skills are a prerequisite in 59% of job vacancies. Transversal skills are also highly desirable.
- Usually, it's not required to have specific digital knowledge of an individual program like Microsoft Excel or Word, but a full set of digital skills.
- Personal skills, including a high level of responsibility, accuracy, ability to work independently/self-discipline, positive attitude and ability to learn are also highly valued in the job market.



5. Participation of women in the ICT sector:

- The percentage of female ICT students in Latvia, in 2017 was 18, slightly above the EU average (17%).
- The image is slightly more positive in the workforce.
- 21,3% of people employed in the ICT sector are women, a number above the EU average (17%).

SPAIN

1.1: General characteristics:

- Population: 46,72m.
- General employment rate: 60,80%
- Women: 59,60% in the workforce.

Employment rate, 2017		
	Thousands persons	Percentage of total population
Males	7.138	71,5
Females	5.945	59,6
Total	13.283	60,8

1.2: NEET employment rates: Men and women, 2018 (15-29):

Unemployment rates NEET (15-29) age groups							
15-29		15-19		20-24		25-29	
women	men	women	men	women	men	women	men
17,1%	15,7%	7,6%	8,7%	18,1%	19%	24,8%	19,4%

- The majority of NEETs in Spain are aged between 25 and 29.
- There is a higher percentage of unemployed female NEETs than of male, in total.

1.3: NEET employment rates per sector:

Sector	Women	Men
Agriculture, forestry and fishing	2%	5,6%
Extractive industries	0	0,3
Manufacturing industry	7,3	16,9
Supply of electric power, gas, steam and air conditioning	0,3	0,6
Water supply, sanitation activities, waste management and decontamination	0,3	1,2
Building	1,2	10,6

Wholesale and retail trade, repair of motor vehicles and motorcycles	17,0	14,5
Transportation and storage	2,1	7,4
Hostelry	11,0	8,2
Information and communications	1,9	4,0
Financial and insurance activities	2,5	1,9
Real State activities	0,9	0,7
Professional, scientific and technical activities	5,5	4,7
Administrative activities and auxiliary services	6,3	4,2
Public administration and defense; mandatory social security	6,3	7,5
Education	9,4	3,8
Health and social services activities	14,4	3,7
Artistic, recreational and training activities	1,9	2,2
Other services	3,5	1,4
Activities of households as employers of domestic personnel/producers of goods and services for their own use	6,2	0,7
Activities of extraterritorial organizations and organizations	0	0

Source: Spanish Statistic Institute

- The majority of women are employed in Wholesale and retail trade, repair of motor vehicles and motorcycles.
- The majority of men are employed in the Manufacturing industry and Wholesale/Retail trade.
- There are significantly more men than women employed in ICT (double the number), but the percentage is very low for both genders.

2. Structure and Intensity of the Industrial Sector: Medium

Type		Distribution
Without salaried employees		55,00%
With salaried employees		45,00%
Micro	1 to 9	90,75%
Small	10 to 49	7,70%
Medium	50 to 249	1,30%
Large	250 or more	0,25%

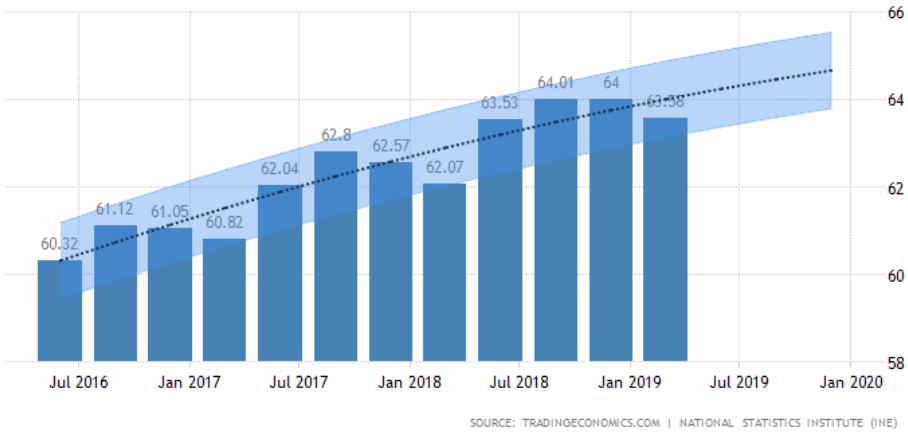
- The table reveals first and foremost, the bias in Spain's firm size distribution towards smaller sized industries and secondly, the perpetuation of this trend over at least the last twenty years.
- Spain's business structure is highly fragmented, consisting of small business units. In fact, eight out of every 10 companies in Spain has two or fewer employees.
- The largest percentage of small enterprises is in the services sector, especially trade.
- In contrast, the bulk of large companies is concentrated in the industrial sector. Moreover, a significant number of large companies are major international players in sectors related to infrastructure development, renewable energy, tourism, banking, insurance, the textile industry, health technology, aeronautics, the agri-food sector and the car industry.

3. Industries with Growth Potential:

Tourism
Real Estate
Food and cuisine
Aeronautics
Environment and Water treatment
Renewable energy
Logstics
Biotechnology

Pharmaceutical and Health Sciences
ICT

- The major contributing sector to the Spanish economy is the farming and agriculture, however, recently the manufacturing (pharmaceutical, technology and telecommunication) industry is also growing rapidly and contributing to the Spanish economy. The service sectors including tourism and construction also are still considered pillars of the Spanish economy. Other important industries include clothing and footwear, construction equipment, manufacturing, the medical industry.



4. Job supply and demand:

- Employment Rate in Spain is expected to be 63.80% by the end of this quarter, according to Trading Economics global macro models and analysts' expectations. Looking forward, we estimate Employment Rate in Spain to stand at 64.00 in 12 months' time. And at around 65.00 percent in 2020, according to our econometric models.

- Future employment growth in Spain up to 2025 will be concentrated in the distribution and transportation sector, business and the service sector. However this growth is offset by job losses in manufacturing and non-marketed (mainly public sector) services.
- In Spain, most job opportunities (around 27%) will be for service and sales workers, much higher than the 16% forecast for the EU as a whole (16%).

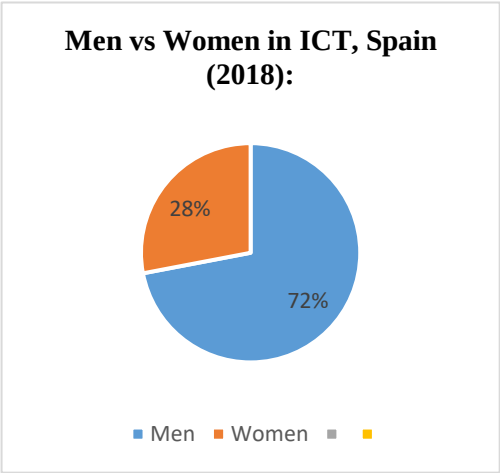
Table 6: Skills Stability, 2015–2020, industries overall

Industry group	Unstable	Stable
Industries Overall	**35%**	**65%**
Media, Entertainment and Information	27%	73%
Consumer	30%	71%
Healthcare	29%	71%
Energy	30%	70%
Professional Services	33%	67%
Information and Communication Technology	35%	65%
Mobility	39%	61%
Basic and Infrastructure	42%	58%
Financial Services & Investors	43%	57%

Source: Future of Jobs Survey, World Economic Forum.

- The share of job opportunities for professionals (high level occupations in science, engineering healthcare, business and teaching), which is around 13% in Spain is lower than the 24% forecast for these occupations in the EU as a whole.
- Most job opportunities will require high-level qualifications (ISCED 97 levels 5 and 6). However, there will also be significant numbers of job opportunities requiring medium-level qualifications (ISCED 97 levels 3 and 4).

4.1: National report on skills sets in demand:



- Companies require new skills in their professionals. Apart from technical knowledge, the market will increasingly value the professional skills of transversal character (soft skills), such as a favorable disposition towards continuous learning, adaptation, creativity or innovation.
- The digital competences will pass of being a differential element to become a basic need and the mathematical thought will have an important weight in the market for work.
- Other skills elated to social performance, management of emotions, communication or leadership will be also important.

5. Participation of women in the ICT sector:

- The percentage of female ICT students in Spain, in 2016 was 13%, below the EU average (17%).

- Reportedly, the biggest barrier holding female students back are of social nature.
- However, the image is a lot more positive in the workforce.
- 28% of people employed in the ICT sector are women, well above the EU average (17%).

	Value	**Percentage**
Telecommunications	31,4	0,4
Programming, consulting and other activities related to computer science.	70,6	0,8
Information services	7,5	0,1
Architectural and engineering technical services; technical tests and analyzes	78,3	0,9

- The majority of women in the ICT sector are employed in Computer Science and Architecture/Engineering services.

GREECE

1.1 General characteristics:

- Population: 10,7m
- General employment rate: 60%
- Women: 43,9% in the workforce

Employment rate, 2017		
	Thousands of persons	Percentage of total population
Males	2.138	62,7
Females	1.545	44,4
Total	3.683	53,5

1.2: NEET employment rates: Men and women, 2018 (15-34):

Male			%	Female			%
Age	15-19	31.4	4.6	Age	15-19	26.5	4.0
Age	20-24	69.6	12.7	Age	20-24	88.9	14.0
Age	25-34	234.9	12.4	Age	25-34	221.9	13.5

- Greece is classified as one of the EU countries with high NEET rates (compared to the EU average which is).
- The majority of NEETs in Greece are aged between 20 and 24.
- There is a higher percentage of female NEETs than of male.

1.3: NEET employment rates per sector:

Employment per sector, 2017			
Sector	Males	Females	Total
Agriculture, forestry and fishing	272,7	180,7	453,3
Mining and quarrying	11,2	0,8	12,0
Manufacturing	252,7	105,5	358,2

Electricity, gas, steam and air conditioning supply	23,7	7,7	31,4
Water supply; sewerage, waste management and remediation activities	21,2	6,2	27,4
Construction	140,5	8,8	149,3
Wholesale and retail trade; repair of motor vehicles and Motorcycles	393,1	286,1	679,2
Transportation and storage	157,9	30,3	188,2
Accommodation and food service activities	192,4	158,3	350,7
Information and communication	58,0	29,0	87,0
Financial and insurance activities	45,1	47,7	92,8
Real estate activities	2,2	1,7	3,9
Professional, scientific and technical activities	107,3	97,4	204,7
Administrative and support service activities	49,9	40,2	90,1
Public administration and defence; Compulsory social Security	211,4	119,2	330,6
Education	97,3	198,5	295,8
Human health and social work activities	75,2	156,3	231,5
Arts, entertainment and recreation	31,0	21,5	52,5
Other service activities	34,0	43,3	77,3
Activities of households as employers	2,6	32,4	35,0
Activities of extraterritorial organisations and bodies	1,4	0,3	1,7

- The biggest share of both men and women are working in wholesale/retail trade.
- The second most popular sector for women was Education.
- The number of men working in the information and communication sector was bigger than that of women (alost double).

2. Structure and Intensity of the Industrial Sector: Low

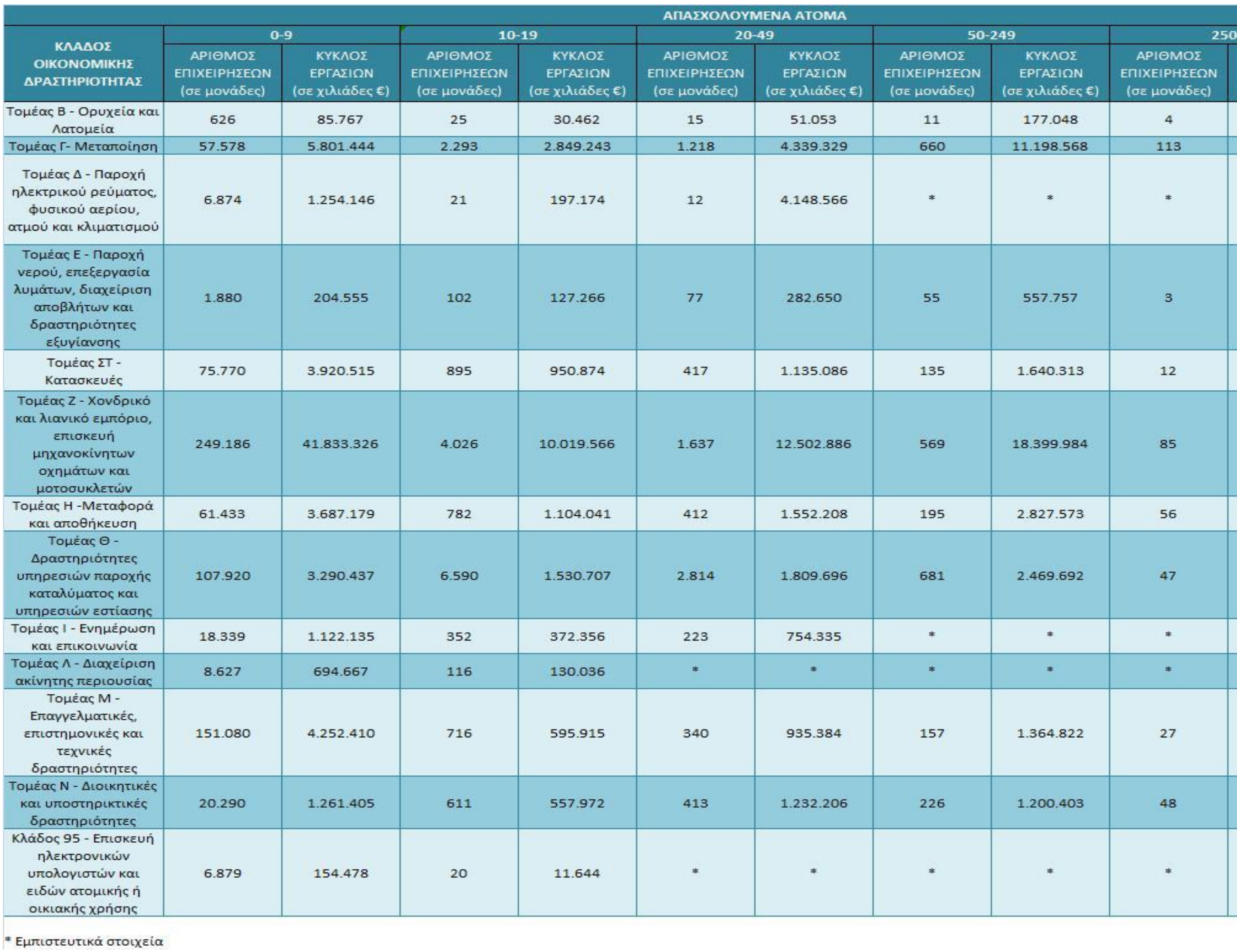
Percentage of the VA of the total manufacturing in Greece – Intensity (2017):	
High-technology manufacturing	4.1
Low-technology manufacturing	40.5
Medium high-technology manufacturing	13.8
Medium low-technology manufacturing	41.6

- Low and Medium-low technology manufacturing produce the majority of the VA in Greece (40.5 and 41.6 alike).

- The vast majority of enterprise population is comprised by micro-firms (215.592 enterprises).
- Micro-firms and small firms employ the majority of employees (28,624 and 27,223 respectively)

Firm size structure, 2016 – 2017			
	Enterprises	**Employees**	**% (to the total number of employees)**
Micro firms (1-9 employees)	215.592	544.863	28,624
Small firms (10-49 employees)	27.525	518.182	27,223
Medium firms (50-249 employees)	3.535	350.694	18,424
Large firms (250+ employees)	584	489.741	25,729

TOTAL	247.236	1.903.480	100



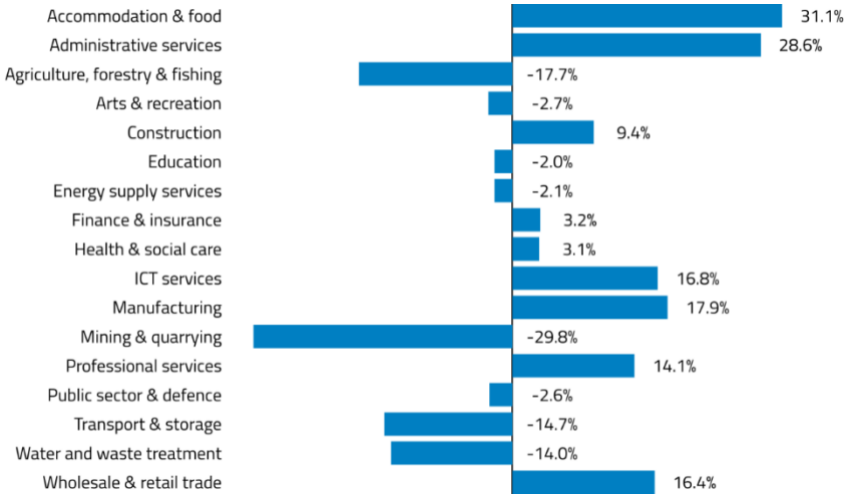
ΚΛΑΔΟΣ ΟΙΚΟΝΟΜΙΚΗΣ ΔΡΑΣΤΗΡΙΟΤΗΤΑΣ	ΑΠΑΣΧΟΛΟΥΜΕΝΑ ΑΤΟΜΑ								
	0-9		10-19		20-49		50-249		250
	ΑΡΙΘΜΟΣ ΕΠΙΧΕΙΡΗΣΕΩΝ (σε μονάδες)	ΚΥΚΛΟΣ ΕΡΓΑΣΙΩΝ (σε χιλιάδες €)	ΑΡΙΘΜΟΣ ΕΠΙΧΕΙΡΗΣΕΩΝ (σε μονάδες)	ΚΥΚΛΟΣ ΕΡΓΑΣΙΩΝ (σε χιλιάδες €)	ΑΡΙΘΜΟΣ ΕΠΙΧΕΙΡΗΣΕΩΝ (σε μονάδες)	ΚΥΚΛΟΣ ΕΡΓΑΣΙΩΝ (σε χιλιάδες €)	ΑΡΙΘΜΟΣ ΕΠΙΧΕΙΡΗΣΕΩΝ (σε μονάδες)	ΚΥΚΛΟΣ ΕΡΓΑΣΙΩΝ (σε χιλιάδες €)	ΑΡΙΘΜΟΣ ΕΠΙΧΕΙΡΗΣΕΩΝ (σε μονάδες)
Τομέας Β - Ορυχεία και Λατομεία	626	85.767	25	30.462	15	51.053	11	177.048	4
Τομέας Γ- Μεταποίηση	57.578	5.801.444	2.293	2.849.243	1.218	4.339.329	660	11.198.568	113
Τομέας Δ - Παροχή ηλεκτρικού ρεύματος, φυσικού αερίου, ατμού και κλιματισμού	6.874	1.254.146	21	197.174	12	4.148.566	*	*	*
Τομέας Ε - Παροχή νερού, επεξεργασία λυμάτων, διαχείριση αποβλήτων και δραστηριότητες εξυγίανσης	1.880	204.555	102	127.266	77	282.650	55	557.757	3
Τομέας ΣΤ - Κατασκευές	75.770	3.920.515	895	950.874	417	1.135.086	135	1.640.313	12
Τομέας Ζ - Χονδρικό και λιανικό εμπόριο, επισκευή μηχανοκίνητων οχημάτων και μοτοσυκλετών	249.186	41.833.326	4.026	10.019.566	1.637	12.502.886	569	18.399.984	85
Τομέας Η -Μεταφορά και αποθήκευση	61.433	3.687.179	782	1.104.041	412	1.552.208	195	2.827.573	56
Τομέας Θ - Δραστηριότητες υπηρεσιών παροχής καταλύματος και υπηρεσιών εστίασης	107.920	3.290.437	6.590	1.530.707	2.814	1.809.696	681	2.469.692	47
Τομέας Ι - Ενημέρωση και επικοινωνία	18.339	1.122.135	352	372.356	223	754.335	*	*	*
Τομέας Λ - Διαχείριση ακίνητης περιουσίας	8.627	694.667	116	130.036	*	*	*	*	*
Τομέας Μ - Επαγγελματικές, επιστημονικές και τεχνικές δραστηριότητες	151.080	4.252.410	716	595.915	340	935.384	157	1.364.822	27
Τομέας Ν - Διοικητικές και υποστηρικτικές δραστηριότητες	20.290	1.261.405	611	557.972	413	1.232.206	226	1.200.403	48
Κλάδος 95 - Επισκευή ηλεκτρονικών υπολογιστών και ειδών ατομικής ή οικιακής χρήσης	6.879	154.478	20	11.644	*	*	*	*	*

* Εμπιστευτικά στοιχεία

- The biggest sectors of economic activity in Greece, both in terms of enterprise population and number of employees are Retail, trade and repair of vehicles, Tourism, Accommodation and food service activities and professional, technical and scientific activities.

3. Industries with Growth Potential:

- **Per the table, the sectors with the biggest growth are:**
  1. Tourism
  2. Energy
  3. Life Sciences
  4. Food & Agriculture
  5. Logistics
  6. Information & Communication Technology (ICT)

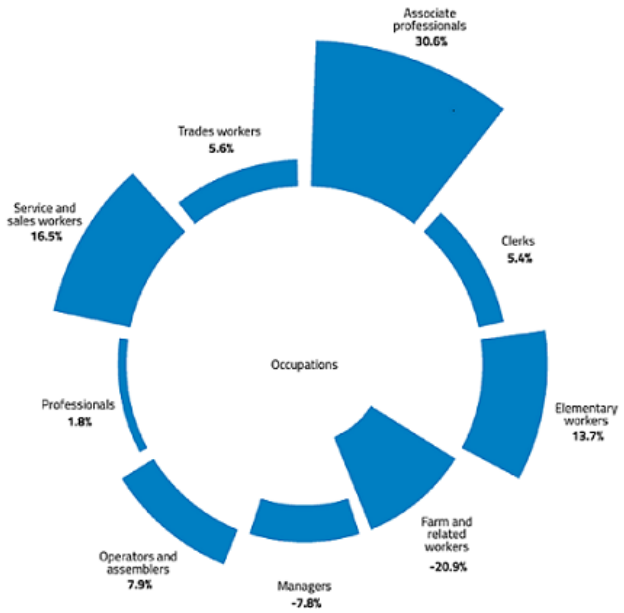


- The ICT sector is expected to grow in the Greek economy, driven by the demand for automation and digitalization in the Public and Private sector.
- It offers opportunities for investment in high-end

services with a global reach, availability of skilled labor, existing know-how and research capabilities, a strong IT and telecoms infrastructure and pleasant working conditions.

- These opportunities, including the establishment of software development labs, data centers or microchip and MEMS design centers can be established with state support, leading to high returns in a short time.
- In the last few years, Greece became the center of several important investment initiatives announced by some of the largest companies in the global ICT industry such as Nokia-Siemens and Oracle.
- The Greek startup ecosystem was brought into the spotlight during the financial crisis and it keeps growing. Greece is home to many aspiring entrepreneurs who are working on new ideas and innovative business models. During the last seven years, more than €250 million has been invested in startups, gaining international fame.

- Overall, the number of ICT business opportunities is expected to increase significantly over the next years.



4. Job supply and demand:

- According to cedefop skill forecasts, Agriculture, the Maritime Industry and Tourism are essential sectors of the Greek economy, slowly recovering from the recession. The forecast paints an optimistic future for Greece, with decent employment growth driven by accommodation & food, administrative services and manufacturing.
- Medium-skilled occupations like sales and personal service workers are predicted to grow substantially till 2030.
- Although most job openings (including replacements for vacated jobs) till 2030 will be for high- or medium-level qualifications, decent job opportunities will be available for low-skilled people, too.
- Future employment growth in Greece over the period 2016-2030 is estimated at 3.2%. The

minimum is -29.8% for Mining and quarrying, while the maximum is 31.1% for Accommodation and food. There are no statistically abnormal values in the samples.

Sectors expected to have the strongest employment change over the period in Greece (2016-2030)	**Occupations expected to have the largest numbers of job openings in Greece (2016-2030):**
Accommodation & food services (31.12%)	Sales workers (369,863)
Administrative services (28.65%)	Personal service workers (314,935)
Manufacturing (17.92%)	Farmworkers and gardeners (298,125)
ICT services (16.78%)	Cleaners and helpers (131,238)
Wholesale & retail trade (16,42%)	Drivers & vehicle operators (104,471)

- Future employment growth mean in Greece over the period 2016-2030 is estimated at 5.9%. Associate professionals exhibit the highest value equal to 30.6%, while Farm and related workers the lowest equal to -20.9%.

4.1: National report on skills sets in demand:

Skills expected to be in high demand: (CEDEFOP's EU skills forecasting model):
ICT
Exports
Environmental and Energy Management
Financial Management
Quality assurance and Regulatory management
Customer Services

- Skills foresight activities tend to concentrate on those sectors where Greece has a degree of comparative advantages, such as tourism, agriculture/food, ICT, and logistics.
- High-skilled, technical occupations such as ICT and technical crafts continue to experience bottleneck vacancies, same as prior to the crisis. Sectors that experience difficulties in recruiting skilled staff are the ICT sector (particularly with knowledge of programming languages and developers), as well as Craft and related Trades workers (such as plumbers and building-related engineers).
- In addition to technical skills, skills expected to be in demand across a variety of sectors and occupations include: ICT competencies, including knowledge/awareness of online sales; environmental, energy and waste management skills; financial and economics skills; quality

assurance and regulatory compliance; customer service skills; knowledge of English; and, in hospitality and catering, knowledge of Russian.

- Looking at past, current and future trends (3-4 years), a number of occupations have been identified as **mismatch priority occupations for Greece**, meaning they are either in shortage of surplus.

- **Shortage occupation**: an occupation that is in short supply of workers, and for which the employers typically face difficulties finding a suitable candidate.

Managers and ICT professionals belong to high shortage occupations for

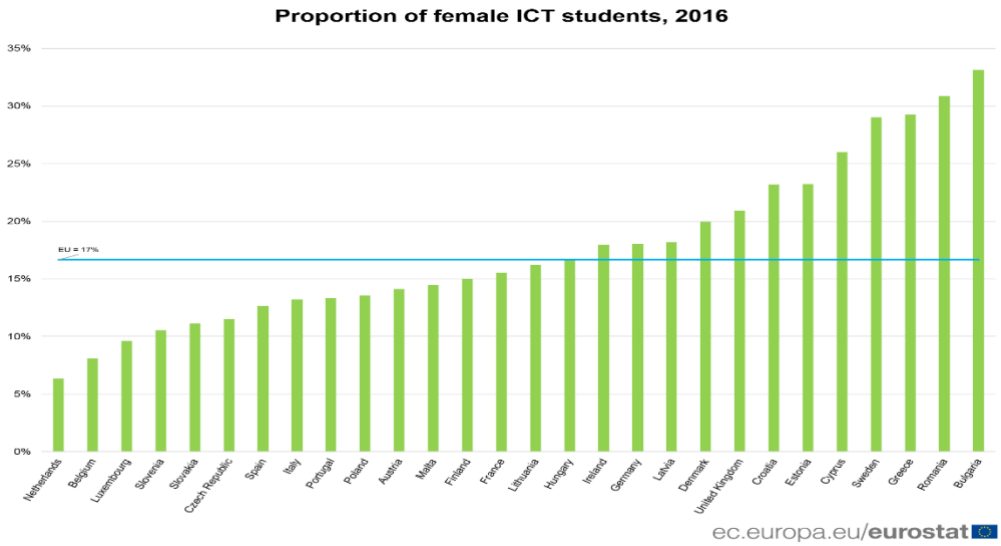
- **Main reasons:**

1. Lack of knowledge transfer and development within organizations.
2. Aging workforce.
3. Sectorial development
4. Redistribution of skilled workers
5. Stagnant technological infrastructure.

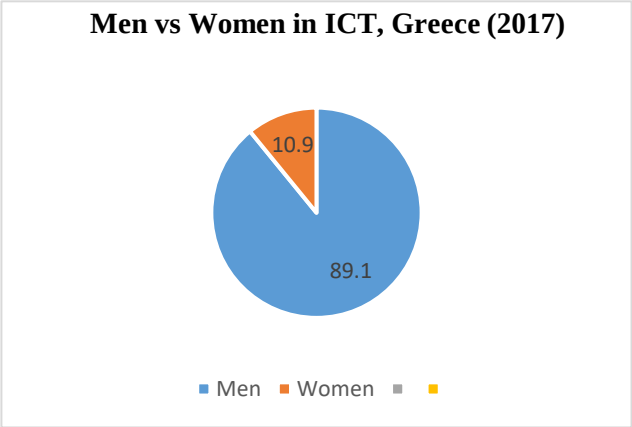
- **Surplus occupation**: an occupation for which there are plenty of suitable workers available but low demand. The employers have no problems filling such posts.

- **Main reasons:**
  1. Economic recession in specific sectors (e.g. construction), leading to a decrease in the number of available jobs (building trades workers, construction laborers).
  2. Influx of economic migrants in construction and domestic work leading to a growth of uninsured labour, increasing unemployment among workers legally working in the industry and sharp drop in the quality of work.
  3. Increased mechanization/automation applied in the sectors of mining, wood and furniture.
  4. Low salaries.
  5. Limited job security.

5. Participation of women in the ICT sector:



- The percentage of female ICT students in Greece, in 2016 was 29%, well above the EU average (17%).
- This is likely due to the nature of university-entry exams, as well as social factors.



- However, the image is drastically different in the workforce.
  - In 2017, only 10, 9% of ICT professionals in Greece were women, way below the EU average (17%).
  - This reality is interpreted as a mixture of financial and cultural reasons, such as the traditional family values that are still prevalent in the Greek society.

MALTA

1.1: General characteristics:

- Population: 460,297
- General employment rate: 58.45%
- Women: 55.5% in the workforce

Employment rate			
Age	Female	Male	Total
15-64	55,5%	83,1%	58,45

1.2: NEET employment rates: Men and women, 2018 (15-29):

Unemployment rates NEET (15-29) age groups							
15-29		15-19		20-24		25-29	
women	men	women	men	women	men	women	men
11,1%	12,7%	4,6%	5,7%	12,1%	13%	9,8%	12,4%

- There are more male NEETs in unemployment than female.
- The majority of unemployed NEETs belong in the 20-24 age group.

1.3: NEET employment rates per sector:

Per Industry:			
	Males	Females	Total
	No.	No.	No.
Agriculture, forestry and fishing	2165	:	2559
Manufacturing, mining and quarrying and other industry	21766	6990	28755
Construction	13208	1372	14579
Wholesale and retail trade, transportation and storage, accommodation and food service activities	39488	21132	60620
Information and communication	6490	2737	9227
Financial and insurance activities	5999	5653	11652
Real estate activities	1767	1130	2897
Professional, scientific, technical, administration and support service activities	12310	11499	23809
Public administration, defence, education, human health and social work activities	25593	34136	59729

Other services	9193	9375	18568
Total	137979	94418	232397

- The majority of both men and women and employed in Wholesale and retail trade, transportation and storage, accommodation and food service activities.
- There are significantly more men working in ICT than women.

2. Structure and Intensity of the Industrial Sector:

Type		**Distribution**
Micro	1 to 9	88,6%
Small	10 to 49	8,24%
Medium	50 to 249	2,91%
Large	250 or more	2,13%

(Central Statistical Bureau of Latvia, 2017)

- The vast majority of enterprise population is comprised by micro-firms (88% of the enterprise population).
- The second largest category is small firms (8%).
- Major market sectors include: Information Communications Technology (ICT), oil and gas, infrastructure, construction, information handling, pharmaceuticals, medical equipment, automotive components, light engineering, alternative and renewable energy, research & development, franchising, security, environmental waste technology, and agriculture technology including medical marijuana production.

3. Industries with Growth Potential:

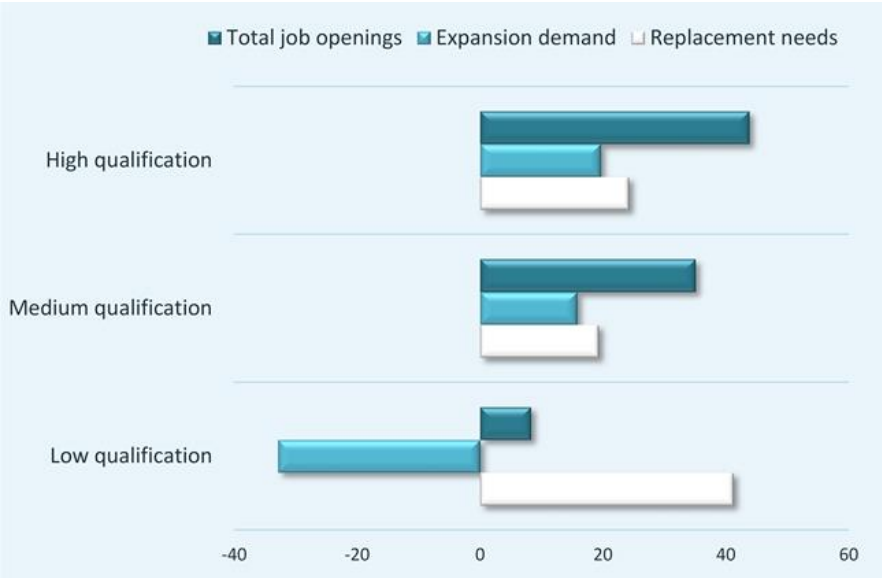
Tourism
Healthcare services
Financial Services
Online Gaming
Insurance
ICT

- Malta is one of the EU's fastest-growing economies.
- Services represent the largest and fastest-growing sector of the Maltese economy. Banking, investment, blockchain and cryptocurrency, insurance, communications, software development and online gaming, education, tourism, ship-repair/aircraft servicing, registration of ships and

aircrafts, health care services, aviation, logistics, film industry, professional services, and back office operations are the largest service sub-sectors

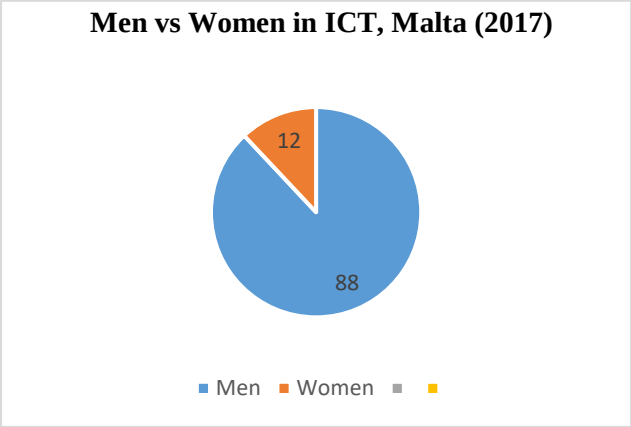
- Malta's GDP in 2017 was $13.5 billion – representing more than 6% growth over 2016, with an estimated per capita GDP of $42,239. The European Commission predicts economic growth for Malta at 5.4 percent in 2018 and 5 percent in 2019, outperforming most EU member states through 2019 – 2020.
- Domestic demand will become the main driver of growth, underpinned by an expansion in public and private consumption.
- Malta is working toward maximizing its potential as a center for international business in the Euro-Med region. A number of companies increasingly use Malta as a base for operations in North Africa, particularly those from Tunisia and Libya.
- Since 2014, the government has promoted public-private partnerships (PPPs) in the healthcare sector to establish Malta as a Mediterranean health hub for medical tourism and to expand capacity for the domestic market. The government is interested in pursuing new PPP opportunities.

4. Job supply and demand:



Total job opportunities by qualification, 2013-25, Malta (thousands).

- According to Cedefop's supply and demand forecast, further positive economic growth in Malta is expected to have only a limited effect on employment, which should be stable, staying close to or slightly above its current level between now and 2025.
- Malta withstood the economic crisis relatively well, but employment still fell in the primary, manufacturing and construction sectors between 2008 and 2013 In contrast, employment in business and other services as well as non-marketed (largely public sector) services increased substantially over the same period.
- Future employment growth in Malta, up to 2025, will be concentrated in business services, and the distribution and transport sectors, while, in the primary and manufacturing sectors employment will continue to fall.
- In Malta, most job opportunities (26%), will be for professionals (high level occupations in science, engineering healthcare, business and teaching), followed by service and sales workers(20%). Shares of job opportunities in Malta for skilled agricultural and fisheries workers,(1%) and technicians and associate professionals (occupations applying scientific or artistic concepts, operational methods and regulations in engineering, healthcare, business and the public sector), (9%), well below the EU averages for these occupational groups.



4.1: National report on skills sets in demand:

- Although a little older, Malta's labour force is becoming more highly qualified. This is explained by older less-qualified people leaving and younger more highly-educated people entering the labour market. By 2025, the share of the labour force with high-level qualifications should rise to 39.2% compared to 28.4% in 2013 and 21.3% in 2005. People with medium-level qualifications in 2025 will account for 34.4 % of the labour force, compared to 25.6% in 2013. The share with low-level or no qualifications is forecast to fall from 46% in 2013 to 29.4% in 2025.

- Due to the nature of shortage occupations, the skills that are considered highly desirable in the labour market are a combination of digital skills, such as data analysis, social media, graphic design and other technical abilities and soft skills, such as communication, adaptability and the will to learn and stay up to date with the changes in the field.

5.

Participation of women in the ICT sector:

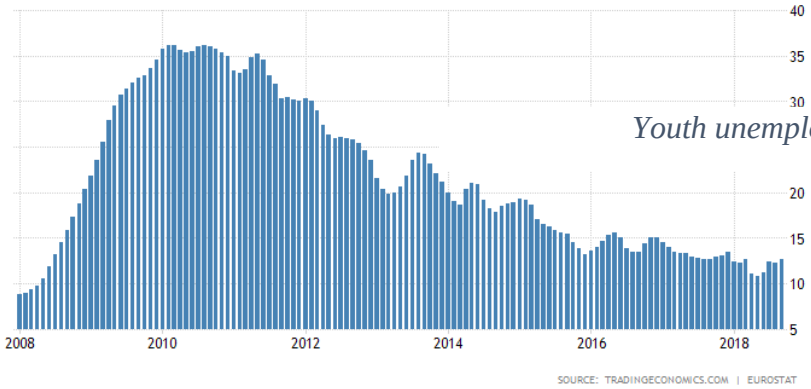
- The percentage of female ICT students in Malta, in 2016 was Just 14 %, a figure below the EU average (17%).

- The image is identical in the workforce.
- In 2017, only 12% of ICT professionals in Malta were women, way below the EU average (17%).
- This fact is interpreted as a result of societal norms, as Malta has the biggest gender gap in employment across the EU

LITHUANIA

1.1: General characteristics:

- Population: 2,8m
- General employment rate: 72,1%
- Women: 50,6% in the workforce



Youth unemployment rate in Lithuania, 2008 – 2018

1.2: NEET employment rates: Men and women, 2018 (15-29):

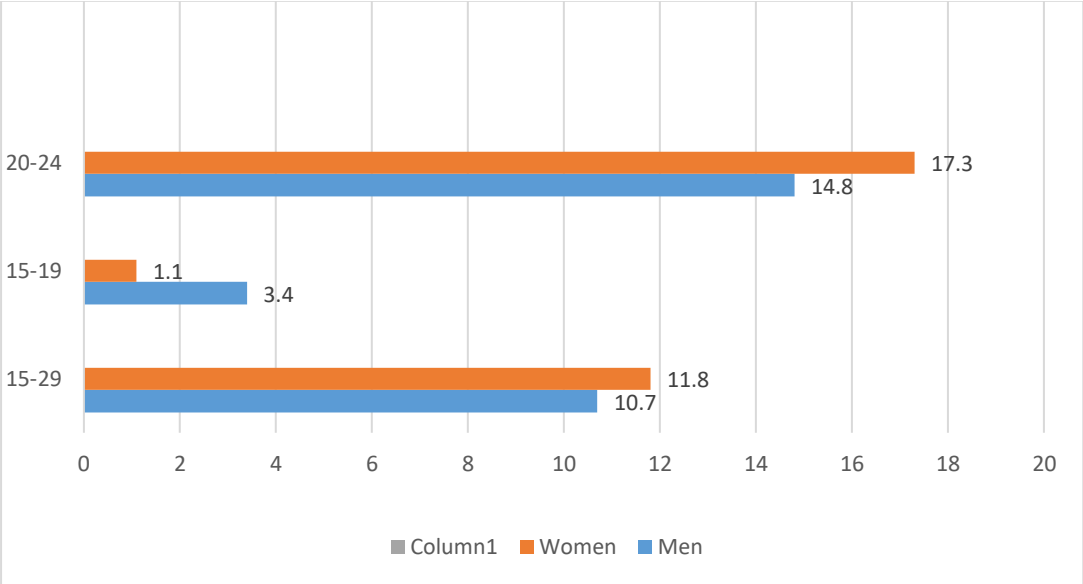


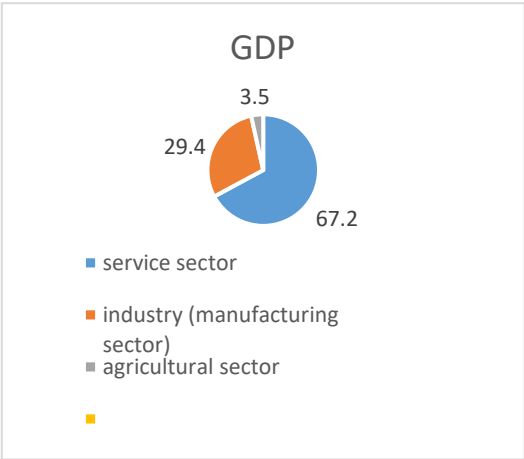
Figure 2: Employment rates per industry gender disaggregated in Lithuania, 2017-2018

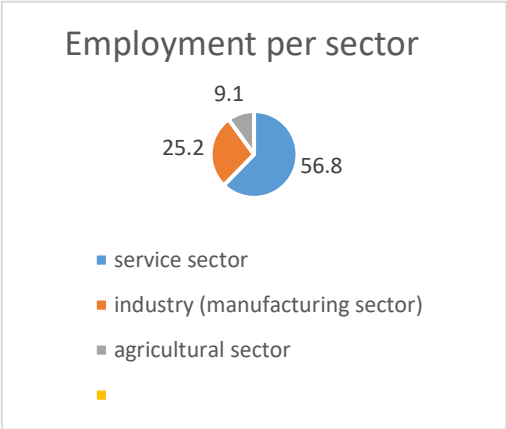
- In 2017, NEET percentage in both was lower than the OECD average but the percentage of women was higher.

	Males				Females			
	2017K4	2018K1	2018K2	2018K3	2017K4	2018K1	2018K2	2018K3
All NACE branches	567.6	562.5	582.2	590.9	627.5	620.9	623.3	633.1
Agriculture, forestry and fishing	36.6	31.7	31.8	42.3	12.6	14.7	14.3	12.6
Mining and quarrying	2.7	2.0	2.2	4.0	/	/	/	/
Manufacturing	105.7	110.9	115.5	107.2	87.3	90.8	91.3	92.9
Electricity, gas, steam and air conditioning supply	9.6	11.4	10.6	7.6	3.2	1.5	2.9	3.0
Water supply; sewerage, waste management and remediation activities	11.3	10.7	12.7	12.5	4.5	2.4	3.0	4.6
Construction	74.5	69.0	72.9	72.4	8.1	8.8	10.9	9.7
Wholesale and retail trade; repair of motor vehicles and motorcycle	88.5	84.7	90.8	85.1	116.8	113.6	113.1	130.0
Transportation and storage	71.5	71.3	71.0	70.7	23.8	24.9	26.1	25.2
Accommodation and food service activities	9.3	7.1	6.1	15.6	20.7	19.3	25.7	25.5
Information and communication	14.9	16.9	17.6	17.6	9.8	10.7	10.6	8.0
Financial and insurance activities	6.2	6.4	3.7	5.9	10.9	12.7	15.4	12.3
Real estate activities	7.2	8.3	8.7	6.0	6.2	4.8	4.4	6.7
Professional, scientific and technical activities	19.5	18.1	19.8	19.9	30.0	30.6	26.6	25.8
Administrative and support service activities	23.7	28.8	25.7	26.6	32.3	23.8	23.8	23.4
Public administration and defence; compulsory social security	36.5	33.5	35.4	41.5	43.5	47.4	45.1	39.2
Education	27.7	26.8	27.9	28.1	105.5	103.3	103.7	109.3
Human health and social work activities	11.1	10.0	12.0	13.1	80.9	74.9	72.6	75.1
Arts, entertainment and recreation	6.6	8.8	10.3	10.0	15.8	19.4	19.9	18.8
Other service activities	4.6	5.9	7.2	5.1	14.6	16.1	12.9	9.7

- The second age group 15-19, had the lowest percentage for both women and men and the percentage of NEET women was three times lower than men.
- Also, in this age group, Lithuania has the lowest percentage of NEET women from all OECD countries. The biggest percentage of NEET women and men was seen in the 20-24 age group and the percentage of women was higher.

1.3: NEET employment rates per sector:





- The biggest share of all employed women is working in wholesale and retail trade and education sectors. Through the year, the number just increased.
- The biggest share of all employed men was working in the manufacturing sector.
- The number of men working in the information and communication sector was bigger than women and increased through the year.
- At the same time, a number of women working in the information and communication sector decreased.
- However, women were more active in scientific and technical activities but the number was decreasing while the number of men working in the same sector was increasing.

. Structure and Intensity of the Industrial Sector:

- 2017 was an attractive year to start a new business or expand an existing one.
- The number of self-employed people is decreasing.
- We can observe an incensement in wages and economic activity.

Size											Employess
	Total	0-4	5-9	10-19	20-49	50-99	100-149	150-249	250-499	500-999	1000 <
Number, thous.	83,4	51,4	16,3	7,9	4,9	1,5	0,5	0,4	0,2	0,1	0,1
Share		61,6	19,6	9,5	5,9	1,9	0,6	0,4	0,3	0,1	0,1
Change per year	0,2	0,0	0,3	-0,2	0,1	0,0	0,0	0,0	0,0	0,0	0,0

Sectors											
	Total	Agriculture	Industry	Construction	Wholesale and retail trade	Scientific and technical activities	Transportation	Real estate	Accommodation and catering services	Administrative activities	Other services
Number, thous.	83,4	2,3	9,3	8,0	24,7	10,2	8,1	4,8	3,5	3,2	9,3
Share		2,8	11,1	9,6	29,6	12,2	9,7	5,8	4,2	3,8	11,0
Change per year	0,2	0,0	-0,1	0,3	-0,5	0,0	0,1	0,2	0,0	0,0	0,2

- The biggest share of the whole market is occupied by small companies employing 0 to 4 employees (61.6%). The smallest amount of companies are the big ones, with 500-999 or more than 1000 employees (0.1%).
- The biggest share of companies is in the wholesale and retail trade sector (almost 30% of the whole market). The 2nd place is taken by companies in the scientific and technical sector – 12.2% companies. The smallest amount of companies were seen in the agricultural sector (2.8%) and administrative activities sector (3.8%

3. Industries with Growth Potential:

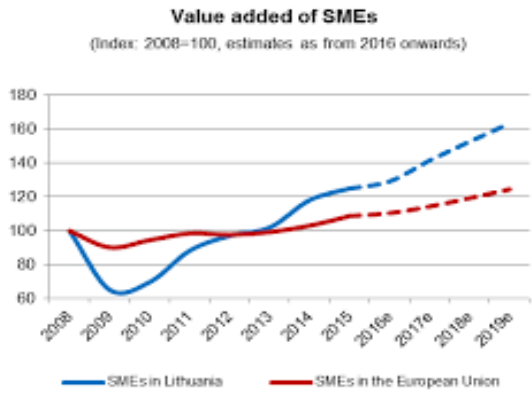
Robotics	Games	Financial technologies
The spread of new technologies makes it easier and cheaper to adapt and thus, render this sector an attractive investment for an increasing number of companies. Lithuania is investing not only aiming to increase manufacturing rates, but with a focus on innovation. In this climate of growth, there is no need to convince companies concerning the advantages of new technologies, vice versa – companies are looking for innovative solutions on their own accord. Specialists estimate that during the period of one year, this industry will grow twice its existing size in the country.	Studies indicate that within seven years, the games industry will grow in a much faster pace than ever before. Despite currently being in an embryotic stage, potential in Lithuania is huge. Companies are increasing their production sizes, creating new job positions and increasing turnover, slowly becoming competitive in the vast global market. However, specialists highlight an issue concerning supply, as Lithuanian professionals in this field are, at this stage, scarce.	The intensive spread of block-chain and "fintech" technologies result in an imminent need for specialists in this industry. Companies from both the private and the public sphere invest significant amounts of human and financial capital in this swiftly growing field. The development of financial technologies in Lithuania is promptly encouraged and it is currently considered one of the main strategic development directions on a national and international level.

- Lithuania has the largest ICT industry in the Baltic States, with an outstanding potential both for local and foreign expanding businesses.

Job supply and demand:

- IT specialists: The most wanted specialists in the year 2018 were programmers in C#, C++, .net and JAVA. Additionally, companies were seeking analysts, developers and mobile app specialists. Every month, there is an average of 800 employment offers, most of them being long-term and a minority concerning a specific task. Common requirements include: similar work experience, wide knowledge of IT processes, methods and tools, analytical and critical thinking, excellent knowledge of the English language and the ability to work in a team. The average salary is 1200 Euros.
- Team leaders: The second most wanted specialists were project managers and team leaders in the business development sphere. Every month, there is an average of 410 long-term employment offers in this field. Common requirements include: experience in sales and management, high self-motivation, excellent communication skills, result oriented mind. The average salary is 1500 Euros.
- Engineers: In the third place for 2018, there were technicians and technologists in the food, metal and wood industry. Every month, there is an average of 390 long-term employment offers for such professionals. Common requirement include: an engineering degree, work experience, technical use of the English language, analytical thinking, good computer skills, and the ability to work well in a team. The average salary is 1000 Euros.

Most wanted specialists in the job market (2018):
1. IT project managers
2. IT systems service support professionals (delivery, R#1)
3. Data analysts (R#9)
4. IT solution developers (programming, R#3, R#5)
5. Game seal managers



- Tendencies: As the IT industry is growing in popularity and importance, data analysts with strong programming and analytical skills are increasingly needed. At the end of this year, professional analysts predict a significant need for high-tech specialists. More specifically, data protection specialists are estimated to be the most wanted specialists in the next five years.
- Demand: The mismatch between demand and supply is still significant and easily observable. While companies are looking for the specialists listed above, most Lithuanians or

working age specialize and are thus seeking to be employed in more “traditional” fields, such as law, culture, marketing, media, human resources management and education.

4.1: National report on skills sets in demand:

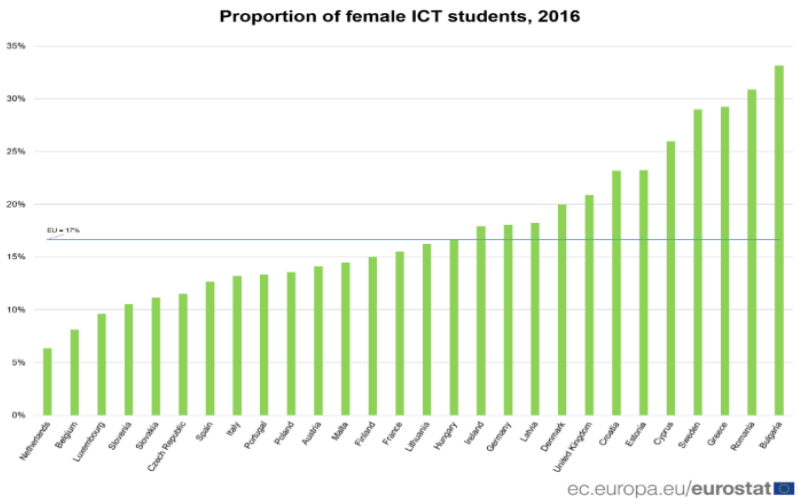
Most needed skills in the Lithuanian job market (2018):
1. Complex problem solving
2. Creativity
3. Critical thinking
4. Team work
5. Decision making
6. Netgotiation
7. Flexibility

*All technical skills should be aligned with high social and emotional intelligence skills.

Top 7 requirements for IT specialists (2018):
1. Similar work experience (>2 years)
2. Knowledge of foreign languages (at least 2)
3. Collaboration skills
4. Critical/analytical thinking
5. Continuous learning
6. Technical skills
7. Mobility

5. Participation of women in the ICT sector:

- The percentage of female ICT students in Lithuania, in 2017 was 14%, below the EU average (17%).
- Reportedly, stereotypical thinking in Lithuania has a profound impact regarding the attitude of students choosing their future. This trend continues after high school and is reflected in universities.
- In the labour market, the situation is slightly improved, but still severely skewed in favour of men. In 2018, there were around 25% of women among ICT specialist in employment, as seen in the graph. The index is low, but still significantly higher than the EU average.



- The image is slowly changing and more women start to see the potential in this sector. Young women reportedly consider this career prospect exciting, diverse, creative and very useful.
- According to studies, in the year 2020 there will 800.000 jobs which require ICT knowledge across EU,, but not enough skilled applicants for these positions. This is another reason why training young women is critical.
- According to the European Commission, the European GDP would increase by nine million euros each year, if more women would be working in the ICT sector.

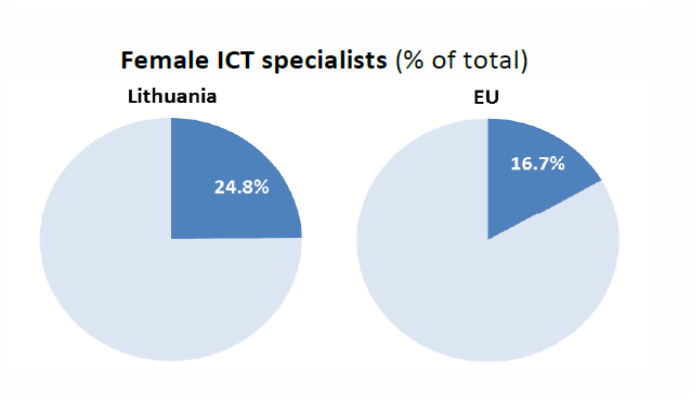
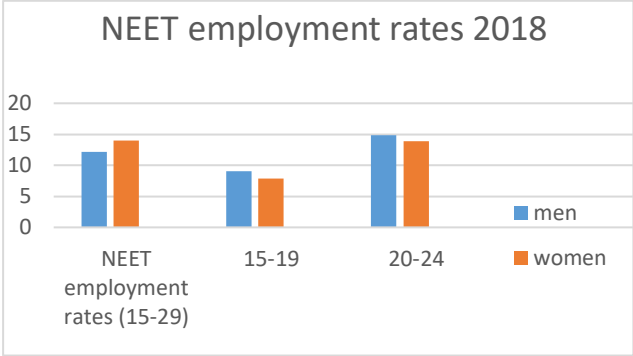


Figure 8: Female ICT specialists employed in Lithuania and EU (% of total), 2018

IRELAND

1.1: General characteristics:

- Population: 4,8m
- General employment rate: 69.3%
- Women: 59% in the workforce



1.2: NEET employment rates: Men and women, 2018 (15-34):

Male	1,206.80	1,215.50	%	Female	1,013.90	1,039.50	%
Age	15-19	33.8	2.7	Age	15-19	26.8	2.6
Age	20-24	92.2	7.5	Age	20-24	89.7	8.6
Age	25-34	253.9	20.8	Age	15-34	244.7	23.5

1.3: NEET employment rates per sector:

	Male		Female	
	Q1 2018	Q2 2018	Q1 2018	Q2 2018
Agriculture, forestry and fishing	95.6	91.3	17.7	15.2
Total Industry	332.9	330.2	83.9	90.2
Construction	129.1	137.4	8.2	8.4
Total Services	773.8	789.3	910.4	929
Wholesale and retail trade	149.6	155.2	145.4	142.9
Transportation and storage	76.1	79.9	18.8	17.6

Accommodation and food service activities	80.8	81.4	88.8	95.7
Information and communication	79.3	77.7	36.5	37.6
Financial, insurance and real estate activities	55.9	58.1	49.6	52.6
Professional, scientific and technical activities	75.4	78.7	58.9	62.5
Administrative and support service activities	57.5	58.4	42.3	45.2
Public administration and defence; compulsory social security	50.2	51.9	53.3	53.7
Education	41.8	43.1	125.2	123.5
Health and Social Work	55.6	57.5	221.7	228.5
Other NACE activities	51.6	47.3	69.9	69.3

- Very few women tend to be employed in the Industrial sector, as opposed to men.
- The majority of both men and women tend to be employed in the total services sector.
- However, men tend to be concentrated in the areas of Accommodation and food service activities, as well as Information and communication, while women are a majority in the sectors of Education, Health and Social Work.
- Men severely outnumber women in the Information and Communication sector.

2. Structure and Intensity of the Industrial Sector: Medium

- Small and Medium Sized Enterprises (SMEs) represent 52.1% of Ireland's GDP20 and employ 65% of the private sector employees.
- The Top 50 industrial enterprises in Ireland represented over 71% of the overall NSV with a value of €81.2 billion. This highlights that the Manufacturing sector in Ireland is heavily reliant on a very small number of enterprises.

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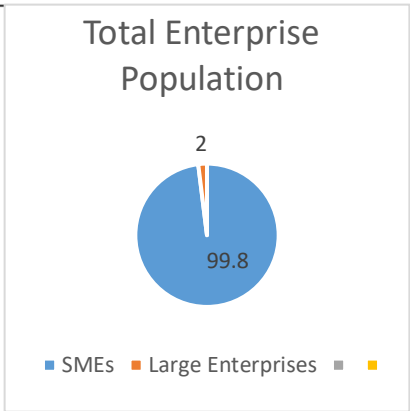
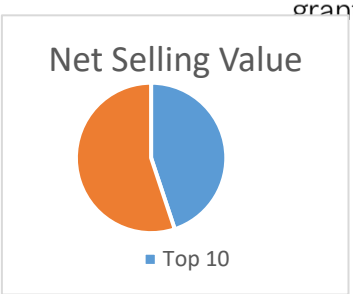




igure 1: SMEs account for 99.8% of the total enterprise population ?016). They also account for 68.4% of the population engaged. On the ther hand, large enterprises (employing 250 or more persons) employ 1.6% of the workforce, despite accounting for a tiny fraction of the opulation.

igure 2: The Top 10 industrial enterprises accounted for 4.9% of all production in Ireland in 2017. These 10 nterprises had an aggregate Net Selling (NSV) of €50.9 illion, while the remaining 3,406 industrial enterprises eported €62.5 billion

3. Industries with Growth Potential:

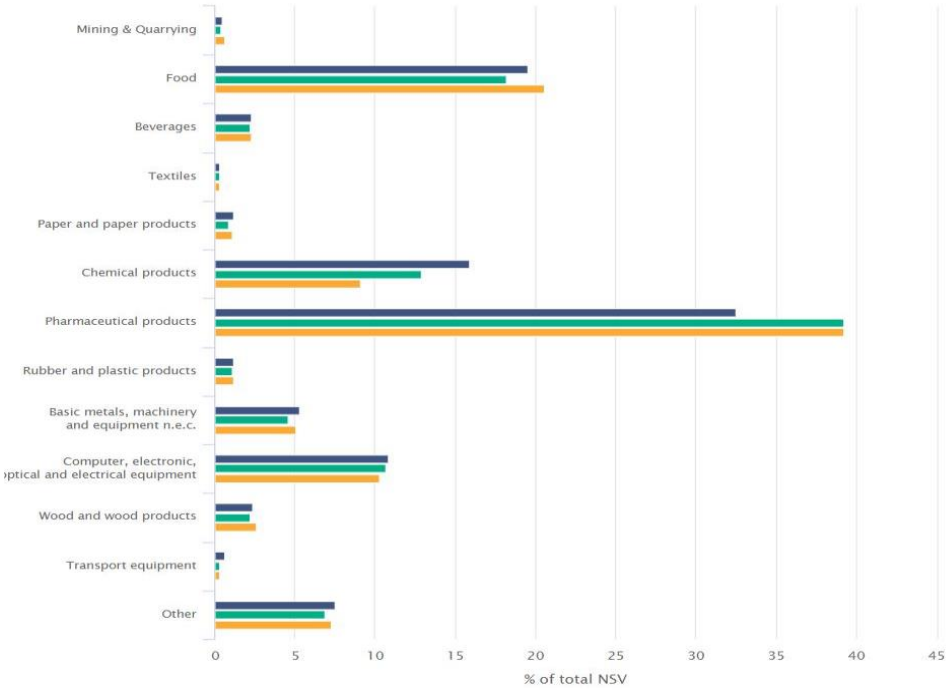
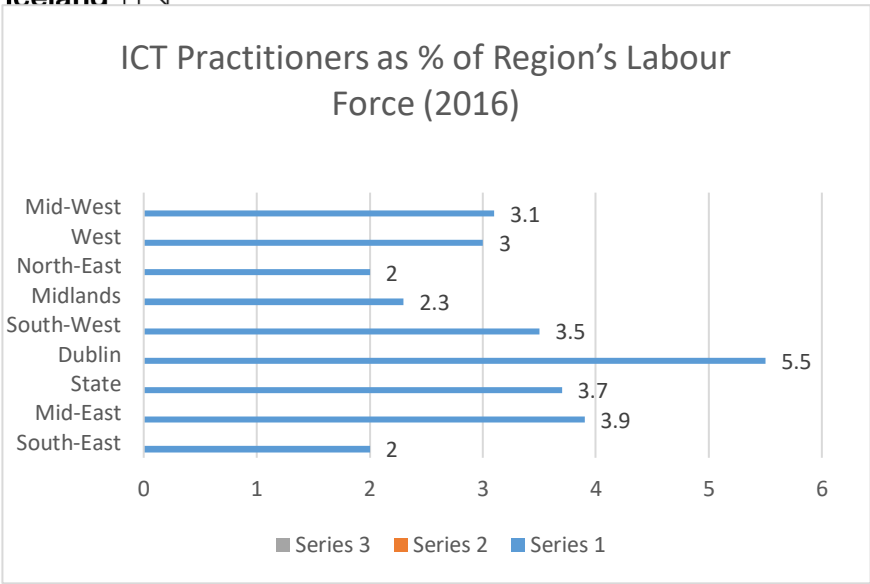


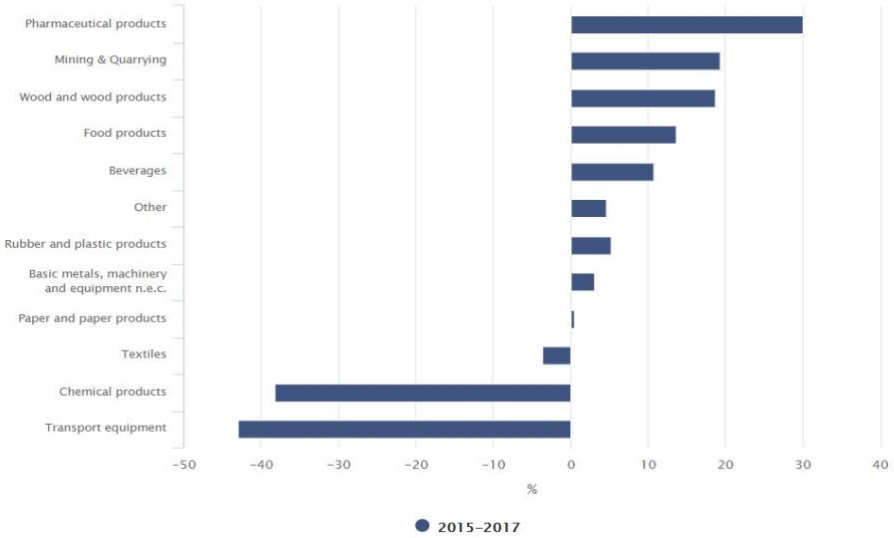
Figure 68: Irish Manufacturing trends 2015 to 2017

- The most significant increase in Net Selling Value was in the Pharmaceutical sector. Basic pharmaceutical products and preparations increased by 30.1% from €34.2 billion in 2015 to €44.5 billion in 2017.



- In terms of NSV, the 4 largest sectors (Food, Chemicals, Pharmaceutical products and Computing) accounted for 79.2% or €89.8 billion of total NSV in 2017, down from 81.0% or €96.1 billion in 2016.

Figure 5: Percentage change in NSV by sector, 2015–2017



- The Pharmaceutical sector recorded the biggest (%) increase in NSV between the years 2015 - 2017 with 30.1% growth recorded. The value of the Mining and Quarrying sector rose per 19.3%, while Food products rose per 13.7% in the same period. The Transport sector experienced a decline of 42.9% , while the Chemical sector reported a fall of 38.2%.

4. Employment trends:

- Nearly 4/5 of those at work (78.6%) were employed in the services sector. Among females, 90.7% of all those in employment worked in this sector.

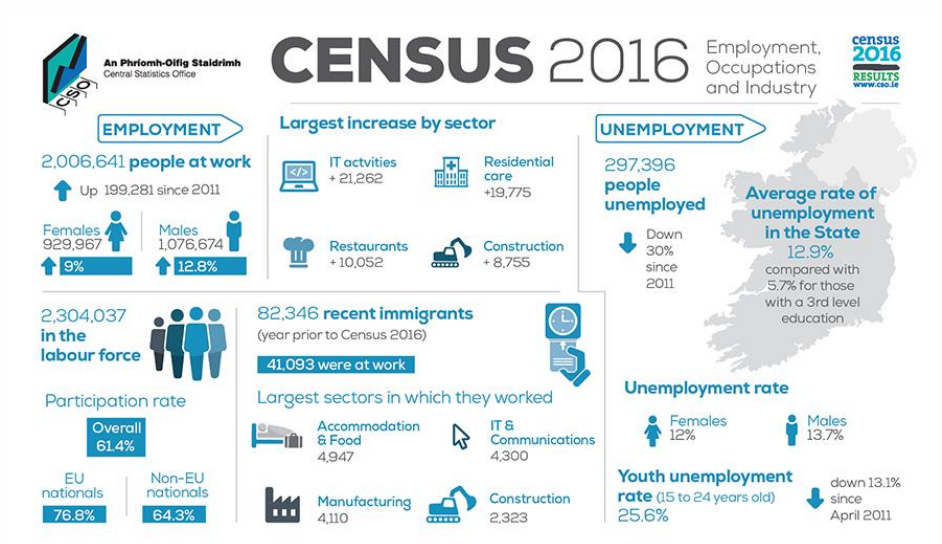
- Health and Social Work saw the biggest increase, with 25,647 more employees than reported in the previous census. Other sectors that experienced notable increases included: Computing and Related Activities (up by more than 50%) and Construction. A decrease was noted in Public Administration and Defence, as well as Financial Intermediation (banking).

- In terms of socio-economic grouping, the largest category was non-manual, with 996,696 employees. The biggest increase (+67,169) occurred in the Lower Professional group. Both Own Account Workers (-17,493) and Farmers (-12,209) showed declines.
- The population is also classified into one of seven social class groups ranked on the basis of occupation. In Census 2016, 28.1% of the population (1,336,896 persons) were in social class group 2, Managerial and Technical. The only class to show a decline since 2011 was Skilled Manual, where numbers fell by 5.0%.

5. Job supply and demand:

- There are approximately 97,000 ICT practitioners in Ireland.
- An estimated 50% are employed in dedicated technology product/ service providers.
- Three other sectors (Manufacturing, Financial & Insurance, Professional and Scientific) account for approximately 15% of ICT employees, while 35% are seeded across firms of other nature.
- ICT technologies offer opportunities to boost productivity and efficiency in areas such as Wholesale/Retail, Transport and Logistics.
- This suggests that a wide range of private and public sector organisations in Ireland are likely to compete for ICT practitioners.

Strong growth in number of ICT practicioners nationwide.

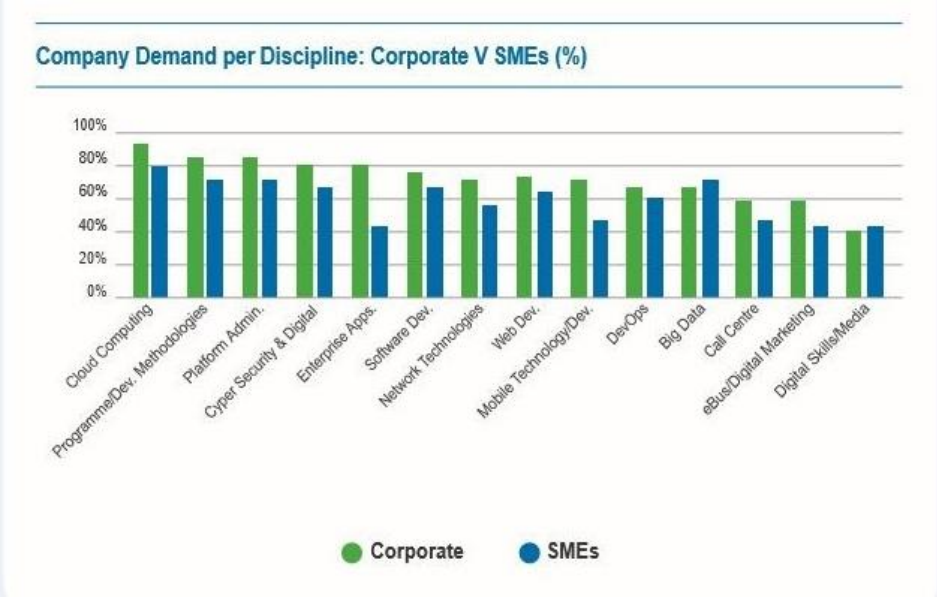


- It is even likely that the impetus Brexit is giving a chance to indigenous industries to diversify their export markets and heighten their requirements to adopt enhanced ICT capabilities.
- When looking at the future of jobs we can look at it from two angles, a supply side and a demand side. The supply sides has three areas: (i) Technical skills and specialisition – market relevant skills will be a must to survive in the economy, very dynamic as skills most in demand at present are big data & cloud computing which barely existed five years ago (ii) Human-centric skills – (becoming increasing important in the tech

economy) adaptability will be the most desirable skill in ten years, and (iii) Future proofing skills is critical – we are increasingly seeing a multi-disciplinary approach as a method to future proofing.

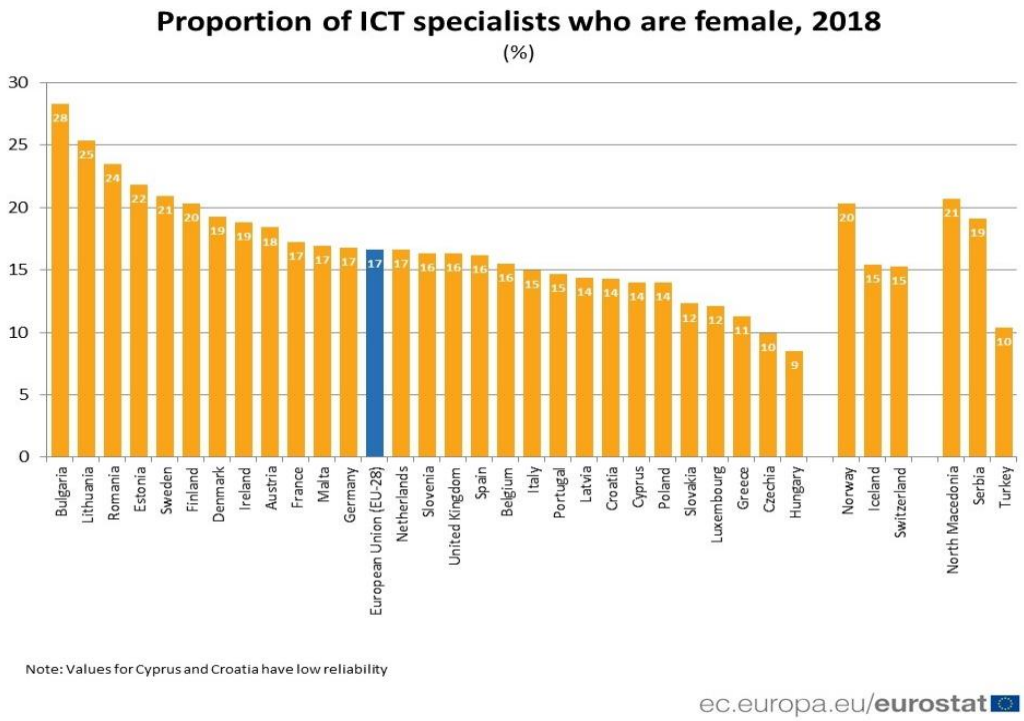
- On the demand side workers are seeking increased flexibility; there is an unprecedented increase in the number of people classified as freelancers.

5.1: National report on skills sets in demand:



- The more highly desirable skills across all fields are: cloud computing, programming, platform administration and cyber security.
- 50% of Fortune 500 companies in 2000 no longer exist. The emergence of the "Sunday to Monday phenomenon", exemplifies the dynamism of the business world and shows that employers will need to continually alter the way they interact with their employees in order to retain the best talents.
- Currently, 30% of professionals feel that their skills will be outdated in 2 years and a further 38 %feel that this will be the case in 4-5 years. Cumulatively, 68% of professionals feel that their skills will be obsolete in 5 years.

- The concept of a job for life is outmoded as according to a report by Dell 85% of the jobs in 2030 have not even been invented yet.
- Today's worker can expect to have 5 careers and 20 different jobs over the course of their working life. By 2020, 66% of people will have multiple sources of income.
- Thus, we have to redefine our understanding of "working". Ireland should focus on inclusivity and creating a motivated and empowered workforce starting with the individual and a 'growth mindset'. Government's role should be towards a more human-centric approach. This approach could include life-long learning, avoiding a digital divide and re-designing learning systems. Government should take a 'No regrets' and 'Big Bet' approach to decision making.



6. Participation of women in the ICT sector:

- According to Eurostat, 19% of ICT specialists in Ireland are women in 2018
- The EU average for the labour market is 17%.
- Women in IT are more likely to have a college degree (82%), than their male counterparts (69%).
- Men in IT make 6% more than their female counterparts.

ROMANIA

1.1: General characteristics:

- Population: 19.64m.
- General employment rate: 63,9%
- Women: 55,85% % in the workforce

Employment rate			
Age	**Female**	**Male**	**Total**
15-64	55,8%	71,8%	63,9%

1.2: NEET employment rates: Men and women, 2018 (15-29):

Unemployment rates NEET (15-29) age groups							
15-29		**15-19**		**20-24**		**25-29**	
women	**men**	**women**	**men**	**women**	**men**	**women**	**men**
5,9%	8,1%	5,6%	7,4%	6,4%	8,2%	4,9%	6,05%

- The majority of unemployed NEETs in Romania are between the ages of 20 and 24.
- There is a higher percentage of male NEETs in unemployment than of female.

1.3: NEET employment rates per sector:

Economic activities	Total	Men	Women
TOTAL *(thousand persons)*	**6696**	**3760**	**2936**
	- in % as against total -		
Mining and quarrying	1.0	1.5	0.3
Manufacturing	24.9	25.0	24.7
Production and supply of electric and thermal energy, gas, hot water and air conditioning	1.2	1.8	0.4
Water distribution; sanitation, waste administration, decontamination activities	1.6	2.0	1.0
Constructions	10.4	17.4	1.5
Wholesale and retail; repair of motors vehicles and motorcycles	18.0	14.4	22.7
Transport and storage	7.4	11.3	2.3
Hotels and restaurants	3.0	2.1	4.2
Information and communications	2.8	3.1	2.4
Financial intermediation and insurance	1.7	1.0	2.7
Real estate transactions	0.2	0.2	0.2
Professional, scientific and technical activities	3.2	2.4	4.2
Activities of administrative services and activities of support services	3.1	3.9	2.0
Public administration and defense; social insurance of public system	6.3	6.9	5.6
Education	5.4	2.4	9.4
Health and social assistance	6.1	2.1	11.2
Showbiz, cultural and recreation activities	1.0	0.8	1.2
Other activities of the national economy	2.7	1.7	4.0

- The majority of both men and women are employed in Manufacturing.

- The second most popular sector among women is Wholesale/Retail and Construction among men.
- There are slightly more men employed in ICT (3.1) than women (2.4%), with the percentage for both genders being very low.

2. Structure and Intensity of the Manufacturing Sector: Medium

Class size	Number of enterprises			Number of persons employed			Value added		
	Romania		*EU-28*	Romania		*EU-28*	Romania		*EU-28*
	Number	Share	*Share*	Number	Share	*Share*	Billion €	Share	*Share*
Micro	412 452	88.5 %	93.0 %	915 629	23.1 %	*29.8 %*	11.7	17.9 %	*20.9 %*
Small	44 012	9.4 %	5.8 %	886 830	22.4 %	*20.0 %*	11.1	16.9 %	*17.8 %*
Medium-sized	7 945	1.7 %	0.9 %	831 804	21.0 %	*16.7 %*	11.8	18.0 %	*18.2 %*
SMEs	**464 409**	**99.7 %**	**99.8 %**	**2 634 263**	**66.4 %**	***66.6 %***	**34.6**	**52.8 %**	***56.8 %***
Large	1 571	0.3 %	0.2 %	1 333 113	33.6 %	*33.4 %*	30.9	47.2 %	*43.2 %*
Total	**465 980**	**100.0 %**	**100.0 %**	**3 967 376**	**100.0 %**	***100.0 %***	**65.6**	**100.0 %**	***100.0 %***

- The vast majority of enterprises in Romania (88.5%) are considered “Micro-Firms”.
- The majority of employees work in Large firms (33,6%), while Micro-Firms employ 23.1% of persons.
- At the same time, Large firms contribute 47.2% of Added Value, while Micro-Firms contribute 17.9% of AV respectively.

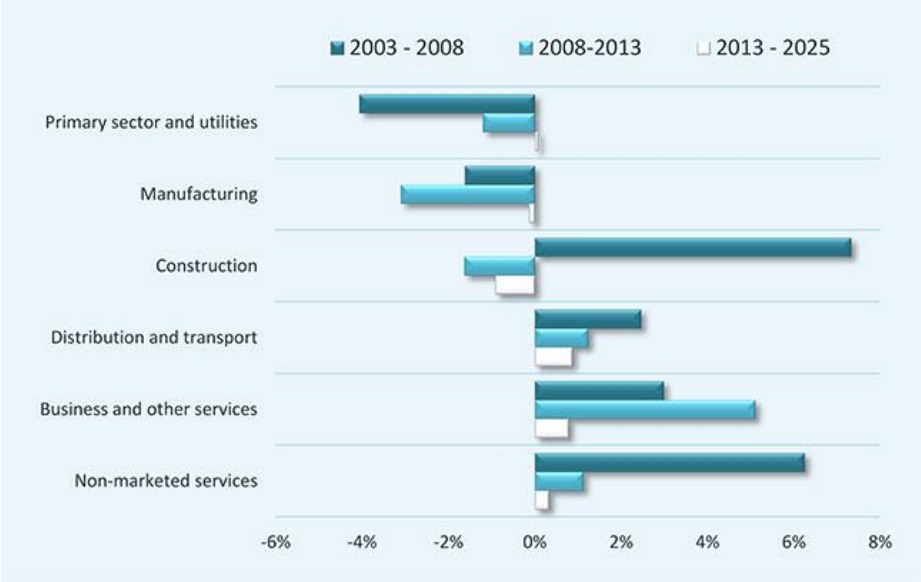
Industrial Structure/Nature of Enterprises:	
Financial services, banking, insurance	16%
Industrial and consumer goods	14%
Business and professional services	13%
Consumer services	11%
Utilities, energy and basis materials	11%
Healthcare	8%
Public sector	5%
Other services – logistics, transportation, automotive, pharma, etc	7%

- The majority of enterprises are active in the sector of finance, banking and insurance.
- The second largest sector is the production of industrial/consumer goods.

3. Industries with Growth Potential:

Construction
Manufacturing
Car manufacturing
High technology
Steel industry
Information technology

- Construction is predicted to remain the top sector in Romania, growing even more in terms of AV and employment.
- The great advantage of Romania in the ICT sector is the presence of a highly skilled workforce.



- The most dynamic sectors are represented by the development of software and services, with a growth of 40% since 2000.
- The most developed regions are located in the west of the country (Timisoara, Cluj).

4. Job supply and demand:

- The most significant increase in job vacancies is in finance, banking and accounting.
- Manufacturing is still the sector with the largest employee shortage, followed by public administration and social services, hospitality, constructions and retail.
- The shortage of specialists in Romania continues to be one of the largest in the world. There are many career opportunities on the market, and employers are ready to offer everything employees ask for in order to attract the best.

- One of the most successful combinations in the Romanian labor market is currently accounting/finance along with IT and programming. The best paid programmers are those who also know banking and telecommunication. A variety of positions such as system architect, software application architect or business analyst have emerged.

- Internet development will also continue to generate jobs, as more and more activities move online. In order not to lose contact with customers, businesses will need online strategies to attract more public. Thus, web developers, web designers, SEO specialists, online content editors will be in great demand.
- Business Process Outsourcing is an industry that generates many jobs on the Romanian market, as more and more companies are interested in focusing on their core business, leaving BPO to manage adjacent activities. The sustained economic growth in recent years has also led to the resumption of some activities that have stalled in the years of crisis: marketing and construction, which are currently among the top employers.
- Marketing (and clearly digital marketing) is growing rapidly, as the income has increased, and this is reflected in consumption which has increased rapidly. To differentiate from competition, companies need the best marketing specialists.
- The resumption of large residential projects has also led to a boom in hiring offers for constructions specialists, from engineers, electricians and plumbers, to site workers.

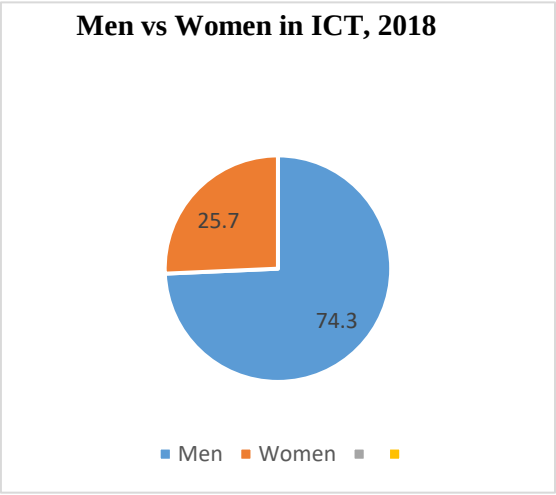
4.1: National report on skills sets in demand:

- Looking at past, current and future trends (3-4 years), a number of occupations have been identified as mismatch priority occupations for Romania, i.e. they are either in shortage of surplus.

Romania: Mismatch priority occupations (October 2016)

- ICT is considered a shortage occupation in Romania, meaning there is a higher demand for professionals in the sector, than there is a supply.
- This development is in line with the ongoing digitalization across every industry.
- Brain Drain in Romania is one of the biggest problems faced by the job market. Employers' mission to occupy all the job vacancies will not be easy, given the already existing workforce shortage that will increase in the coming years. More than half of Romanians (55%) have expressed their will to work abroad, and most of them are under 30 and highly educated.

5. Participation of women in the ICT sector:



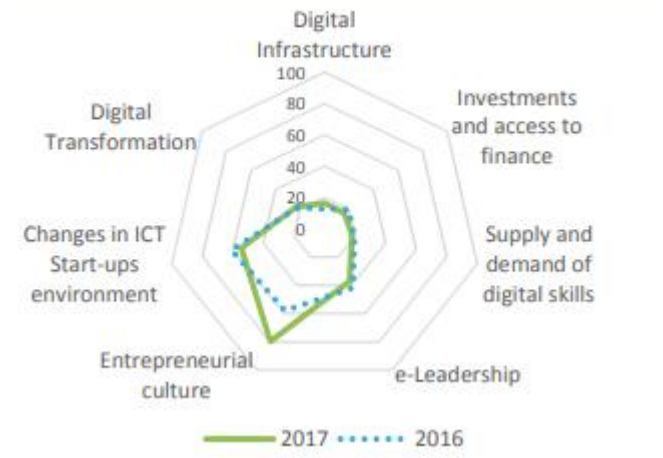
- 31.5% of students in ICT are female, a percentage way higher than the EU average (17%) and the second highest in the Union.
- That same picture is reflected in the workforce, with 25.7% (1 in 4) of ICT specialists in Romania being female, ranking in the second highest position once again.

Part 2: Digital transformation, challenges and opportunities (based on Digital Transformation Scoreboard, 2018)

LATVIA

1. Digital Transformation:

Figure 9.31: Latvia's framework conditions for digital transformation



- Latvia continues to display a mixed performance in digital transformation. Its strongest assets are entrepreneurial culture and ICT startups.
- Latvian performance in digital transformation, is relatively low, as it was in 2016
- There is room for improvement compared to other EU Member States in areas such as digital infrastructure, digital skills, and investments and access to finance.
- Various policy practices have been implemented over the last few years to improve in areas of moderate performance (e.g. the Innovation Voucher) and consolidate the dimensions of strong performance (e.g. the Law on Aid for Start-up Companies).
- From 2010 to 2016, in the spirit of digital transformation, Latvia experienced net employment gains of 44 000 jobs. The largest net gains were recorded in professional and business services, followed by construction. Job losses occurred mainly in the wholesale, retail, hospitality, and transport sector. The share of Latvia's business sector jobs sustained by foreign final demand increased from 35% in 2004 to 43% in 2014; the majority of these jobs had high or medium skill intensity. A relatively low share of researchers in Latvia work in

the business sector compared to other OECD countries - 16.7% in 2015 (up from 14.3% in 2005).

2. Digital Infrastructure:

- The country's low performance in digital infrastructure is linked, among other things, to the fact that the use of ERP software, DLS and customer relationship management is uncommon among Latvian companies.
- In order to improve the current situation, there are 7 established policy implementation instruments: ICT architecture and state information system integration, E-service development, State portal, Digital skills development and lastly, a Network of State and Municipal Unified Customer Service Centres.
- The national broadband plan of Latvia meets the high-speed internet coverage targets of the DAE for 2020. Through the project areas broadband coverage will be improved for the rural regions of Latvia as operators will be able to provide access services using neutral passive optical infrastructure supported by state aid programme. Latvia supports the Gigabit society targets in the policy plan for the electronic communications sector 2018-2020

3. Investments and access to finance:

- With one of the lowest rates of direct investment in the ICT sector in the EU, it is unsurprising that the dimension of investments and access to finance has room for improvement.
- The European Investment Fund (EIF) and ALTUM, a state-owned development institution of Latvia, have signed a microfinance guarantee agreement under the EU Programme for Employment and Social Innovation (EaSI). This new financing agreement was made possible by the European Fund for Strategic Investments (EFSI), the core of the Investment Plan for Europe. Micro-entrepreneurs will be able to benefit from loans at a reduced interest rate with lower collateral requirements under the EU supported programme.
- This new EaSI guarantee agreement allows ALTUM to provide loans to 600 micro-entrepreneurs over the next 3 years across Latvia. Micro-entrepreneurs will be able to benefit from loans at a reduced interest rate with lower collateral requirements under the EU supported programme. ALTUM will primarily target start-ups and small businesses.

4. Supply and demand of digital skills:

- In the area of supply and demand of digital skills, there are weaknesses that need to be addressed, in order to catch up with the leading EU nations.

- The challenge is to fight the mismatch between supply and demand in ICT, and encourage young professionals in Latvia to study ICT, as well as attract talented ICT professionals from across the globe, in order to build a competitive market.
- In order to achieve that goal by 2020, the state has committed to a series of measures, including: to promote digital media creating solutions and their benefits, as well as inform the public about the state of e-opportunities. Additionally, there is dedicated funding towards the training of public administration employees, so that they provide the public with advice on aspects of the use of the digital environment. Lastly, the state has vouched to develop training materials and programs for e-management tools, and to develop information materials.

5. e-Leadership:

- The dimension of e-leadership still ranks below the EU average, and has not improved in comparison to the scores of last year.
- The low ranking in this sector is in line with the low rankings in the fields of supply and demand, as well as digital infrastructure. These all result in a lack of e-leadership skills across all professions, even among the high-educated professionals.
- The state has acknowledged the slow and bumpy process of changing the current situation. Several measures that are being thoroughly discussed later on have been implemented to address this weakness, in order to align growth in the ICT sector with the general job and productivity growth that has been predicted for the following years. The creation of dedicated funds is in the horizon, to support the faster implementation of the aforementioned process.

6. Entrepreneurial culture:

- The Global Entrepreneurship Monitor shows that Latvia's strong performance in entrepreneurial culture is backed by its citizens' well developed entrepreneurial intentions and a widespread perception of entrepreneurship being a desirable career choice.
- The Innovation Motivation Programme is a support programme whose main goal is to raise awareness among the community about innovative entrepreneurship. It also aims to support those wishing to develop a new innovative business idea. Within the framework of the Innovation Motivational Programme, various hackathons, networking meetups, workshops, capacitybuilding activities, and various award-winning competitions are organised to encourage the widest possible participation among society and business in the development and use of innovative solutions.

- The programme also aims to increase the proportion of innovative businesses in the economy and motivate the setting up of commercial activities in the specialisation priorities or areas specified in the Latvian Smart Specialisation Strategy.
- The programme's budget is €5.6 million, of which 85% is provided by the European Regional Development Fund and 15% comes from the Latvian state budget. The programme was launched at the end of 2016 and is implemented by the LIAA (Investment and Development Agency of Latvia).

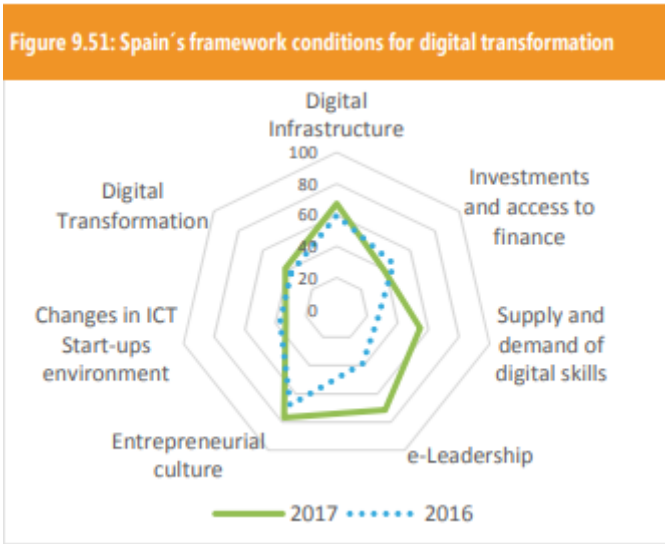
7. Changes in ICT start-ups environment:

- Latvia also performs well in the dimension of ICT start-ups. This favourable environment supports one of the highest ICT enterprise birth rates in the European Union.
- The startup ecosystem in Riga is still quite young, but it has developed quite rapidly over the last year. While the increasing number of startups are mainly supported by universities and coworking spaces, the involvement of ecosystem institutions, as well as private players has markedly improved. Events such as hackathons, conferences and meetups have been growing steadily.
- 2016 brought about the formation of the Latvian Startup Association "Startin.LV" – a grassroots initiative to promote ecosystem development and dialogue with policy makers. First projects include new events and ground-breaking legislative proposals on flat-rate startup tax and startup visa, enacted as of 2017.

Shortage of local smart capital is still the main challenge and there is a need for more experienced entrepreneurs to act as mentors and angel investors. Riga placed in the bottom 5 of our Index for access to capital as capital available for investments in Latvia is still not comparable with other major European centres, global VCs still lack appreciation of opportunities in this geography. Yet the Latvian Venture Capital Association (LVCA) has announced that by 2020 there will be €200 million available to startups via various financial instruments.

SPAIN

1. Digital Transformation:



- Overall, Spain's performance has improved in comparison to last year's results. In summary, Spain displays a mixed performance with relatively high scores in four areas, average results in two fields and one low performing field.
- Its score in digital transformation is marginally above the EU average.
- Although it is necessary to distinguish between the maturity of the different sectors that make up Spain's economy - 91% and 86% of telecommunications and financial companies, respectively, claim to have the means to perform their digital transformation, but less than half of the industrial, energy, pharmaceutical or healthcare companies believe they have sufficient resources to do so - the research provides a clear recipe on what Spanish companies should do: to promote a cultural change in companies and, at the same time, to foster a coordinated action by the public administration.
- This transformation could reportedly increase the gross added value of Spain's economy by 120 billion in 2025. This would lead Spanish companies to reduce their production, maintenance and logistics costs by 10% or 20%, and reduce their inventory costs by up to 50%.

2. Digital Infrastructure:

- Similar to last year, Spain's solid digital infrastructure is due to the percentage of enterprises using ERP software to share information between different functional areas. In addition, the number of enterprises using DLS or another fixed broadband connection is significant.
- Spain's national broadband strategy supports the goals related to broadband coverage set by the European Union in the Digital Agenda for Europe (DAE). Spain is working on removing regulatory and administrative barriers and ensuring a dynamic and flexible use of spectrum to promote the deployment of ultra-fast broadband networks. Actions are taken to support public-private cooperations and joint and venture capital investments. In line with the EU 5G

Action Plan, Spain has published a 5G National Plan 2018-2020 and has already started its implementation. The fibre optic network deployed in Spain is the widest in Europe with more than 33.3 million access points, covering more than 75% of the population, with 4G coverage at over 95%.

- The Digital Agenda for Spain addresses an EUR 200 million programme to extend next-generation broadband, which will provide financial support to bring at least 100 Mbps connectivity to small and medium-sized municipalities in white areas and improve backhaul and access networks providing at least 30 Mbps connectivity in other white areas.
- The Secretary of State for Information Society and Digital Agenda plans to dedicate EUR 277 million to develop actions co-financed by the ERDF under the Operational Programme 2014-2020 Smart Growth.

3. Investments and access to finance:

- The level of investments and access to finance is low compared with other EU Member States.
- Equity funding for new and growing firms has significantly worsened since 2015. In addition, business angels funding for new and growing firms does not progress. Overall, small companies heavily rely on bank financing and the availability of alternative financing is underdeveloped in Spain.
- Furthermore, despite a steady reduction in recent years, the total amount of time it takes for SMEs to be paid still remains far higher than the EU average. On a positive note, Spanish banks are now far more willing to provide loans than in 2013 and this is continuing to improve. Similarly, the percentage share of rejected loan applications continues to fall — dropping by around 15 percentage points since 2012. However, since 2008, Spain's policy progress has been significant. For instance, grants and risk capital measures are in place to support SMEs and start-ups. However, the government lacks a one-stop-shop to support SMEs in accessing available funds. In addition, funding is available for the start-up phase — but is lacking at the scale-up phase for SMEs to expand.
- During 2017 and the first quarter of 2018, several significant new measures were introduced under this principle: The 'ENISA growth', which provides financial support to SMEs to grow and improve competitiveness, the 'ICO line FOND-ICOSME', which also provides financial support to SMEs to put a long-term growth plan in place. Funding is available either in the form of equity financing or through participative loans.
- In addition to that. 'Financing Industry' measure provides personalised advisory services to industrial companies on how to access public financing
- Lastly, 'With a Guarantee, Yes' is an electronic platform that aims to facilitate SME financing through mutual guarantee societies.

4. Supply and demand of digital skills:

- The area of supply and demand of digital skills reveals a remarkable improvement.
- Spain acknowledges that increasing the number of ICT specialists and promoting the role of the education system in the advancement of digital skills is a challenge that the country faces. Analysis of the public consultation has identified several key challenges, such as: digital inclusion, re-training of the workforce for a digital environment, digital skills training and digital entrepreneurship. Given their relevance, digital education and the digital transformation of employment might be specially considered in a joint "Citizenship, Education and Digital Employment" pillar in the new digital strategy. In October 2017, the government adopted the latest Spanish Digital Competence Framework for Teachers to improve teaching skills in ICT.. The Spanish National Digital Jobs Coalition finally became operational in July 2017. This coalition is coordinated by ICT industry association AMETIC through the Spanish Information Technology Foundation.
- A high degree of skills mismatches in companies' workforces limit their capacity to innovate and capitalise from innovation. Increasing the number of Spanish ICT specialists but also reskilling the lab

5. e-Leadership:

- Spain's strong performance in e-leadership is attributable to the ease of finding skilled employees within the country and the high number of enterprises recruiting ICT specialists. The broadband and connectivity indicator also scores among the highest in the EU.
- For effective e-leadership, the skills required are seen as those which enable people with very strong ICT skills to lead qualified staff from ICT and other disciplines towards identifying and designing business models and exploiting key innovation opportunities. Their success is defined as making best use of developments in ICT and delivering value to their organizations. As initial scope, the initiative has chosen to focus on the leadership needs of medium and large size enterprise at the top levels of decision-making.
- The present event at IE Business School in Madrid is one of 10 Regional Cluster Events on 'New Curricula for e-Leadership – Delivering Skills for an Innovative and Competitive Europe' organised by the European Commission in cities across the entire European Union. Each event will be hosted by a leading university, business school or other organisation with a strong contribution to e-leadership skills development.
- This Regional Cluster Event at IE Business School in Madrid is organised with the key objectives to bring together a wide group of complementary stakeholders and policy makers from different countries, present and discuss results, achievements and conclusions on guidelines for new e-leadership curricula and for participation to universities and business schools from across each cluster region

6. Entrepreneurial culture:

- Some progress has been achieved entrepreneurship culture.
- Entrepreneurial intentions in Spain remain among the lowest in the EU, with the second worst score. Furthermore, successful entrepreneurs are often not perceived well despite the increasing media attention given to entrepreneurship since 2013. On a positive note, the proportion of high-growth companies has increased since 2012 and now is performing above the EU average. Moreover, entrepreneurship education is perceived as being much better incorporated within the education and training system at post-secondary levels than in last year's fact sheet. Since 2008, Spain has introduced a significant number of policy measures to promote entrepreneurship. A majority of SBA recommendations have been addressed, notwithstanding the relatively weak performance.
- During the current reference period, two additional significant measures were adopted: The programme on 'development and implementation of equality plans' provides subsidies to SMEs that aim to improve gender equality and nondiscrimination at work. Additionally, the 'business growth programme' provides up to 50 hours of professional guidance to SMEs with growth potential. The services provided include: organisation and business analysis; individualised consultation plan; follow-up and evaluation of the consultation plan; marketing and commercialisation; and visits to business premises. The measure aims to improve the growth capabilities and competitiveness of Spanish SMEs.

7. Changes in ICT start-ups environment:

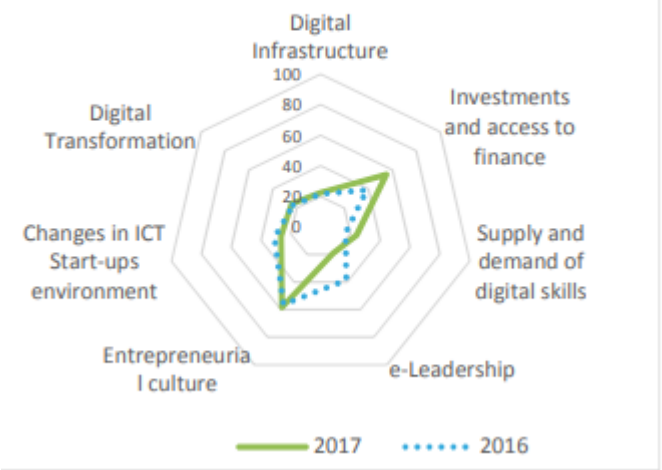
- The presence of changes in ICT start-up environment is significantly weak compared to its EU partners, as it scores 10% lower than the EU average
- Red.es is a programme launched in 2016 under the Digital Agenda for Spain. It aims to stimulate the country's digital economy, innovation and entrepreneurship by encouraging efficient and intensive use of ICTs. The programme consists of helping mainly SMEs and public administrations to adopt business solutions based on cloud computing. Regarding the implementation of cloud computing policies in public administrations, the programme advocates for programmes on smart cities, connected schools, open data, digital culture, e-health, broadband connectivity and telematic payments. On the other hand, the programme boosts the digital economy for SMEs by promoting entrepreneurship and internationalisation, e-commerce, digital skills, e-tourism and cloud computing platforms.

GREECE

1. Digital Transformation:

- Greece performs below the EU average in six out of seven dimensions. Greece's strongest asset is investments and access to finance, despite being below the EU average last year. In this field, Greece ranks 9% above the average.
- Greece is proceeding with the implementation of the National Digital Strategy, but is well behind other EU countries. According to the Digital Economy and Society Index (DESI) our country ranks 27th among the 28 member states.
- In the public sector, despite projects on digital transformation being carried out, there are delays related to lack of knowledge, limited resources, and bureaucracy.
  More and more municipalities are taking up initiatives in order to develop digital services for their citizens by participating in European Innovation Programs. However, the implementation pace is not the expected.
- In the private sector, businesses recognize the need for digital transformation. 82% of the enterprises have already begun the implementation of their strategy, but only the 50.8% have created a Digital Transformation or Innovation Department.

Figure 9.23: Greece´s framework conditions for digital transformation



- Only 36.1% of the employers asked believe that their employees' mentality is from satisfactory to very supportive regarding changes. As a result, resistance to change is considered as the greatest challenge they have to face.
- Data indicates that Greece's greatest challenges are digital infrastructure and e-leadership, where it scores 27% and 36% below the EU average respectively. In summary, there is significant room for improvement in all dimensions to foster Greece's digital transformation, and the country should make serious efforts in this direction.

2. Digital Infrastructure:

- A significant challenge for Greece is in the field of digital infrastructure, as the country has one of the lowest shares of companies using DSL or another fixed broadband connection. At

the same time, the use of customer relationship management for marketing purposes is not widespread among Greek companies.

- Thus, in its Digital Strategy 2016-2021 report, the Greek government has declared its will to focus on the High Availability and Penetration of New Generation Broadband Services, as a prerequisite for creating prospects for economic growth, employment, outward orientation and innovation in the modern digital age.
- European funds have been allocated to broadband networks and other substantial investments are planned. Expectations are set for the EuroAsia Interconnector, linking the electricity systems of Israel, Cyprus and Greece, to include fiber-optic cables, for example
- The private sector is also investing in Greece's networks. Forthnet is putting money into fiber-optics. OTE Group, Greece's largest telecommunications provider, has already spent €2 billion on NGAs and plans to invest another €1.5 billion by 2020. Vodafone Greece is also investing and sees itself as a "catalyst in moving Greece to fiber and NGA," says Chairman and CEO Haris Broumidis.

3. Investments and access to finance:

- Despite a well-developed workforce base with tertiary education, investments and access to finance is the only improvement for Greece compared to 2016. This is mainly due to the fact that public investment fell in order to reduce the deficit, and foreign investment sees opportunities in a recovering economy. Indeed, Greece's strongest asset is investments and access to finance. In this field, Greece ranks 9% above the average.
- The **PA (Partnership Agreement for the Development Framework) 2014-2020** constitutes the main strategic plan for growth in Greece with the contribution of significant resources originating from the European Structural and Investment Funds (ESIF) of the European Union.
- Public Private Partnerships (**PPPs**) are a valuable tool leading to the construction of public infrastructure and the provision of quality services to citizens. Via the implementation of PPPs, the public sector is making use of contemporary finance tools to provide services to citizens enhancing the existing framework of public procurement. For more information, please contact the Special Secretariat for PPPs of the Ministry for Economy & Development.
- **Venture Capital** and **Private Equity** financing are at a quite mature stage of development in Greece and have enabled many investors to realize their plans.
- Financial Institutions, offer to the entrepreneur a wide selection of customized financial instruments and complement the above mentioned financial tools to cover financing needs that cannot be met from other sources or shareholder capital. A list of the major Greek banks is available on the website of the Hellenic Bank Association.

4. Supply and demand of digital skills:

- The Human Capital dimension in DESI measures the skills needed to take advantage of the possibilities offered by a digital society and has two sub-dimensions. The 'basic user skills and usage' that enable individuals to interact online and consume digital goods and services and 'advanced skills and development' that empower the workforce to take advantage of technology for enhanced productivity and economic growth. According to the latest report, Greece ranks also very low, being just above Bulgaria and Romania

- 23% of individuals in Greece had low and 24% have basic digital skills compared to EU28 average (26%). Similarly, 22% of individuals in Greece (from 16% in 2015) had above basic digital skills compared to 31% of individuals in the EU28 (2017).
- In Greece, 60 thousand people are employed as ICT specialists representing only 1.6% of total employment. On the other 1 in 5 enterprises in Greece, slightly higher than EU (19%) employ ICT specialists. Therefore, ICT specialists may represent a smaller part of the employment, but the Greek businesses have access to them and hire them to the same extent as in EU average.
- The Integration of Digital Technology dimension measures the digitization of businesses and their exploitation of the online sales channel. By adopting digital technology businesses can enhance efficiency, reduce costs and better engage customers, collaborators and business partners. Furthermore, the Internet as a sales channel offers access to wider markets and potential for growth.. Greece scores around 24, which is significantly lower than EU28 average.

5. e-Leadership:

- As one of the dimensions in which Greece performs the lowest, e-leadership is a major challenge. Its score has dropped significantly since 2016.
- E-leadership is a key component of the Digital Single Market Strategy's drive to foster digital skills needed for the modern European industry. The stakeholders are calling on Member States to increase their support to the development of e-leadership skills.
- There is now a Ministry for Digital Policy, Telecommunications and Media, as a central platform for all digital and ICT initiatives. It's also updated its Digital National Strategy. Nikos Pappas, the department's minister, says "Greece is experiencing a significant technological revolution."
- The updated strategy's first priority is deploying new generation access (NGA) network infrastructures. Fixed high-speed broadband access is only 7% and it's "the only European country with one telecom access network, an old copper one." points out Panos Papadopoulos, CEO and Vice Chairman of internet and telecommunications services company Forthnet

6. Entrepreneurial culture:

- Greece has a well-developed entrepreneurial culture. This favourable entrepreneurial environment is backed up by a strong performance in the field of investments and access to finance.
- **Entrepreneurship Fund II:** The Managing Authority for the Operational Programme Competitiveness, Entrepreneurship and Innovation 2014-2020 (EPAnEK) launched Entrepreneurship Fund II in November 2016. This policy measure aims at facilitating access to finance for new and existing companies, particularly microenterprises and SMEs. The fund will provide access to finance through loans and guarantees for establishing new innovative, outward-looking and dynamic businesses; developing existing businesses through by modernising them technologically and organisationally; strengthening their operation by introducing innovative practices; and strengthening businesses and other organisations active in the social economy. The overall budget is €400 million..

7. Changes in ICT start-ups environment:

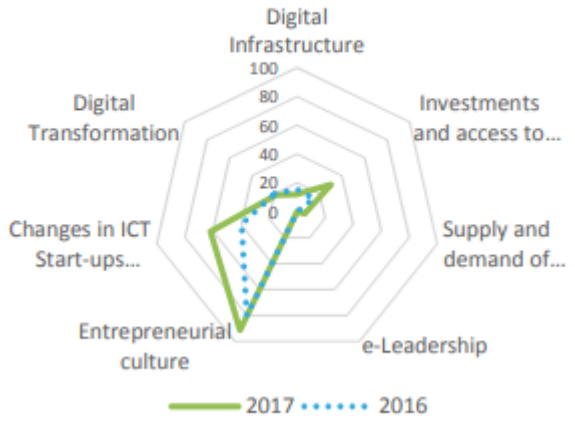
- One way Greece intends to create a stronger ICT industry is by nurturing startups and research centers. Incubators have been set up, plus venture-capital schemes, accelerators and technology clusters for sectors like microelectronics, gaming, space and biotechnology. Entrepreneurial projects that have taken advantage of this support network include Taxibeat, a cab-hailing application recently sold to Daimler for €40 million, and Upstream, a mobile commerce platform, which has €25 million in European Investment Bank financing.
- The Equifundfund-of-funds programme, which launched this year and is backed by the Greek government, the European Investment Bank and the European Investment Fund, is offering a total of €300m to Greek-founded startups and is aiming to back around 200 early-stage companies over the next five years.

MALTA

1. Digital Transformation:

- Malta shows a high level of digital transformation in the majority of the dimensions.
- It performs strongly in ICT start-ups, entrepreneurial culture and digital infrastructure, while challenges persist in the area of investments and access to finance. Compared to its EU partners, Malta's performance is well above average in five dimensions and marginally better in the two remaining areas. Recent policy measures, such as the Mobile Government Strategy and the Start-up Investment Grant Scheme, aim at further enhancing the digital transformation of the country.
- In conclusion, while Malta performs above the EU average in five dimensions, minor challenges persist in entrepreneurial culture and e-leadership.

Figure 9.45: Romania´s framework conditions for digital transformation



- Steady employment growth is predicted despite, or even because of, increasing digital transformation. This development is especially important for women, who are just now joining the workforce en masse, reducing the gender gap which is currently the largest in the EU.

2. Digital Infrastructure:

- The country scores above the EU average in digital infrastructure (20%),
- Digital Malta is the national Information Communication Technology strategy for 2014 - 2020. In a few words, it is a vision for "a digitally-enabled country empowering its people, communities and entrepreneurs through the intelligent and universal use of ICT". It's about making citizens' lives better, improving community services and helping enterprises to flourish and become more competitive through ICT. The Strategy is built upon three vertical pillars: Citizens, Business and Government. It is supported by a suite of enabling / driving forces, including Regulation and Legislation, Infrastructure and Human Capital.
- To further accelerate digitalization, Malta-based telco GO launched an investment programme of €100m aimed at improving the island country's digital infrastructure,

according to a press statement by the company. GO promised to stay “committed” to Malta’s technology vision.

3. Investments and access to finance:

- Malta performs well in investments and access to finance. Great progress has been made in this area since last year, when the country ranked below the EU average.
- The financing sources deemed relevant by SMEs in Malta and in the EU were analyzed. The strong preference for bank-related products such as bank loans, overdrafts and credit lines as opposed to other market-based products and other sources of finance, persisted, though the share of domestic SMEs which used bank loans or expected to use them in the future fell compared with 2017. Nonetheless, SMEs in Malta continued to attach greater reliance on bank financing when compared with SMEs across the EU. In 2018, 74% and 53% of domestic SMEs considered overdrafts and bank loans respectively, as being highly relevant, in comparison with around 52% and 47% of firms respectively, across the EU.
- The European Commission has adopted an 'operational programme' worth €15 million in investments to Malta's economy - specifically to support SME competitiveness. The value of the investment, provided by the European Regional Development Fund (ERDF) in the form of guarantees is expected to quadruple to some €60, thanks to the leverage effect of expected private investment as new loans to SMEs.

4. Supply and demand of digital skills:

- There is room for improvement in the dimension of the supply and demand of digital skills. For instance, recent data shows that the innovation output could be further increased, as well as the number of employees with portable devices provided by their companies.
- SMEs in Malta and across the EU cited the availability of skilled staff or experienced managers as the most pressing problem. At 34%, the share of domestic SMEs which found it difficult to find the right staff has constantly exceeded the EU average. The latter stood at 25% in 2018. This partly reflects faster economic growth and lower unemployment in Malta.
- There are almost 7000 individuals employed in ICT jobs (4.3% of the population) (Source: Malta Vision 2015). When comparing Malta to other European destinations, 22.8% of employed have ICT user skills, above the EU average of 18.4% (Europe’s Digital Competitiveness Report 2010).
- Malta placed 27th in the Networked Readiness Index (2010-2011) amongst 138 countries.
- Business Usage of ICT ranked 21st in the Networked Readiness Index (2010-2011) amongst 138 countries.

5. e-Leadership:

- The area of e-leadership shows some room for improvement, despite being slightly above the EU average.
- Launched in November 2016 as part of the Digital Malta Strategy 2014-2020, the Mobile Government Strategy 2017-2018 will enable public services to be accessible on mobile devices at any time and from anywhere. This policy practice rests on the following principles: enabling mobility; service channels; citizen-centricity; simplification; personalisation; user experience; collaboration; agility and timeliness; accessibility; awareness and training; and trust.
- The initiative aims at empowering citizens, enabling mobility within public administration, achieving increased take-up of electronic public services, and facilitating the availability of public-sector information.
- Last but not least, the strategy has three phases. In November 2016, 17 mobile apps were produced for testing and launched for the general public in March 2017. More mobile apps will follow the same procedure in phase two. Finally, the official launch took place in December 2018.

6. Entrepreneurial culture:

- Entrepreneurial culture is a high performing area in Malta. One of the reasons for the high score in entrepreneurial culture is people's support of starting a business as a desirable career choice.
- A number of organisations are active in promoting youth entrepreneurship, including JA-YE Malta, Junior Chamber International Malta, Young Business Entrepreneurs and Young Entrepreneurs and Leaders. JCI promotes business and entrepreneurship among its members through networking events, training and competitions. Young Business Entrepreneurs, which targets young, aspiring entrepreneurs by working on five strategic priorities, namely scientific research, education, entrepreneurial programmes, policymaking and raising awareness about entrepreneurship with young people and Maltese society. Young Entrepreneurs and Leaders aims at encouraging youths to enhance their entrepreneurship and leadership skills.

- There are also a large number of initiatives and organisations that promote an entrepreneurial culture in Malta. For example, there are a number of radio programmes, including the 'Fi Kliem Iehor' programme on the national Radio Malta - the Maltese National Radio Station and 'Entrepreneur Clinic', which aired in 2016 on Campus FM, the local radio station broadcasting from the University of Malta. The Malta Chamber of Commerce and Industry also actively promotes entrepreneurship.

7. Changes in ICT start-ups environment:

- Malta's strongest asset, a well-developed environment for ICT startups, is supported by one of the highest employment shares of ICT companies in the EU, according to Eurostat. Therefore, the high share of the ICT sector in proportion to Malta's GDP is less surprising.
- ICT start-ups is the field in which Malta performs the strongest, as it did in 2016, at 31.5% above the EU average.
- The Ministry of European Affairs and Implementation of the Electoral Manifesto implemented the Start-up Investment Grant Scheme in 2016. The initiative aims at providing non-repayable grants to SMEs to help finance initial investments and implement growth strategies in the first three years of their activities.

- The Grant Scheme assists start-ups engaged in activities such as research and technological innovation, ICT development and eco-innovations, among many others. Eligible costs are the lease/rental or construction/upgrade of private operational premises, patents and licenses, and the purchase of new equipment, machinery and plant. The maximum grant value is €300,000 and the maximum aid intensity is 50%.
- The scheme has an overall budget of €7 million and is administered through a series of competitive calls that will last until December 2020.

LITHUANIA

1. Digital Transformation:

- Overall, Lithuania is performing well in fields related to digital development.

- In comparison with other EU Member States, Lithuania is performing above the EU average in four out of seven indicators. Integration of digital technology is taking off with the increasing number of enterprises purchasing online in the last two years. Moreover, share of enterprises' total turnover from e-commerce is also steadily growing. Entrepreneurial culture is showing better results than the EU average as over half of the employees are willing to be self-employed with or without governmental support.

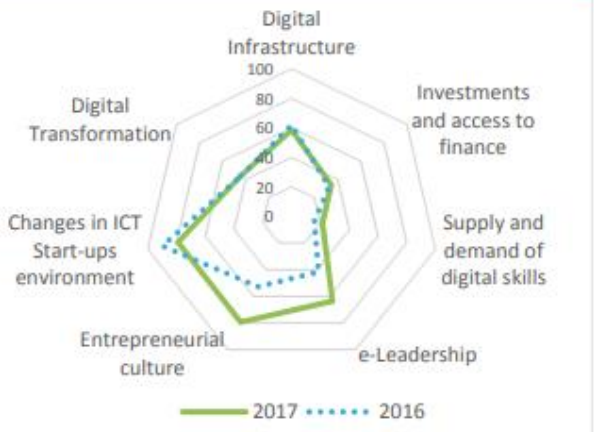
- Furthermore, the government foresees different initiatives and programmes such as innovation vouchers to innovate and stimulate the uptake of digital technologies in the entrepreneurial environment. These initiatives also aim attackling the lower supply and demand of digital skills and boosting e-Leadership, two of the core challenges of the country, the report suggests.

2. Digital Infrastructure:

- Given Lithuania's relatively strong digital infrastructure, there may be spillover effects from the country's performance in digital skills.

- Lithuania's Next Generation Internet Access Development Plan for 2014 – 2020 further defines the country's goal to develop next generation Internet access infrastructure in the areas in which the market fails to ensure development of this infrastructure and provision of Internet services, and induce competition in broadband market and use of broadband services.

Figure 9.33: Lithuania´s framework conditions for digital transformation



- The State supports the development of broadband networks in rural areas that are unattractive for private investors using various funds (ERDF, EARDF) for construction of NGA networks in remote areas.

The Information Society Development

Committee, under the Ministry of Transport and Communications and other related institutions prepared a model for inducing broadband infrastructure development and the use of broadband services for 2014-2020.

3. Investments and access to finance:

- Investments and access to finance are areas for improvement in order for Lithuania to meet to the EU average.
- Access to finance – or financial inclusion – is one of the top priorities on the international development agenda. This creates a supportive environment and provides potential funding opportunities from international development bodies. With recent advancements in technology and digitization of financial services, increasing financial inclusion seems ever more possible. Digital platforms offer the opportunity to reduce transaction costs and rapidly scale up access to financial services using mobile phones, retail points of sale, and other broadly available access points, when supported by an appropriate consumer protection framework.
- On the positive side, Lithuania offers progressive regulation to encourage investments, which includes: the fastest pan-European Fintech license in the EU, E-money or payments license in just 3 months, Specialized "lite" bank license for challenger banks, Regulatory Sandbox Test financial innovations under the guidance and supervision of the regulator Guidance and cooperative attitude Newcomer Programme to facilitate the entry of new players and application documents accepted in English.

4. Supply and demand of digital skills:

- Lithuania's low performance in the supply and demand of digital skills can be seen as its main point of improvement.
- To a large extent, this performance is caused by employees' low ICT and IT skills. In addition, relatively few enterprises employ ICT specialists.
- Additionally, only a low proportion of Lithuanian employees are provided with portable devices to access the Internet for business purposes.
- Lithuania's economy and employment has been growing steadily in past years. The country has increasingly shifted towards becoming a knowledge-based economy, with the biotechnology sector offering a prominent example of substantial high-tech jobs creation.
- The government has implemented policies designed to improve the quality and accessibility of vocational guidance services, both in order to ensure that people in the labour force acquire the skills needed to support the economy, and to assist young people in making a fast and sustainable transition from the education system into the labour market.

- As well as other Baltic countries, Lithuania faces an ageing challenge and both employment and working age population (15-64) are forecasted to decline over the period to 2030. Sectors offering most new job opportunities in the future will be arts & recreation, ICT and financial services.

5. e-Leadership:

- Lithuania has a fairly advanced e-leadership compared to its European counterparts.
- An active policy for developing information society and promoting digital literacy has been pursued during the last decade in Lithuania: The Lithuanian Information Society Development Programme for 2011-2019 (currently being updated) aims at improving the life quality and business environment of Lithuanians through the ICT usage. There are three priorities outlined in the Programme: improvement of e-skills, development of e-services and ICT infrastructure, as well as promotion of take-up.
- The Programme for Universal Computer Literacy: digital literacy is regarded as relevant universal knowledge. It implies competencies in communication technologies and skills in hardware and software on the user level. The programme aimed at creating conditions for all country residents to acquire computer literacy skills, ensuring an adequate quality of teaching digital literacy and conducting the monitoring of the digital literacy programme. Within the context of developing digital literacy implementation measures, the following aspects should be brought into focus: inclusion of IT into the curriculum of educational institutions, development of relevant to it infrastructure (in educational institutions, public institutions and households), other political measures (for example, taxation mechanisms

6. Entrepreneurial culture:

- Following a dive caused by the global financial crisis, the Lithuanian entrepreneurial scene is recovering fairly quickly.
- An indicator reflecting this trend is the fact that the number of newly established start-ups has tripled in the last five years.
- Compared to 2015 indicators, a relatively high number of skilled workers are either nascent entrepreneurs or owner-managers of new businesses. In addition, most people consider starting a business to be a desirable career choice
- **Lithuanian Innovation Development Programme 2014-2020**: This programme was initiated with the aim of gathering and mobilising resources at state level to enhance innovativeness in the country. Through the programme, the Lithuanian Government seeks to foster a more competitive economy based on a digitally and technically qualified labour force, in line with its smart specialisation strategy. The overarching goal is to embed innovation across all sectors and in different aspects such as business models, branding and services, industrial design, and creative solutions. The programme addresses all relevant stakeholders that can

benefit from innovation policies. Along with SMEs, start-ups, businesses and public associations, major companies are also defined as target groups. With the Innovation Development Programme, the Lithuanian Government intends to further improve the country's HR capacities and skills. Lithuanian entrepreneurial culture performs very well.

7. Changes in ICT start-ups environment:

- The entrepreneurial culture is also reflected in the high number of the newly-created ICT Start-ups. ICT Startups in Lithuania create more and more jobs and consequently play a greater role in the employment share.

- **Startup Visa programme**: Aiming at boosting innovation and being more accessible to innovative businesses, the Lithuanian Ministry of Economy has introduced a Startup Visa programme for non-EU start-ups. The Startup Visa programme is legislation containing simplified rules and regulations for non-EU start-ups to obtain a temporary work permit, provided that they operate in an innovative field and have enough financial resources to meet their goals for one year. The programme aims to bring high-impact new technologies that will help to spread innovative ideas while at the same time creating new jobs in the field of ICT. Non-EU start-ups eligible for Lithuania's Startup Visa programme include any that adhere to "scalable and innovative business models" across electronics, biotech and the broader IT umbrella. To date, four companies have participated in this programme. The Startup Visa programme has a low administrative burden and a fairly simple application procedure.

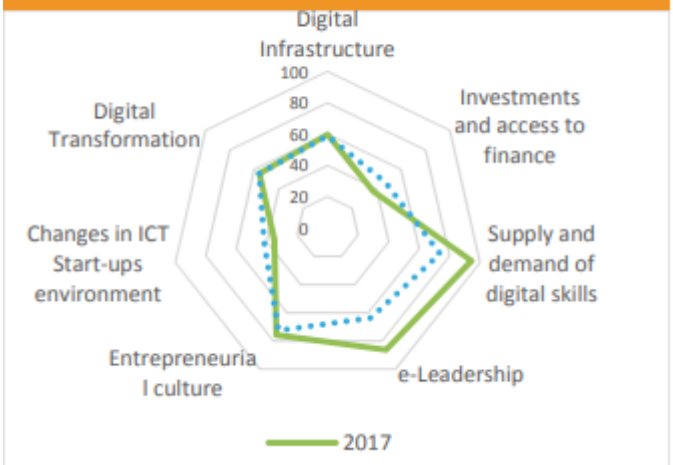
IRELAND

1. Digital Transformation:

- Ireland scores above the EU average in five out of seven dimensions. Ireland's strongest performance continues to be the supply and demand of digital skills, leading by nearly 50%. It also scores well in the areas of e-leadership and digital transformation. Meanwhile, Ireland displays a rather average to narrow lead performance in entrepreneurial culture and digital infrastructure. The area of ICT start-ups performs lower than last year, leaving room for improvement. The performance in investments and access to finance shows the same trend. Overall, Ireland performs far above the EU average in the supply and demand of digital skills, e-leadership and digital transformation. While entrepreneurial culture and digital infrastructure are slightly above the EU average, the fields of ICT start-ups and investments and access to finance could be improved.

- Digitalization/automation is happening gradually in Ireland and this slow yet steady progress is expected to continue.
- 1 in 3 jobs in Ireland are at high risk (probability greater than 70%) of being disrupted by digital technologies. Much of the disruption, however, will result in changes to job roles and tasks rather than job losses. While it is expected that the number of jobs lost will increase steadily over the next decade, this report estimates that the adoption of digital technologies over the next five years will lead to a hypothetical loss of 46,000 jobs.

Figure 9.27: Ireland´s framework conditions for digital transformation



2. Digital Infrastructure:

- Meanwhile, Ireland displays a rather average to narrow lead performance in entrepreneurial culture and digital infrastructure.

- Ireland has made a lot of progress in becoming a digital nation, capable not only of hosting and regulating global technology companies, but of reaping the social and economic benefits of new technologies, such as cloud and machine learning. Ireland's successful digital journey has now brought it to a moment of important strategic choice: will it enable and undertake the digital transformation necessary to become a genuine leader amongst the digital nations of the world? In a connected world the digital competitiveness of nations is determined not by geographical distance but by factors such as their capacity to digitally transform their public and private sectors. Research from The Fletcher School of Law and Diplomacy at Tufts University on the leading digital nations (the Digital 5/D5) shows that Ireland is well-positioned to evolve into an advanced digital society. In fact, Ireland could be a candidate country to join the group of advanced digital nations if it can address key gaps and adopt best practices from countries such as Estonia and New Zealand. The central challenge for Ireland, beyond the need to foster digital entrepreneurship and attract highly skilled technological talent from around the world, is that its public services are under-digitised.

3. Investments and access to finance:

- At the same time, the area of investments and access to finance has moderate values. This performance can be explained by a low percentage of commercial profits of Irish companies.
- However, the average score in this field contrasts with the solid business R&D expenditure.
- There are many reasons, to invest in Ireland, including: its growing population, which is the youngest in Europe with a third being under 25, an increasing number of technology graduates, a favorable tax regime and government initiatives.

4. Supply and demand of digital skills:

- Ireland's strong performance in the field of the supply and demand of digital skills is backed by the country's high innovation output.
- The ICT Skills Action Plan successfully achieves its objectives of reducing the gap between demand and supply, leveraging more active collaboration with industry to attract talent to ICT and to promote awareness of the relevance and attractiveness of ICT careers.

- Digital transformation sets new demands on the leadership of the organisations. There has been a wave of new senior positions with titles such as chief digital officer, which demand experience and both technology and business capabilities or in other words,

real hybrid skills.

- Ireland's position as an attractive country for talent and multinationals remains strong. In particular, there are policy initiatives to provide affordable housing and improve public transport. Urban renewal initiatives in cities like Cork and Galway can help attract young ICT professionals.

- A number of reasons why technical skills are difficult to find were outlined by organisations. In many cases the difficulty is because the skill being sought are in very new disciplines and therefore are in short supply. Examples are artificial intelligence, machine learning and, even more recent, blockchain and robotics. Demand is high for the small number of people with these skills. Cybersecurity is a discipline where demand so outnumbers supply that new creative methods are being employed to upskill people from different backgrounds with the necessary skills.
- The demand for high-level ICT skills will show healthy growth over the period with a CAGR of 8.5%, as shown in the table. Growth is especially driven by the ICT sector (9.3%) but demand is also stronger in the other sectors than was the case prior to 2016 as innovation technology adoption increases. Demand for computing skills will grow faster than demand for electronics and electrical engineering skills.

5. e-Leadership:

- A large workforce with tertiary education, as well as training provided to ICT employees by companies, explains why e-leadership is Ireland’s second-strongest pillar. This is supported by a high number of enterprises providing their employees with portable devices.
- In support of Project Ireland 2040 plan for social, economic and cultural development, Cisco has announced measures to help accelerate digitisation, creating 100 highly-skilled jobs, including software development roles around artificial intelligence (AI), machine learning (ML) and internet of things (IoT) in Galway.
- The new roles will be based across offices in both Dublin, as indirect hires in partnership with N3, and at the cloud collaboration R&D operation in Galway to develop the Webex portfolio and in voice, video, and chat collaboration.
- According to the e-Leadership in Europe Demand and Supply Forecasts (2015-2020), Ireland is a top performer in terms of growth of the core ICT workforce on Europe between 2004 and 2014.
- Ireland is near the top in the 'Indicative ICT Workforce "Maturity" Index along with Germany and Estonia, yet still just below the likes of the UK, Netherlands and Luxembourg.

6. Entrepreneurial culture:

- Ireland displays a rather average to narrow lead performance in entrepreneurial culture.
- In March 2017, the Department of Education and Skills announced a call for higher education institutions to submit proposals to organise entrepreneurship summer camps. The Entrepreneurship Summer Camps programme is intended to provide students with environments that stimulate their creativity, innovation and invention. In the same vein, activities aiming at stimulating entrepreneurial thinking and design skills among students will be developed.
- This policy measure is expected to contribute to the delivery of the Action Plan for Education, whose main goal is to strengthen cooperation between education and the wider community and to ensure that entrepreneurship, creativity and innovation are nurtured by the education system.
- €250,000 has been invested to provide nearly 1,000 places on summer camps in higher education institutions across the country.

7. Changes in ICT start-ups environment:

- The area of ICT start-ups performs lower than last year, leaving room for improvement.
- Ireland has been home to a lot of high tech companies, that categories themselves as early stage and late-stage startups.
- Nine of the world's top ten medical technology companies, such as Boston Scientific and Medtronic have a significant presence in Ireland.
- Twenty-four top pharma companies including Pfizer, Amgen, Johnson & Johnson, Roche, Novartis, Sanofi, Bristol-Myers Squibb have considerable presence in Ireland.
- Ten top digital companies like Apple, Microsoft, Google, Twitter, HP, Dropbox, Intel, and Facebook are also some of the biggest employers in Ireland. These bigger companies come to Ireland because of attractive taxation rates, benefits of being in the EU, access to international talent and quality of life.
- Ireland also boasts of a large number of early-stage technology startups that are building global businesses. Most Irish early-stage technology startups provide cloud-based solutions such as platform as a service, software as a service or infrastructure as a service. In the last few years, technology startups building Artificial Intelligence, AR/VR, Blockchain and Internet of Things are also gaining momentum.

ROMANIA

1. Digital Transformation:

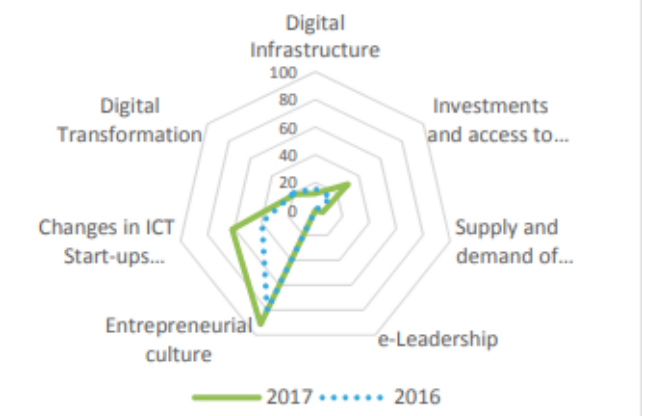
- Romania's performs poorly overall in the field of digital transformation. Its scores relatively highly in relation to entrepreneurial culture, as well as having a dynamic ICT start-up environment. The main challenges that Romania faces relate to the lack of high-quality digital infrastructure, a weak investment climate and a very low level of digital skills among professionals. The Romanian Government's recent policy measures focus on addressing the challenges in digital transformation by facilitating SMEs' access to finance, as well as by developing the country's digital infrastructure
- Despite higher results compared to last year, the country continues to be impeded by an unfavourable investment climate with additional challenges in the field of digital transformation. Overall, further efforts are needed in the supply and demand of digital skills, as the data shows that professionals have a rather low level of digital skills. Overall, there is a particular need for improving Romania's digital transformation and digital infrastructure, as well as further concrete measures for enhancing all dimensions

2. Digital Infrastructure:

- A significant challenge faced by Romania is the lack of high-quality digital infrastructure.
- Romania's broadband plan focuses on building up a national broadband network as a first step towards achieving the targets set by the Digital Agenda for Europe.

- The National Strategy for Romanian Digital Agenda 2020 represents Romania's broadband strategy. Broadband and digital services infrastructure is one of the four action fields defined in the strategy. The Romanian Strategy aims at achieving coverage of 100% of households with fixed broadband by 2020, 80% of households with access to over 30 Mbps broadband and 45% of households with subscriptions over 100 Mbps. The National Plan for Next Generation Network infrastructure development states the same and opts for prioritising the development of fibre networks as close to the end user as possible. The National Strategy for the Implementation of 5G has been launched for public consultation.

Figure 9.45: Romania´s framework conditions for digital transformation



- The broadband plan has a number of specific objectives such as: connecting

public institutions (public demand aggregation), increased use in public, supporting SMEs in training, configuring and implementing infrastructure projects and services, increasing accessibility of services, content and applications development, consumer education, and inclusion of disadvantaged groups of users.

3. Investments and access to finance:

- Romania scores lower than the EU average regarding companies' access to investment and finance.
- In light of that fact, the Investment Plan for Europe includes three guarantee agreements under the COSME Loan Guarantee Facility to support small and medium-sized companies (SMEs) in Romania.
- Research on the matter highlights a number of persistent challenges for Romania such as weaknesses related to public sector infrastructure planning and prioritisation, leading to repeated changes in focus, inefficient use of resources, including EU structural funds.
- First, there is a strong need for more consistent project planning and stable prioritization. This would facilitate the absorption of EU funds in general and is particularly crucial for areas like (large scale) infrastructure or education and skills, which require longer term strategies. While the EIB has been traditionally very active in project capacity building in Romania – through JASPERS and most recently also through the work of the European Advisory Hub – one of the possibilities discussed at the conference was the potential for greater coordination among international financial institutions and the European Commission to foster sectoral transformation.
- Second, the relatively low financial intermediation in Romania remains an issue. Against this background instruments like guarantees could play an important role to facilitate transformation of liquidity into sustainable risktaking. A new cooperation between EIB and five Romanian banks, which aims to facilitate access to finance for small and medium enterprises by providing a partial guarantee on loans, reflects this idea.
- Third, improvements in the business environment remain crucial. Impediments to investment are related to uncertainty, the business and regulatory environment, transport infrastructure gaps as well as constraints in terms of skills

4. Supply and demand of digital skills:

- In Romania, there is a particular need for improving the digital skills of its workforce, as it is difficult for enterprises to find employees with suitable ICT skills. Moreover, the number of enterprises recruiting ICT specialists is under the EU average.
- Overall, further efforts are needed in the supply and demand of digital skills, as the data shows that professionals have a rather low level of digital skills.

- In Romania, about six in 10 workers need at least a fundamental level of ICT skills to do their jobs effectively. However, currently, only 3 in 10 employees fulfill that requirement.
- Romania has taken over the rotating six-month EU Presidency for the first time. Its programme, published on 15 January, focuses on 'cohesion, a common European value' and includes provisions for vocational education and training (VET), digital skills and mobility.
- The programme is mainly future-oriented stating that 'innovation and research contribute to job creation, and help increase companies' competitiveness on global markets, improve people's quality of life and generate sustainable economic growth.' It makes the case for 'a significant decrease of the digital gap between Member States, regions, categories of European citizens, and industrial sectors.' It calls for special attention 'to developing and implementing measures to improve digital skills and digital literacy, including by making this a long-term priority for the EU'.

5. e-Leadership:

- There is a lack of reliable data concerning e-leadership in Romania, mostly due to the low performance in the rest of digital and developmental sectors.
- An early (2004) definition of e-business skills, which were later renamed into e-leadership skills, was that by the European e-Skills Forum8 , naming e-Business skills: The capabilities needed to exploit opportunities provided by ICT, notably the Internet, to ensure more efficient and effective performance of different types of organisations, to explore possibilities for new ways of conducting business and organisational processes, and to establish new businesses. e-Business skills are strategic and related in particular to innovation management, rather than technology-management, skills - which are part of ICT practitioner skills. This definition is at a meta-level as it lacks the definition content of the skills and replaces this solely by the goals or reasons why these skills are necessary.
- This kind of definition is very useful in giving a rationale for defining the term, but needs to be further elaborated to be operationally useful. We have therefore tried to define e-Leadership skills in four layers, with each layer becoming more concrete in the specification of skills.

6. Entrepreneurial culture:

- Romania scores higher than the EU average in entrepreneurial culture.
- **Government Strategy for developing SMEs and improving the business environment in Romania -Horizon 2020:** This strategy updates the Romanian policy priorities in the field of SMEs to new developments in Europe. The strategy sets out a series of priorities: smart growth, by developing an economy based on knowledge and innovation; as well as sustainable growth, by promoting a more efficient, greener and competitive economy in terms of resources use. The strategy aims to develop a viable entrepreneurial ecosystem for

businesses by implementing ambitious objectives, such as: supporting and promoting entrepreneurship through developing entrepreneurial education at all levels; facilitating SMEs' access to adequate financing through specific operational instruments; stimulating innovative SMEs by encouraging technology transfer; improving SMEs' access to international markets by stimulating the use of information technology; and supporting e-commerce and other forms of online business.

- This strategy is an important policy measure for supporting the SMEs and growing start-up ecosystem in Romania.

7. Changes in ICT start-ups environment:

- In addition, the development of ICT start-ups in Romania is nearly 20% above the EU average.
- **Business Incubators Law:** This law regulates the legal establishment and functioning of such undertakings by providing incentives for stimulating the establishment of business incubators, creating jobs, diversifying economies and supporting entrepreneurship in local communities. It is a significant measure that aims to stimulate facilities for incubators, such as: tax relief for lands and buildings; a tax exemption for the local budget; and other facilities granted according to the law by local or central government. According to the Law's provisions, there are several types of business incubators that can benefit from all these facilities, including: incubators with a mixed portfolio of SMEs in various industries; incubators with a technological portfolio catering to the needs of SMEs in the technology industry; academic incubators for SMEs active in the R&D sector; virtual incubators; and sector-specific incubators. Although the measure does not specifically target the ICT sector, it can support the SME ecosystem in Romania.
- By facilitating access to finance for SMEs, the Business Incubators Law addresses one of the key barriers to the further development of innovative IT start-ups in Romania.

ANNEX 2: Employers' interview points

THEME	QUESTION/SCALE
Company Name **Contact Person** **Position** **Company years of operation**	(Organization name)
Company type	Please select: Private NGO Public Social enterprise
Company size	Please select: 1 - 0 to 9 employees 2 - 10 to 19 employees 3 - 20 to 49 employees 4 - 50 to 249 employees 5 - 250 to 499 employees 6 - 500 or more employees

	Low 1	High 5
How would you describe the competition your company is facing:		

How would you describe the complexity in the environment of your company? (a complex business environment is characterized by a multitude of diverse, but interconnected factors and by rapid, unpredictable changes)	1 5

What is your company's main activity/sector? Please select:

Service provider …… Product developer …… Both ……

1-Agriculture, forestry and fishing
2 -Extractive industries and Manufacturing industry
3 - Building
4 -Trade, accommodation and catering services
5 - Transportation and storage
6 - Information and communications
7 - Financial and insurance activities, Real Estate activities, scientific and administrative activities
8 - Public administration and defense; mandatory social security
9 - Education
10 - Health and social services activities
11 - Other services

What percentage of your employees has university degrees? ……..%

What is your opinion regarding the following technologies?

	Useful Not at all Very 1 5	Does your firm use any of the following ICT technologies? Not at all To a great extent 1 5	In the following months, does your firm plan to invest in …? No Yes
Social media			
Mobile services			
Cloud technologies			
Internet of things			
Cybersecurity solutions			
Robotics and automated machinery			
Big data and data analytics			
3D printing			

Artificial intelligence			
Enterprise systems			

Which are the main reasons that prevent your company from using digital technologies, or at least to the extent envisaged? (Please select all that apply)

- **Low level of digital skills by employees**
- **Low awareness of digital technologies benefits**
- **Lack of IT professionals**
- **The company's strategy and business model does not focus on the use of digital technologies**
- **Low security of digital technologies**
- **Cost**
- **Other…….**

How many of your employees have:

	MEN	WOMEN
The right skills?		%
Education?		%
Experience?		%

Based on your experience, during the last 1-2 years, how many job applicants seeking work in your firm have:

	MEN	WOMEN
The right skills?		%
Education?		%
Experience?		%

What digital skills and of what levels have you found difficult to recruit in recent years?

Basic Advanced

……

……

……

	Less required 1	2	3	4	Most required 5
Service Support Role (provides user support and troubleshoot ICT problems and issues)					
Digital Media Specialist Role (Designs and codes social media applications and websites)					
Test Specialist Role (Ensures delivered or existing products, applications or services comply with technical and user needs and specifications)					
Database Administrator Role (Administer and monitor data management systems and ensures design, consistency, quality and security)					
Data Analyst (Conducts full lifecycle analysis to include requirements, activities and design)					
Developer (Ensures building and implementing of ICT applications)					
Graphic Designer (Creates visual concepts using computer software, to communicate ideas that inspire, inform, or captivate consumers)					
Solution Designer (Provides the translation of business requirements into end-to-end IT solutions)					
CRM platforms manager (Compiles, organizes, analyses and utilizes end-user data to support the organization's sales objectives)					
Systems Administrator (Installs software, configures and upgrades ICT systems)					

What job profiles do you believe will be most in-demand the following 5 years?

What ICT and soft skills do you think will be required in the next 5 years?

……
……
……

Which is the percentage of women employees in your firm …….%
Which is the percentage of women in digital/IT positions in your firm ……%

When advertise for recruiting, which is the percentage of women applicants:
for IT positions ……..%
for non IT positions …….. %

What do you think is the most important aspect of the work for your women employees?
(Please prioritize from 1 = most important to 5 less important)

- **work organization (how work is structured, e.g. tele-working)**
- **job satisfaction (degree of contentedness with their job)**
- **work flexibility (ability to coordinate their work - schedules)**
- **economic growth**
- **remuneration**

Does the company have an Equality Plan: Yes No
Does the company have policies for work-family reconciliation? Yes No

Comments/suggestions: ……
……..
……..

If you want to be informed about the results of this European survey, please fill-in your email:
……

Thank you!

ANNEX 3: European ICT Professional Role Profiles

EUROPEAN ICT PROFESSIONAL ROLE PROFILES VERSION 2

CWA 16458:2018 LOGFILE

Overview all ICT Profile changes in title, summary statement, mission and e-Competences from version 1 to version 2

Versions	Version 1	Version 2
Role Profile TITLE	**Account Manager (1)**	**Account Manager Role (1)**
Summary statement	Senior focal point for client sales and customer satisfaction.	No change
Mission	Builds business relationships with clients to facilitate the sale of hardware, software, telecommunications or ICT services. Identifies opportunities and manages sourcing and delivery of products to customers. Has responsibility for achieving sales targets and maintaining profitability.	No change
e-Competences (from e-CF)	D.5. Sales Proposal Development 1.4 D.6. Channel Management 1.4 D.7. Sales Management 1.5 E.1. Forecast Development 1.3 E.4. Relationship Management 1.4	D.5. Sales Proposal Development **1.3** D.6. Channel Management 1.4 D.7. Sales Management **1.4** E.1. Forecast Development 1.3 E.4. Relationship Management 1.4
Role Profile TITLE	**Business Analyst (2)**	**Business Analyst Role (2)**
Summary statement	Analyses Information System for improving business performance.	Analyses the business domain and optimises business performance through technology application.
Mission	Identifies areas where information system changes are needed to support business plans and monitors the impact in terms of change management. Contributes to the general functional requirements of the business organization in the area of ICT solutions. Analyses business needs and translates them into ICT solutions.	Analyses the information and the processes needed to support business plans. Formulates functional and non-functional requirements of the business organisation and advises on the lifecycle of the information solutions. Evaluates the impact in terms of change management.

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Versions	Version 1	Version 2
e-Competences (from e-CF)	A.1. IS and Business Strategy alignment - L.4 A.3. Business Plan Development L.4 E.5. Process Improvement L.4	A.1. IS and Business Strategy Alignment L.4 A.3. Business Plan Development L.4 **D.10. Information and Knowledge Management L.4** **D.11 Needs Identification - L.4** E.5. Process Improvement L.4
Role Profile TITLE	**Business Information Manager (3)**	**Business Information Manager Role (3)**
Summary statement	Proposes plans and manages functional and technical evolutions of the Information System within the relevant business domain.	Proposes, plans and manages functional development of the Information System (IS) focusing upon the needs of users.
Mission	Manages and implements updates to existing applications and maintenance activities guided by the needs, costs and plans agreed with internal users. Ensures quality of service and internal user satisfaction.	Aligns the Information System to the business strategy within their area/domain. Ensures continuous enhancement whilst accounting for user requirements, service quality and budgetary constraints.
e-Competences (from e-CF)	A.1. IS and Business Strategy Alignment - L.4 A.3. Business Plan Development L.4 D.10. Information and Knowledge Management L.5 E.2. Project and Portfolio Management - L.4 E.7. Business Change Management L.4	A.1. IS and Business Strategy Alignment L.4 A.3. Business Plan Development L.4 **E.4. Relationship Management L.4** E.7. Business Change Management L.4 **E9. IT Governance L.5**
Role Profile TITLE	**Chief Information Officer (4)**	**Chief Information Officer Role (4)**
Summary statement	Develops and maintains Information Systems compliant to business and organisation's needs.	Develops and maintains Information Systems to generate value for the business and meet the organisation's needs.

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Versions	Version 1	Version 2
Mission	Defines and implements governance and ICT strategy. Determines necessary resources for ICT strategy implementation. Anticipates ICT market evolutions and company business needs. Contributes to the development of the organisation's strategic plan. Leads or participates in larger change projects.	Ensures the alignment of the Information Systems strategy with the business strategy. Provides leadership for the implementation and development of the organisations architecture and applications.
e-Competences (from e-CF)	A.1. IS and Business Strategy Alignment - L.5 A.3. Business Plan Development L.5 E.2. Project and Portfolio Management - L.5 E.4. Relationship Management L.4 E.9. IT Governance L.5	No change
Role Profile TITLE	**Database Administrator (5)**	**Database Administrator Role (5)**
Summary statement	Designs and implements, or monitors and maintains databases.	Designs, implements, or monitors and maintains data sets, structured (databases) and unstructured (big data).
Mission	Ensures the design and the implementation (Developer), or ensures the maintenance and repair of an organization's database (Administrator) to support information system solutions that meet business information needs. Verifies the development and design of database strategies, monitoring and improving database performance and capacity, and planning for future expansion requirements. Plans, co-ordinates and implements security measures to safeguard the database.	Administer and monitor data management systems and ensures design, consistency, quality and security.

Versions	Version 1	Version 2
e-Competences (from e-CF)	A.6. Application design 1.1 B.1. Design and Develop. 1.3 B.2. System integration 1.2-3 C.4. Problem management 1.3 D.10. Information and knowledge management 1.3	B.1. Design and Develop. 1.3 B.2. System integration **1.3** **C.2. Change Support 1.3** D.10. Information and Knowledge management 1.3 **E.8. Information Security Management 1.3**
Role Profile TITLE	**Developer (6)**	**Developer Role (6)**
Summary statement	Builds/codes ICT solutions and specifies ICT products according to the customer needs.	Designs and/or codes components to meet solution specifications.
Mission	Ensures building and implementing of ICT applications. Contributes to planning, low level design. Compiles diagnostic programs and designs and writes code for operating systems and software to ensure optimum efficiency and functionality.	Ensures building and implementing of ICT applications. Contributes to low-level design. Writes code to ensure optimum efficiency and functionality and user experience.
e-Competences (from e-CF)	B.1. Design and Develop. 1.3 B.2. Systems Integration 1.2 B.3. Testing 1.2 B.5. Documentation Production 1.3 C.4. Problem Management 1.3	No change
Role Profile TITLE	**Digital Media Specialist (7)**	**Digital Media Specialist Role (7)**
Summary statement	Creates websites and multimedia applications combining the power of digital technology with effective use of graphics, audio, photographic and video images.	Integrates digital technology components for internal and external communication purposes.
Mission	Designs, lays out and codes, multimedia applications and websites to maximize information presentation, including marketing messages. Makes recommendations on technical interfaces and ensures sustainability through application of appropriate content management systems.	Designs and codes social media applications and websites. Makes recommendations on Application Programming Interface (API) and supports efficiency through appropriate content management systems.

Versions	Version 1	Version 2
e-Competences (from e-CF)	A.6. Application Design – L.2 B.1. Design and Develop. – L.3 B.3. Testing – L.2 B.4. Solution Deployment – L.3 B.5. Documentation Production – L.3	A.6. Application Design – L.2 B.1. Design and Develop. – L.3 B.3. Testing – L.2 B.4. Solution Deployment – L.3 **D.12. Digital Marketing – L.2**
Role Profile TITLE	**Enterprise Architect (8)**	**Enterprise Architect Role (8)**
Summary statement	Designs and maintains the Enterprise Architecture.	Designs and maintains the holistic architecture of business processes and Information Systems.
Mission	Balances technological opportunities with business (process) requirements. Maintains a holistic view of the organisation's strategy, processes, information and ICT assets. Links the business mission, strategy and processes to the IT strategy.	Maintains a holistic perspective of the organisation's strategy, processes, information, security and ICT assets. Links the mission, strategy and business processes to the IT strategy. Ensures project choices are integrated consistently, efficiently and in a sustainable manner according to the enterprise's digital standards.
e-Competences (from e-CF)	A.1. IS and Business Strategy Alignment – L.4-5 A.3. Business Plan Development – L.3-4 A.5. Architecture Design – L.4 A.7. Technology Watching – L.5 E.7. Business Change Management – L.4-5	A.1. IS and Business Strategy Alignment – **L.5** A.3. Business Plan Development – **L.4** A.5. Architecture Design – L.4 A.7. Technology Watching – L.5 **E.8. Information Security Management – L.3**
Role Profile TITLE	**ICT Consultant (9)**	**Digital Consultant Role (9)**
Summary statement	Supports understanding of how new ICT technologies add value to a business.	Supports understanding of how digital technologies add value to a business.
Mission	Ensures technological watch to inform stakeholders of emergent technologies. Anticipates and brings to maturity ICT projects by the introduction of appropriate technology. Communicates the value of new technologies to the business. Contributes to project definitions.	Maintains a technology watch to inform stakeholders of existing and emerging technologies and their potential to add business value. Supports the identification of needs and solutions for achieving business and IS strategic goals.

Versions	Version 1	Version 2
e-Competences (from e-CF)	A7. Technology watching – L.5 A3. Business Plan Development – L.4 A4. Product or Project Planning – L.3 E3. Risk Management – L.3 E7. Business Change Management – L.4-5	A7. Technology Trend Monitoring – **L.4** **A9. Innovating – L.4** **D.11. Needs Identification – L.4** E3. Risk Management – **L.4** E7. Business Change Management – **L.4**
Role Profile TITLE	**ICT Operations Manager (10)**	**ICT Operations Manager Role (10)**
Summary statement	Manages operations, people and further resources for the ICT activity.	Manages operations, people and overall ICT resources.
Mission	Implements and maintains a designated part of the ICT infrastructure. Ensures that activities are conducted in accordance with organizational rules, processes and standards. Anticipates necessary changes according to company strategy and cost controls. Evaluates and recommends investments based on new technologies. Ensures the effectiveness of the ICT and associated risk management.	Implements and maintains a designated part of an ICT operation ensuring that activities are conducted in accordance with organisational rules, processes and standards. Plans changes and implements them in accordance with organisational strategy and budget. Risk manages and ensures the effectiveness of the ICT infrastructure.
e-Competences (from e-CF)	D.9. Personnel Development – L.4 E.3. Risk Management – L.3 E.6. ICT Quality Management – L.3 E.7. Business Change Management – L.4 E.8. Information Security Management - L.3	D.9. Personnel Development – L.4 **E.2. Project and Portfolio Management – L.4** E.3. Risk Management – L.3 E.6. ICT Quality Management – L.3 E.8. Information Security Management – L.3
Role Profile TITLE	**ICT Security Manager (11)**	**Information Security Manager Role (11)**
Summary statement	Manages the digital security policy.	Leads and manages the organisation information security policy.

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Versions	Version 1	Version 2
Mission	Defines the Information System security policy. Manages security deployment across all Information Systems. Ensures the provision of information availability. Recognized as the ICT security policy expert by internal and external stakeholders.	Defines the information security strategy and manages implementation across the organisation. Embeds proactive information security protection by assessing, informing, alerting and educating the entire organisation.
e-Competences (from e-CF)	A.7. Technology Watching – L.4 D.1. Information Security Strategy Development – L.5 E.3. Risk Management – L.3 E.9. IT Governance – L.4 E.8. Information Security Management – L.4	A.7. Technology Trend Monitoring – L.4 D.1. Information Security Strategy Development – L.5 E.3. Risk Management – **L.4** E.8. Information Security Management – **L.4** E.9. IT Governance – L.4
Role Profile TITLE	**ICT Security Specialist (12)**	**Information Security Specialist Role (12)**
Summary statement	Ensures the implementation of the organisations security policy.	Ensures the implementation of the organisation's information security policy by the secure and appropriate use of ICT resources.
Mission	Proposes and implements necessary security updates. Advises, supports, informs and provides training and security awareness. Takes direct action on all or part of a network or system. Is recognized as the ICT technical security expert by peers.	Defines, proposes and implements necessary information security technique and practices in compliance with information security standards and procedures. Contributes to security practices, awareness and compliance by providing advice, support, information and training.
e-Competences (from e-CF)	C.2 Change Support – L.3 C.3 Service Delivery – L.3 D.9 Personnel Development – L.3 D.10. Information and Knowledge Management – L.3 E.8 Information Security Management – L.3-4	**A.7. Technology Trend Monitoring – L.4** **A9. Innovating – L.4** **D.1. Information Security Management – L-4** **D.3. Education and Training Provision – L-3** **E.3. Risk Management – L.3**
Role Profile TITLE	**ICT Trainer (13)**	**Digital Educator Role (13)**

Versions	Version 1	Version 2
Summary statement	Educates and trains ICT professionals and practitioners to reach predefined standards of ICT technical/business competence.	Educates and trains Professionals to reach optimal digital competence to support business performance.
Mission	Provide the knowledge and skills required to ensure that students are able to effectively perform tasks in the workplace.	Provide the knowledge and skills required to ensure that people are able to effectively perform tasks in the workplace.
e-Competences (from e-CF)	D.3. Education and Training Provision L.2-3 D.9. Personnel Development L.3	**B.5. Documentation Production L.3** D.3. Education and Training Provision - **L.3** D.9. Personnel Development L.3 **E.2. Product and Portfolio Management L.2**
Role Profile TITLE	**Network Specialist (14)**	**Network Specialist Role (14)**
Summary statement	Ensures the alignment of the network, including telecommunication and/or computer infrastructure to meet the organisation's communication needs.	No change
Mission	Manages and operates a networked information system, solving problems and faults to ensure defined service levels. Monitors and improves network performances.	Manages and operates a networked information system, solving problems and faults to ensure defined service levels. Monitors and improves network performances and security.
e-Competences (from e-CF)	B.1. Design and Development L.2-3 B.2. Systems Integration L.2-3 B.4. Solution Deployment L.2-3 C.4. Problem Management L.2-3 E.8. Information Security Management - L.2	**A.6. Application Design L.3** B.2. Component Integration **L.3** B.4. Solution Deployment **L.3** C.4. Problem Management **L.3** E.8. Information Security Management **L.3**
Role Profile TITLE	**Project Manager (15)**	**Project Manager Role (15)**
Summary statement	Manages project to achieve optimal performance that conforms to original specifications.	Manages projects to achieve optimal performance and results.

Versions	Version 1	Version 2
Mission	Defines, implements and manages projects from conception to final delivery. Responsible for achieving optimal results, conforming to standards for quality, safety and sustainability and complying with defined scope, performance, costs, and schedule.	Defines, implements and manages projects from conception to final delivery. Responsible for achieving optimal results, conforming to standards for quality, safety and sustainability and complying with defined scope, performance, costs, and schedule. Deploys agile practices where applicable.
e-Competences (from e-CF)	A.4. Product or Project Planning – L.4 E.2. Project and Portfolio Management – L.4 E.3. Risk Management – L.3 E.4. Relationship Management – L.3 E.7. Business Change Management – L.3	No change
Role Profile TITLE	**Quality Assurance Manager (16)**	**Quality Assurance Manager Role (16)**
Summary statement	Guarantees that Information Systems are delivered according to organisation policies (quality, risks, Service Level Agreement).	Ensures that processes and organisations implementing Information Systems comply to quality policies.
Mission	Establishes and operates an ICT quality approach compliant with the organization's culture. Ensures that management controls are correctly implemented to safeguard assets, data integrity and operations. Is focused and committed to the achievement of quality goals and monitors statistics to forecast quality outcomes.	Establishes and operates an ICT quality approach aligned with the organisation's culture. Commits the organisation to the achievement of quality goals and an encourages an environment of continuous improvement.
e-Competences (from e-CF)	D.2. ICT Quality Strategy Development – L.4-5 E.3. Risk Management – L.3 E.5. Process Improvement – L.3 E.6. ICT Quality Management – L.4	D.2. ICT Quality Strategy Development – **L.4** E.3. Risk Management – L.3 E.5. Process Improvement – **L.4** E.6. ICT Quality Management – L.4
Role Profile TITLE	**Service Desk Agent (17)**	**Service Support Role (17)**

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Versions	Version 1	Version 2
Summary statement	Provides first line telephone or e-mail support to clients with technical issues.	Provides remote or onsite diagnosis or guidance to internal or external clients with technical issues.
Mission	To provide user support and troubleshoot ICT problems and issues. The primary objective is to enable users to maximize their productivity through efficient use of ICT equipment or software applications.	To provide user support and troubleshoot ICT problems and issues. The primary objective is to enable users to maximize their productivity through efficient and secure use of ICT equipment or software applications.
e-Competences (from e-CF)	C.1. User Support – L.2 C.3. Service Delivery – L.1 C.4. Problem Management – L.2	C.1. User Support – L.2 **C.2. Change Support – L.2** C.3. Service Delivery – L.1 C.4. Problem Management – L.2
Role Profile TITLE	**Service Manager (18)**	**Service Manager Role (18)**
Summary statement	Plans, implements and manages solution provision.	No change
Mission	Manages the definition of Service Level Agreements (SLAs), Operational Level Agreements (OLAs) contracts and Key Performance Indicators (KPIs). Negotiates contracts with the various business domains or customers and in alignment with the *Business IS Manager*. Man manages the staff who monitor, report and fulfil the SLAs. Takes mitigation action in case of non-fulfilment of agreements. Contributes to the development of the maintenance budget together with business/finance organisations.	Manages the definition of Service Level Agreements (SLAs), Operational Level Agreements (OLAs) contracts and Key Performance Indicators (KPIs). Provides people management of staff monitoring, reporting and fulfilling service activities. Takes mitigation action in case of non-fulfilment of agreements.
e-Competences (from e-CF)	A.2. Service Level Management – L.4 C.3. Service Delivery – L.3 C.4. Problem Management – L.4 D.8. Contract Management – L.4 D.9. Personnel Development – L.3	A.2. Service Level Management – L.4 C.3. Service Delivery – L.3 C.4. Problem Management – L.4 D.8. Contract Management – **L.3** D.9. Personnel Development – L.3
Role Profile TITLE	**Systems Administrator (19)**	**Systems Administrator Role (19)**

Versions	Version 1	Version 2
Summary statement	Administers ICT System components to meet service requirements.	No change
Mission	Installs software, configures and upgrades ICT systems. Administers day-to-day operations to satisfy continuity of service, recovery, security and performance needs.	Installs software, configures and upgrades ICT systems. Administers day-to-day operations to satisfy continuity of service, recovery, security and performance needs.
e-Competences (from e-CF)	B.2. Systems Integration – L.2 B.3. Testing – L.2 C.1. User Support – L.2-3 C.4. Problem Management – L.2 E.8. Information Security Management - L.2	B.2. Systems Integration – L.2 B.3. Testing – L.2 **C.2. Change Support – L.3** C.4. Problem Management – **L.2** E.8. Information Security Management – L.2
Role Profile TITLE	**Systems Analyst (20)**	**Systems Analyst Role (20)**
Summary statement	Analyses requirements and specifies software and systems.	Analyses organisation requirements and specifies software and system requirements for new IT solutions.
Mission	Ensures the technical design and contributes to implementation of new software and/or enhancements.	Ensures the technical design and contributes to the implementation of new and/or enhanced software provision. Provides solutions for the improvement of organisational efficiency and productivity.
e-Competences (from e-CF)	A.5. Architecture Design – L.3 E.5. Process Improvement – L.3-4 B.1. Design and Develop. – L.3-4	A.5. Architecture Design – L.3 **B.5. Documentation Production – L.3** **B.6. System Engineering – L.4** E.5. Process Improvement – **L.4**
Role Profile TITLE	**Systems Architect (21)**	**Systems Architect Role (21)**
Summary statement	Plans and is accountable for the implementation and integration of software and/or ICT systems.	Plans, designs and integrates ICT system components including hardware, software and services.

Versions	Version 1	Version 2
Mission	Designs, integrates and implements complex ICT solutions from a technical perspective. Ensures, that technical solutions, procedures and models for development are up-to-date and comply with standards. Watches technology development and integrates into new solutions. Acts as a team leader for developers and technical experts.	Designs, integrates and implements complex technical ICT solutions ensuring procedures and models for development are current and comply with common standards. Monitors new technology developments and applies if appropriate. Provides technological design leadership.
e-Competences (from e-CF)	A.5. Architecture Design 1.4 A.7. Technology Watching 1.4-5 B.1. Design and Develop. 1.4-5 B.2. System Integration 1.4	A.5. Architecture Design 1.4 A.7. Technology Watching **1.4** **A.9. Innovating 1.4** B.2. System Integration 1.4 **B.6. System Engineering 1.4**
Role Profile TITLE	**Technical Specialist (22)**	**Technical Specialist Role (22)**
Summary statement	Maintains and repairs hardware and software on client premises.	Maintains and repairs hardware, software and service applications.
Mission	To effectively maintain customer hardware/software. Responsible for delivering timely and effective repairs to ensure optimal system performance and superior customer satisfaction.	No change
e-Competences (from e-CF)	C.2. Change Support 1.3 C.3. Service Delivery 1.2 C.4. Problem Management 1.3	C.2. Change Support **1.3** C.3. Service Delivery 1.2 C.4. Problem Management 1.3 **E.3. Risk Management 1.2** **E.6. ICT Quality Management 1.2**
Role Profile TITLE	**Test Specialist (23)**	**Test Specialist Role (23)**
Summary statement	Designs and performs testing plans.	No change

Versions	Version 1	Version 2
Mission	Contributes to correctness and completeness of a system ensuring that solutions meet technical and user requirements. Contributes in different areas of systems development, testing system functionality, identifying anomalies and diagnosing possible causes.	Ensures delivered or existing products, applications or services comply with technical and user needs and specifications. For existing systems, applications, innovations and changes; diagnoses failure of products or services to meet specification.
e-Competences (from e-CF)	B.1. Design and Develop. 1-3 B.2. Systems Integration 1-2 B.3. Testing 1-2 B.4. Solution Deployment 1-3 C.4. Problem Management 1-2	**B.2. Component Integration 1-3** B.3. Testing 1-3 B.4. Solution Deployment **1-2** **B.5. Documentation Production 1-3** **E.3. Risk Management 1-2**

NEW PROFILES ADDED IN VERSION 2

Role Profile TITLE	Solution Designer Role (24)
Summary statement	Provides the translation of business requirements into end-to-end IT solutions.
Mission	Proposes and designs solutions in line with technical architecture which fit business requirements and support change.
e-Competences (from e-CF)	A.6. Application Design 2-3 A.9. Innovating 2-4 D.10. Information and Knowledge Management 2-3 D.11. Needs Identification 2-4
Role Profile TITLE	**Digital Transformation Role (25)**
Summary statement	Provides leadership for the implementation of the digital transformation strategy of the organisation.
Mission	Drive cultural change and build digital capability to deliver innovative business models and processes.

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Role Profile TITLE	Solution Designer Role (24)
e-Competences (from e-CF)	A.3. Business Plan Development - L.5 A.5. Architecture Design L.5 A.9. Innovating - L.5 E.7. Business Change Management - L.5 E.9. Governance - L.5
Role Profile TITLE	**Devops Expert Role (26)**
Summary statement	Implements processes and tools to successfully deploy DevOps techniques across the entire solution development lifecycle.
Mission	To apply a cross-functional, collaborative approach for the creation of customer-centric software solutions. Introduce automation throughout the software production system to deliver better software faster.
e-Competences (from e-CF)	B.1. Application Development L.3 B.2. Component Integration - L.4 B.3. Testing - L.4 B.4. Solution Deployment - L.3 C.2. Change Support L.3
Role Profile TITLE	**Data Scientist Role (27)**
Summary statement	Leads the process of applying data analytics. Delivers insights from data by optimising the analytics process and presenting visual data representations.
Mission	Finds, manages and merges multiple data sources and ensures consistency of datasets. Identifies the mathematical models, selects and optimises the algorhythms to deliver business value through insights. Communicates patterns and recommends ways of applying data.
e-Competences (from e-CF)	A.7. Technology Trend Monitoring - L.5 A.9. Innovating - L.4 D.10. Information and Knowledge Management - L.5 D.11. Needs Identification - L.4 E.1. Forecast Development Level 4
Role Profile TITLE	**Data Specialist Role (28)**
Summary statement	Ensures the implementation of the organisations data management policy.

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Role Profile TITLE	Solution Designer Role (24)
Mission	Ensures asset protection through the provision of clean, consistent, quality assured data. Maintains the integrity of data, stores and searches data and supports presentation of data analysis.
e-Competences (from e-CF)	A.6. Application Design 3-4 L.3 D.10. Information and Knowledge Management 3-4 L.4 E.6. ICT Quality Management 3-4 L.4 E.8. Information Security Management 3-4 L.4
Role Profile TITLE	**Scrum Master Role (29)**
Summary statement	Leads and coaches an agile team.
Mission	Creates a high performance self-managed dynamic team minimising impediments to development progress. Drives team by applying the agile process to achieve an optimised work-flow through continuous improvement. Supports team goals and coordinates activities with other teams.
e-Competences (from e-CF)	B.3. Testing 4 L.3 B.6. Systems Engineering 4 L.4 D.9. Personnel Development 3-4 L.3 E.4. Relationship Management 3-4 L.3
Role Profile TITLE	**Product Owner Role (30)**
Summary statement	Represents the voice of the customer in an Agile team.
Mission	Understands customer requirements and validates that the developed software solution meets requirements. Links business and Agile teams.
e-Competences (from e-CF)	A.4. Product/Service Planning 3-4 L.4 A.9. Innovation 3-4 L.4 D.11. Needs Identification 3-4 L.4 E.4. Relationship Management L.4

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