European Commission

Women in the Digital Age

FINAL REPORT

A study prepared for the European Commission

DG Communications Networks, Content & Technology by:

iclaves
claves para la innovación

Digital Agenda for Europe

This study was carried out for the European Commission by

Iclaves, SL. in cooperation with the Universitat Oberta de Catalunya (UOC)

Prepared by:

Carlota Tarín Quirós
Esther Guerra Morales
Rafael Rivera Pastor
Alberto Fraile Carmona
Prof. Milagros Sáinz Ibáñez
Usúe Madinaveitia Herrera

Internal identification

30-CE-0834905/00-49
SMART 2016/0025

DISCLAIMER

By the European Commission, Directorate-General of Communications Networks, Content & Technology.

The information and views set out in this publication are those of the author(s) and do not necessarily reflect the official opinion of the Commission. The Commission does not guarantee the accuracy of the data included in this study. Neither the Commission nor any person acting on the Commission's behalf may be held responsible for the use which may be made of the information contained therein.

ISBN: 978-92-79-77625-0

DOI: 10.2759/526938

Abstract

This study aims to identify key factors and trends in the participation of women in ICT and its dynamics and analyses the practices enabling women's participation in the digital world.

57% of tertiary graduates in the EU are women, but only 24.9% of them graduate in ICT-related fields, and very few enter the sector. Women make up 13% of the graduates in ICT-related fields working in digital jobs compared to 15% in 2011. Globally, figures indicate that women's participation in the ICT and digital sector are not improving significantly.

Data trends and qualitative analysis suggest that gender inequality in the digital sphere is essentially a result of the persistence of strong unconscious biases about what is appropriate and what capacities each gender has, as well as about the technologies themselves. Therefore, to address this situation, cultural change and initiatives at micro level can help develop female digital entrepreneurship.

If existing biases are not addressed, rapid economic advances achieved by digital transformation will not take into account existing gender gap in the sector which will simply amplify and, possibly perpetuate gender stereotypes.

Abstrait

FR

Cette étude vise à identifier les facteurs clés et les tendances de la participation des femmes dans les Technologies de l'Information et des Communications (TIC) et à analyser les politiques mises en place pour permettre la participation des femmes au monde du numérique.

57% des diplômés de l'enseignement supérieur dans l'UE sont des femmes, mais seulement 24,9% d'entre elles sont diplômées dans les domaines liés aux TIC, et peu d'entre elles travaillent dans le secteur. Les femmes représentent 13% des diplômés dans les domaines liés aux TIC travaillant dans des emplois numériques, contre15% quatre ans auparavant. Les indicateurs concernant l'entrepreneuriat numérique féminin et le leadership dans le secteur progressent très lentement. Globalement, les chiffres montrent que la participation des femmes dans le secteur des TIC et du numérique ne s'améliore pas de manière significative. Seules les initiatives à un micro niveau montrent le chemin de la transformation.

Les tendances des données et l'analyse qualitative suggèrent que l'inégalité des genres dans la sphère numérique est essentiellement le résultat de la persistance de biais inconscients forts sur ce qui est convenable, sur les capacités de chaque genre, ainsi que sur les technologies elles-mêmes. Par conséquent, un changement culturel est nécessaire.

Si nous ne défions pas les préjugés existants, nous entraverons le développement social et économique et la progression rapide de la dimension numérique dans tous les domaines de notre vie amplifiera et perpétuera les stéréotypes de genre.

Contents

Abbreviations

BAN: Business Angel Networks

CEO: Chief Executive Officer

CMO : Chief Marketing Officer

COO: Chief Operating Officer

DigCompEdu: Digital Competence of Educators

EC: European Commission

EIGE: European Institute for Gender Equality

ELFS: European Labour Force Survey

EP: European Parliament

ESWC: European Survey on Working Conditions

EU: European Union

FEI: Female Entrepreneurship Index

GPG: Gender Payment Gap

GSD: Gender Statistics Database

HMC: Harvey Mudd College

ICT: Information and Communications Technologies

ISCED: International Standard Classification of Education

IT: Information Technologies

ITU: International Telecommunications Union

MEPs: Members of the European Parliament

MIT: Massachusetts Institute of Technology

OECD: Organisation for Economic Co-operation and Development

PC: Personal computer

PP.: Percentage points

R&D: Research and Innovation

S&E: Science and Engineering

SME: Small and Medium sized Enterprises

SP: Spain

STEM: Science, technology, engineering and mathematics

TEA: Total Entrepreneurial Activity

UK: United Kingdom

UN: United Nations

USA/US: United States of America

VC: Venture Capital

Executive Summary

Aim and methodology

This study aims to identify the key factors and trends regarding women's participation in ICT and its dynamics, as well as analysing the state-of-the-art practices enabling women's participation in the digital world. The objective of this study is to provide updated evidence for prognostics and policy making in the area of women in ICT in Europe.

The methodology combines qualitative and quantitative techniques to gather evidence in support of the main findings of this study. The qualitative analysis is based on: (1) desk research conducted by using different sources of information from the industry, public bodies and consultancy and research firms; (2) analysis of the contributions received through a public consultation; and (3) the elaboration of case studies. The quantitative analysis is based on the following datasets provided by European and international organizations and private associations: (1) yearly microdata of the Eurostat European Labour Force Survey (LFS) of 2011 and 2015 to describe the current status of the main trends analysed; (2) the European Survey on Working Conditions of 2015; (3) the European Institute for Gender Equality (EIGE) 2016 database; (4) the special Eurobarometer 88.2 of 2014 on cybersecurity; (5) the special Eurobarometer 460 of 2017 on attitudes towards the impact of digitisation and automation on daily life; (6) the Stack Overflow Developer Survey of 2016, a comprehensive survey of 45 questions given to 56.033 coders in 173 countries; and (7) the 2013 TALIS dataset from the OECD on the learning environment and working conditions of teachers in schools[1].

The following is a summary of the main evidence and findings made in the areas of (1) participation of women in the ICT and digital sector, (2) digital skills and gender, (3) female digital entrepreneurship, (4) female leadership, (5) gender differences in attitudes towards technology and digitalization (6) women's challenges in the digital age (7) the potential impact of gender gaps and biases in technology and (8) the main conclusions of the study.

Participation of women in the ICT and digital sector

Women and formal ICT education

In 2015, 2.7% of Europeans studied in ICT-related fields, 0.3 percentage points (pp.) less than in 2011. Among those with a tertiary ICT-related education, 5.4% had an ICT-related degree, 0.4 pp less than in 2011. The negative trend in the number of people with formal ICT-related education is observed for both genders, but the gap between men and women has increased a little. There are still practically four times more men with ICT-related studies than women in Europe.

Women in digital professions

1 Please see the latest edition of the Gender Equality Index for data on specific countries.

In 2015, 5.8% of European workers were employed in digital jobs, compared to 5.4% in 2011. The slight growth is common for both men and women, but there was a higher growth for men, resulting in a wider gender gap (2011: 5.1 pp.; 2015: 5.8 pp.). The share of men working in the sector is a 313% greater than the share of women. Women represent only 21.5% of all workers in digital jobs.

The study shows that having a tertiary education increases employability for both men and women, regardless of the field; however, the effect of tertiary ICT-related studies on employability is **small and only positive for men, while showing slightly negative results for women** Evidence suggests that, on average, and all other things being equal, having ICT-related studies increases the probability of employment for men between 2 and 3 percentage points. For women, the probability of being employed with ICT-related studies decreases between 1 and 2 percentage points, in comparison to women with other type of studies. Therefore women are not taking advantage of the opportunities created by ICT and digital sectors in the labour market. This is the case, for example, in artificial intelligence: 41% of women have heard, read or seen something about the topic in the last year compared to 53% of men. And similar differences also exist for other technological areas.

Despite the demand for ICT and digital professionals with technical backgrounds, as well as the positive growing trend of the sector as a whole, the share of technical employees in digital jobs does not increase to the same extent and the gender gap is growing.

For every 1,000 female tertiary graduates in the EU, only 24 are graduates in ICT-related fields. Of these 24 graduates, only 6 women end up working in digital jobs. On the other hand, out of every 1,000 male graduates, 92 studied in ICT-related fields of which 49 of end up working in digital jobs.

Women along the digital sector career path

Women who work in the digital sector tend to leave it at a greater rate than men. This is particularly clear with people who are between 30 to 44 years old, the prime working age and the stage in someone's professional development. This age range is also the period when most Europeans have their first child and/or have to take care of their small children. While around 1.2% of those male digital workers with tertiary education left their profession in 2015 for one of these reasons, that number almost quadruples for females at 8.7% in that same year, which is 1.5 pp. more than in 2011.

This "drop-out phenomenon" of women from digital jobs has an economic cost. The annual productivity loss for the European economy due to women leaving their digital jobs is 16.1 bln Euro.

Evolution of working conditions in the ICT sector from a gender perspective

When comparing working conditions of men and women in the ICT sector, women are more motivated than men to give their best job performance, but feel they don’t have as much freedom to apply their own ideas as their male coworkers do. Women in the ICT sector have also experienced discrimination on the basis of their gender to a much greater extent than their male counterparts. When compared to other service sectors, it is observed that ICT workers, both men and women, received less training, but female ICT workers have much more flexibility than females in other sectors.

Comparison of data from 2010 and 2015, show that most of the gender gaps in the ICT sector are narrowing in the context of working conditions; however, there are two aspects in which the gap has widened: positively, women are significantly more motivated than men and, negatively, women experience discrimination to a greater extent than men.

Digital skills and gender

This research shows that there is a shortage of digital skills in the EU that affects the whole population, including the youngest generations, misnamed "digital natives", of which almost half don't have advanced digital skills.

When it comes to basic skills there is no gap among those under 55 years old. There is a 6 pp. difference between men and women over the age of 55. When considering advanced digital skills, girls under 24 surpass their male counterparts, while in the other age groups a gender gap negatively affecting women still persists. There are, though, relevant differences among the EU countries regarding the gender gap of digital skills.

Despite having similar levels of basic digital skills, women more often question their own skills than men do. These data are consistent with existing literature that shows that women tend to undermine their own capabilities and skills to a greater extent than men.

Greater gender differences arise when it comes to what is nowadays considered the "new literacy" and part of what should be basic eSkills: coding. A study recently published by Accenture found that 68% of female undergraduates have taken coding or computing classes, compared to 83% of male undergraduates.

Women represent around 10% of one of the biggest international online coding communities, Stack Overflow. A survey carried out by this community showed that women have, on average, less coding experience and, again, tend to underestimate their programming abilities compared to their male counterparts.

Female digital entrepreneurship

Data and trends

According to the 2nd European Start-up Monitor, only 14.8% of start-up founders are female. The Global Entrepreneurship Monitor in 2016 shows that Europe had the lowest female involvement in Early-stage Entrepreneurial Activity of every analysed region (6%) and the lowest gender parity. Furthermore, European women are half as likely to be engaged in early-stage activity as men are.

The percentage of female entrepreneurs within EU member states for all economic activities shows large disparities with percentages ranging from 19.4% in Malta to 39.5% in Lithuania, the member state with the highest rate of female entrepreneurs.

Women entrepreneurs in the ICT sector in Europe: characteristics and perceptions of their working conditions

In 2015, 23.4% of entrepreneurs in the ICT sector in Europe were women, around 4 pp. more than five years earlier. Despite the scarce percentage of women in entrepreneurship, research shows that female-owned digital startups are more likely to

be successful than those of their male counterparts and that investment in female-founded startups performs 63% better than exclusively male-founded startups.

Female entrepreneurs in the ICT sector in Europe are overall satisfied with their work, have a greater sense of achievement and experience relatively low levels of stress. They are, however, less paid than their male counterparts.

Trends in female start-up investments

Start-ups with 100% female founders obtained 4.9% of all global venture capital deals in 2016, the highest percentage of deals in the past decade. However, average investments in female entrepreneurs have fallen 0.7 pp. since 2014.

The percentage of companies with at least one female founder that have reached venture capital (VC) deals in 2016 in Europe was 16.1%. In the U.K., for example, male entrepreneurs are 86% more likely to obtain VC funds than women.

Existing research shows evidences of the existence of stereotypes affecting investors, regardless of gender. During an experiment in which two entrepreneurial pitch videos with randomly assigned voices were watched, 68.3% of participants preferred to invest in ventures pitched by a male voice even though these voices presented identical pitches.

Female investors and female entrepreneurs

One of the problems that women face when starting a company, a tech company in particular, is the lack of access to capital in a scenario traditionally dominated by men. Only 7.4% of investors who have invested in one or more startups are women. When it concerns women angels, this percentage stand at 7.2%. Despite the increasing number of business angels worldwide, the representation of women is still scarce. As reported by the European Early Stage Market Statistics 2015, the percentage of female business angels has risen from 4% to 10% since 2013, even reaching 30% in some Business Angel Networks (BAN). Regardless, there is still a clear inequitable distribution of female business angels among the European BANs.

Female leadership in the digital era

The situation in the corporate world

Gender inequality in leadership positions is still almost twice that of inequality in the general labour force.

Women on European boards have risen from 13.9% in 2011 to 25% in 2015. Women represent 35% of all newly elected directors at STOXX 600 companies; however, most are independent non-executive seats. Additionally, the average tenure of service for women is 3.7 years in comparison with 6.4 of men, and their participation at board meetings is lower. By sector, the IT sector shows the third highest increase in female board members, a 102% since 2011, but it is also the sector with the highest percentage of all-male boards (17.2%). The Telecommunication Services sector shows the highest percentage of women on boards (27.1%), which represent a 46% increase between 2011 and 2015. This is also the only sector where all companies have at least one woman on their boards.

The representation of women in senior management positions reveals a positive trend in Europe, but we are still far from achieving remarkable goals towards parity. The percentages of female executives in publicly listed companies range from 5.4% in Austria to 34.8% in Estonia. The Information Technology sector is the only sector without women occupying CEO positions in any of the corporations in STOXX 600. In the Telecommunication Services sector, only 9.5% of CEO positions are occupied by women.

The percentage of workers in the ICT sector that have female bosses in Europe was 21.4% and 48.4% in other non-ICT service sectors in 2015. These figures represent an increase of approximately 2 pp. in both cases compared to 2010.

Female leadership in the public sphere

According to the Gender Statistics Database (GSD), the number of female members of parliament/assembly in EU28 in the first quarter of 2017 was 37.3%. In 2016, 18.8% of the leaders of the major political parties in EU countries were females. Currently 6 European Union countries have a woman as head of state or government. When looking at the ministers responsible for telecommunications and or the digital agenda the number of females in charge is reduced to 5 out of 28 member states.

In the European Commission, females were 29.6% of Commissioners in the first quarter of 2017. In the European Parliament, women represent 37.4% of MEPs and 5 out of 14 Vice-Presidents are women; however, only 6 of the recent top ten MEPs influencing European digital and telecommunication policy were identified as women.

e-Leadership and gender

It has been estimated that the demand for e-leadership, defined as "the accomplishment of a goal that relies on ICT through the direction of human resources and uses of ICT", will keep increasing, implying a growing demand for talent. According to some studies, it is expected that the demand for new e-leadership professionals in Europe may rise up to 4.6% over the period spanning 2015-2020. In a conservative scenario, Europe will require 50,000 new high-tech leaders per year in the years up to 2025.

Corporate leadership diversity and its benefits

Organizations with significant female representation for decision-making positions have better governance styles, drive more creative and diverse innovation processes by promoting ideas that are more likely to meet customers' needs and deliver considerable financial benefits, according to some studies.

If companies develop specific gender policies –e.g. hiring, promotion and turnover initiatives- to help break the glass ceiling, it has been estimated that the technology industry could reach 36% female representation at the executive level in 2020, compared to 33% in the "baseline scenario" where no changes to current trends are implemented.

Gender differences in attitudes towards technology and digitalization

Gender differences are not only visible in career options, but also in citizens' attitudes towards technology and innovation. Women have a more negative view on the impact of digital technologies than men in Europe. For example 70% of men vs. 63% of women think that the most recent digital technologies have a positive impact on their quality of

life. They also tend to be less informed than men about new technologies, which may contribute to the greater mistrust they have towards digital technologies.

Women's challenges in the Digital Age

Despite increased awareness and numerous initiatives, women still face significant challenges in the sector that affect all stages of females' career paths and life courses in the digital sphere. These challenges include: (1) Unconscious biases, (2) Tokenism, (3) problems relating to professional and personal life and (4) Low transparency and inclusiveness in business policies. Additionally, there are specific difficulties that women face when it comes to establishing and running a business like reduced access to financing. Women also face other barriers like: (1) the lack of role models, (2) entrenched stereotypes, (3) weaker business networks, (4) stronger perceived difficulties for reconciling business and personal life and (5) gender differences on the sector of activity.

The potential impact of gender gaps and biases in technology If equality in the digital sphere is not achieved we will miss talent, vision, resources and wealth. The lack of diversity, particularly of women, in teams developing technology has an impact on innovation too.

Direct evidence of this fact can be found in examples of failed, inadequate or unfortunate products and services. Indirect benefits of having diverse teams are more complex to prove, but there is evidence that diversity, particularly in intensively knowledge-based industries such as ICT, increases performance and innovation.

If no action is taken, the impact of the lack of diversity in technology can be extreme considering the growing importance of big data and algorithms in our lives. Technology reflects the values of its developers, and that of the information they draw from. It is clear that having more diverse teams working in the development of such technologies might help identifying biases and prevent them.

Approaches to enhancing diversity in the digital sphere

Most of the restraining factors preventing women from fully participating in the digital era are based on stereotypes and preconceptions. Policies and initiatives aimed at increasing gender equality in the digital sector should pay particular attention to the turning points that have the greatest influence on a women's life cycle: childhood, adolescence, entering the world of work, motherhood and returning to the labour market.

The most common prevention and mitigation measures implemented to overcome barriers for women in the digital sector are: (1) role models, (2) training, (3) digital literacy & exposure to tech, (4) reformed ICT formal education, (5) mentoring, (6) transparency and inclusiveness, (7) networking, (8) facilitating access to funding, (9) flexibility & conciliation measures, (10) quotas & targets, (11) sponsorship, (12) lifelong learning initiatives, (13) awareness of unconscious biases and (14) increased women's confidence in tech and digital innovation.

Conclusions and recommendations

Globally, the figures for participation of women in the ICT and digital sectors are not improving significantly. Only by looking at the micro-level initiatives and experiences that

show the way to transformation are found. These initiatives have some features in common: they are based on collaboration and cooperation among diverse stakeholders, have a focus on raising awareness about the situation and clearly rely on education and skills as a driving force for change. These initiatives must be scaled up and implemented in innovative ways.

The analysis of cases, the results of the consultation and the desk research point out progress has been the result of **strategic changes that have permeated the entire organizational culture**. **Education and social awareness** have been identified has the main tools to promote gender equality, and its execution requires **innovative and coordinated solutions** that can spread from **local implementation to global visibility and commitment**. Efforts have to be **constant and sustained** as results are only visible in the long-run.

In practice, this means:

- Considering gender equality in the digital field as an essential element of the Union strategy.
- Education and training should be at the centre of the strategies implemented to achieve gender equality in the digital era. For that reason, educational institutions, both formal and informal, should be considered priority stakeholders for change. Specific strategies should be promoted for the different age ranges, in particular for young girls between 12 and 16 years old and for adapting tertiary studies.
- Promoting more transparent recruiting and human resources policies in the sector.
- Creating a certification scheme for algorithms and AI systems to guarantee neutrality and the absence of biases.
- Further and specifically support female entrepreneurs in digital.
- Continuing to increase awareness raising efforts, with actions and campaigns aimed at the population as a whole, not just girls and women.
- Monitoring and evaluating the impact of the Work-life Balance package in the digital sector and, if necessary, review and improve it on an ongoing basis.
- Improving the availability of data for the elaboration of further evidence-based recommendations.

Résumé

Objectif et méthodologie

Cette étude vise à identifier les facteurs clés et les tendances de la participation des femmes dans les Technologies de l'Information et des Communications (TIC), ainsi que l'analyse des politiques innovantes permettant la participation des femmes dans le monde du numérique. Les objectifs de cette étude sont de fournir des éléments actualisés pour l'élaboration d'analyses et de politiques quant à la présence des femmes dans le secteur des TIC en Europe.

La méthodologie combine des techniques qualitatives et quantitatives pour appuyer les principales conclusions. L'analyse qualitative est basée sur : (1) une recherche documentaire basée sur différentes sources provenant principalement de l'industrie, des organismes publics, des cabinets de conseil et des instituts de recherche ; (2) l'analyse des contributions reçues lors d'une consultation publique ; et (3) sur l'élaboration d'études de cas. L'analyse quantitative est basée sur les données suivantes, fournies par des organisations européennes et internationales et des associations privées : (1) micro données annuelles de l'Enquête européenne sur les forces de travail (LFS) d'Eurostat de 2011 et 2015 pour décrire l'état actuel et les principales tendances ; (2) l'enquête européenne sur les conditions de travail de 2015 ; 3) la base de données de l'Institut européen pour l'égalité entre les hommes et les femmes (EIGE) de 2016 ; (4) L'Eurobaromètre spécial 88.2 de 2014 sur la cyber sécurité et l'Eurobaromètre spécial 460 de 2017 sur les attitudes à l'égard de l'impact de la numérisation et de l'automatisation sur la vie quotidienne ; (5) le Stack Overflow Developer Survey de 2016, une étude complète de 45 questions adressées à 56 033 programmeurs dans 173 pays ; et (6) l'ensemble de données TALIS de 2013 de l'OCDE sur l'environnement d'apprentissage et les conditions de travail des enseignants dans les écoles.[2].

Ce qui suit est un résumé des principaux éléments et constats relatifs aux domaines de la (1) participation des femmes dans le secteur des TIC et numérique, (2) compétences numériques et genre, (3) entrepreneuriat numérique féminin, (4) leadership des femmes, (5) différences de genre dans les attitudes envers la technologie et la numérisation, (6) défis des femmes à l'ère numérique, (7) impact potentiel des disparités entre les sexes et des préjugés dans le monde de la technologie et (8) principales conclusions de l'étude.

Participation des femmes dans le secteur des TIC et du numérique

Les femmes et l'éducation formelle aux TIC

En 2015, 2,7% des Européens était diplômés dans les domaines liés aux TIC, 0,3 point de pourcentage de moins qu'en 2011. Parmi ceux ayant des études tertiaires liées aux TIC, 5,4% avaient un diplôme lié aux TIC, 0,4 point de moins qu'en 2011. On observe, en ce qui concerné les deux sexes, une tendance négative du nombre de personnes

2 Veuillez consulter la dernière édition de l'Indice d'égalité entre les sexes pour obtenir des données sur des pays spécifiques.

ayant une éducation formelle liée aux TIC, mais l'écart entre les hommes et les femmes a légèrement augmenté. Il y a toujours quatre fois plus d'hommes que de femmes en Europe diplômés en TIC.

Les femmes dans les métiers du numérique

En 2015, 5,8% des travailleurs européens occupaient des emplois dans le numérique, contre 5,4% en 2011. La légère croissance est commune aux hommes comme aux femmes, mais la croissance est plus marquée chez les hommes, augmentant l'écart entre les sexes (2011 : 5,1 points ; 2015 : 5,8 points.). La part des hommes travaillant dans le secteur est supérieure de 313% à celle des femmes. Les femmes ne représentent que 21,5% de tous les travailleurs dans les emplois numériques.

L'étude montre que les études tertiaires augmentent l'employabilité des hommes et des femmes, peu importe le domaine. Cependant, l'effet des études tertiaires liées aux TIC sur l'employabilité est faible et seulement positif pour les hommes, tout en montrant des résultats légèrement négatifs pour les femmes. Les constations montrent, en moyenne, toutes choses étant égales par ailleurs, que pour les hommes disposant d'études liées aux TIC l'employabilité augmente de 2 à 3 points. En ce qui concerne les femmes disposant d'études liées aux TIC, la probabilité d'accéder à un emploi diminue de 1 à 2 points par rapport aux femmes ayant d'autres types d'études. Les femmes ne profitent donc pas des opportunités créées par les secteurs des TIC et du numérique sur le marché du travail. C'est notamment le cas, par exemple, en ce qui concerne l'intelligence artificielle : 41% des femmes ont entendu parler, lu ou vu quelque chose à ce sujet au cours de la dernière année, contre 53% des hommes. Des différences du même ordre existent également en ce qui concerne divers autres domaines technologiques.

Malgré la demande de professionnels des TIC et du numérique ayant des profils techniques, ainsi que la tendance positive du secteur dans son ensemble, la part des employés techniques dans les emplois numériques diminue à l'échelle mondiale et, inversement, l'écart entre les sexes augmente.

Pour chaque tranche de 1 000 femmes diplômées de l'enseignement supérieur dans l'UE, seules 24 sont diplômées dans des domaines liés aux TIC, et seulement 6 finissent par travailler dans des emplois numériques. En revanche, sur 1 000 diplômés hommes, 92 ont étudié dans des domaines liés aux TIC, et 49 d'entre eux finissent par travailler dans le numérique.

Les femmes et la carrière dans le secteur du numérique

Les femmes travaillant dans le secteur numérique tendent à le quitter à un rythme plus élevé que les hommes. Cela est particulièrement clair en ce qui concerne les personnes âgées de 30 à 44 ans, l'âge où l'activité est maximale et l'étape clé du développement professionnel. Cette tranche d'âge est également la période où la plupart des Européens ont leur premier enfant et / ou doivent prendre soin de leurs jeunes enfants. Alors qu'environ 1,2% des travailleurs numériques masculins diplômés de l'enseignement supérieur ont quitté leur profession en 2015 pour l'une de ces raisons, ce nombre quadruple presque de 8,7% pour les femmes cette même année, soit 1,5 points de plus qu'en 2011.

Ce «phénomène d'abandon» des femmes des emplois numériques a un coût économique. La perte de productivité annuelle pour l'économie européenne due aux femmes qui quittent leur travail numérique est de 16,1 milliards d'euros.

Évolution des conditions de travail dans le secteur des TIC du point de vue du genre

Lorsqu'on compare les conditions de travail des hommes et les femmes du secteur des TIC, les femmes sont plus motivées que les hommes pour donner le meilleur rendement au travail, mais elles n'ont pas autant de liberté pour appliquer leurs propres idées que leurs collègues masculins. Les femmes du secteur des TIC ont également été victimes d'une discrimination fondée sur le genre beaucoup plus importante que leurs homologues masculins. Lorsque l'on compare avec d'autres secteurs de services, on peut observer que les travailleurs des TIC, hommes et femmes, ont reçu moins de formation, mais les travailleuses des TIC ont beaucoup plus de flexibilité que les femmes des autres secteurs.

La comparaison des données de 2010 et 2015, montre que la plupart des écarts entre les sexes dans le secteur des TIC se rétrécissent en ce qui concerne les conditions de travail ; cependant, il y a deux aspects dans lesquels l'écart s'est creusé : positivement, les femmes sont significativement plus motivées que les hommes et, négativement, les femmes subissent davantage la discrimination que les hommes.

Compétences numériques et genre

Cette recherche montre qu'il y a une pénurie de compétences numériques dans l'UE qui affecte l'ensemble de la population, y compris les plus jeunes générations, mal nommées «natifs numériques», dont près de la moitié n'ont pas de compétences numériques avancées.

En ce qui concerne les compétences de base, il n'y a pas d'écart entre les moins de 55 ans, il y a une différence de 6 points entre les hommes et les femmes de plus de 55 ans. Lorsque l'on considère les compétences avancées, les filles de moins de 24 ans surpassent leurs homologues masculins, tandis que dans les autres groupes d'âge, un écart entre les sexes qui affecte négativement les femmes persiste. Il existe cependant des divergences importantes entre les pays de l'UE concernant l'écart entre les hommes et les femmes en matière de compétences numériques.

Malgré des niveaux similaires de compétences numériques de base, les femmes remettent souvent en question leurs propres compétences par rapport aux hommes. Ces données sont cohérentes avec la littérature existante qui montre que les femmes ont tendance à amoindrir leurs propres capacités et compétences dans une plus grande mesure que les hommes.

Des différences plus importantes entre les sexes se posent en ce qui concerne ce qui est aujourd'hui considéré comme la «nouvelle alphabétisation» et une partie de ce qui devrait être des compétences de base : la programmation. Une étude récemment publiée par Accenture révèle que 68% des étudiants de genre féminin ont suivi des cours de programmation comparé au 83% des étudiants de genre masculin de premier cycle.

Les femmes représentent environ 10% de l'une des plus grandes communautés internationales de programmation en ligne, Stack Overflow. Une enquête réalisée par cette communauté a montré que les femmes ont, en moyenne, moins d'expérience de

programmation et, encore une fois, ont tendance à sous-estimer leurs capacités de programmation par rapport à leurs homologues masculins.

Entreprenariat numérique féminin

Données et tendances

Selon le 2nd European Start-up Monitor, seulement 14,8% des fondateurs de start-up sont des femmes. Le Global Entrepreneurship Monitor en 2016 montre que l'Europe présentait la plus faible participation des femmes dans les start-ups de chaque région analysée (6%) et la plus faible parité entre les sexes. En outre, les femmes européennes sont deux fois moins susceptibles d'être engagées dans une start-up en début de carrière que les hommes.

Le pourcentage de femmes entrepreneurs dans les États membres de l'UE pour toutes les activités économiques montre de grandes disparités avec des pourcentages allant de 19,4% à Malte à 39,5% en Lituanie, l'État membre ayant le taux le plus élevé de femmes entrepreneurs.

Les femmes entrepreneurs dans le secteur des TIC en Europe : caractéristiques et perceptions de leurs conditions de travail

En 2015, 23,4% des entrepreneurs du secteur des TIC en Europe étaient des femmes, soit environ 4 points de plus que cinq ans auparavant. Malgré le faible pourcentage de femmes dans l'entrepreneuriat, les recherches montrent que les start-ups numériques appartenant à des femmes ont plus de chances de réussir que leurs homologues masculins et que les investissements dans les start-ups féminines sont 63% plus performants que les start-ups exclusivement masculines.

Dans l'ensemble, les femmes entrepreneurs du secteur des TIC en Europe sont satisfaites de leur travail, ont un plus grand sentiment d'accomplissement et connaissent des niveaux de stress relativement faibles. Elles sont, cependant, moins payées que leurs homologues masculins.

Tendances dans les investissements de start-up féminines

Les start-ups avec 100% de fondatrices ont obtenu 4,9% de toutes les transactions mondiales de capital-risque en 2016, soit le pourcentage le plus élevé de transactions au cours de la dernière décennie. Cependant, les investissements moyens dans les femmes entrepreneurs ont diminué de 0,7 point depuis 2014.

Le pourcentage d'entreprises ayant au moins une fondatrice ayant atteint des transactions de capital-risque (CR) en 2016 en Europe était de 16,1%. Au Royaume-Uni, par exemple, les hommes entrepreneurs sont 86% plus susceptibles d'obtenir des fonds de capital-risque que les femmes.

La recherche existante prouve l'existence de stéréotypes affectant les investisseurs, indépendamment du sexe. Au cours d'une expérience dans laquelle deux vidéos de pitch entrepreneurial avec des voix assignées au hasard ont été regardées, 68,3% des participants ont préféré investir dans des projets lancés par une voix masculine, même si ces voix présentaient le même message.

Les femmes investisseuses et les femmes entrepreneurs

L'un des problèmes auxquels les femmes sont confrontées lorsqu'elles démarrent une entreprise, en particulier une entreprise de technologie, est le manque d'accès au capital dans un scénario traditionnellement dominé par les hommes. Seulement 7,4% des investisseurs ayant investi dans une ou plusieurs startups sont des femmes. En ce qui concerne les femmes investisseurs providentiels, ce pourcentage s'élève à 7,2%. Malgré le nombre croissant de business angels dans le monde, la représentation des femmes est encore rare. Comme l'indiquent les statistiques européennes sur les premières phases du marché 2015, le pourcentage d'investisseurs providentiels est passé de 4% à 10% depuis 2013, atteignant même 30% dans certains Business Angel Networks (BAN). Quoi qu'il en soit, il existe toujours une répartition clairement inéquitable des femmes business angels parmi les BAN européens.

Le leadership féminin à l'ère numérique

La situation dans le monde de l'entreprise

L'inégalité entre les sexes dans les postes de direction est encore presque le double de celle de la population active.

Les femmes dans les conseils européens sont passées de 13,9% en 2011 à 25% en 2015. Les femmes représentent 35% de tous les directeurs nouvellement élus dans les 600 entreprises du STOXX ; cependant, la plupart sont des sièges indépendants non exécutifs. De plus, la durée moyenne de service pour les femmes est de 3,7 ans contre 6,4 pour les hommes, et leur participation aux réunions du conseil est plus faible. Par secteur, le secteur des TI affiche la troisième plus forte augmentation chez les femmes membres du conseil, soit 102% depuis 2011, mais c'est aussi le secteur qui compte le plus grand pourcentage de conseils composés uniquement d'hommes (17,2%). Le secteur des services de télécommunication affiche le pourcentage le plus élevé de femmes dans les conseils (27,1%), ce qui représente une augmentation de 46% entre 2011 et 2015. Il s'agit également du seul secteur où toutes les entreprises comptent au moins une femme.

La représentation des femmes aux postes de direction révèle une tendance positive en Europe, mais nous sommes encore loin d'atteindre la parité. Les pourcentages de femmes cadres dans des sociétés cotées en bourse vont de 5,4% en Autriche à 34,8% en Estonie. Le secteur des technologies de l'information est le seul secteur sans femme occupant des postes de PDG dans n'importe laquelle des entreprises du STOXX 600. Dans le secteur des services de télécommunication, seuls 9,5% des postes de PDG sont occupés par des femmes.

Le pourcentage de travailleurs du secteur des TIC ayant des patrons en Europe était de 21,4% et de 48,4% dans les autres secteurs de services non-TIC en 2015. Ces chiffres représentent une augmentation d'environ 2 points dans les deux cas par rapport à 2010.

Le leadership féminin dans la sphère publique

Selon la base de données statistiques sur les femmes (GSD), le nombre de femmes parlementaires / assemblées dans l'UE28 au premier trimestre de 2017 était de 37,3%. En 2016, 18,8% des dirigeants des principaux partis politiques des pays de l'UE étaient des femmes. Actuellement, 6 pays de l'Union européenne ont une femme à la tête de l'État ou du gouvernement. En examinant les ministres chargés des télécommunications

et de l'agenda numérique, le nombre de femmes responsables est réduit à 5 sur 28 États membres.

Au sein de la Commission Européenne, les femmes représentaient 29,6% des commissaires au premier trimestre 2017. Au Parlement Européen, les femmes représentent 37,4% des députés européens et 5 des 14 vice-présidents sont des femmes ; Cependant, seuls 6 des dix premiers eurodéputés influençant la politique européenne en matière de numérique et de télécommunication ont été identifiés comme étant des femmes.

e-Leadership et genre

Il a été estimé que la demande de e-leadership, définie comme « la réalisation d'un objectif qui repose sur les TIC à travers la direction des ressources humaines et l'utilisation des TIC », continuera d'augmenter, impliquant une demande croissante de talents. Selon certaines études, on s'attend à ce que la demande de nouveaux professionnels du e-leadership en Europe augmente jusqu'à 4,6% sur la période 2015-2020. Dans un scénario conservateur, l'Europe aura besoin de 50 000 nouveaux leaders high-tech par an d'ici 2025.

La diversité du leadership d'entreprise et ses avantages

Les organisations disposant d'une masse critique importante de femmes – c'est-à-dire, très peu de femmes nommées à des postes clés - pour les postes décisionnels ont de meilleurs styles de gouvernance, conduisent des processus d'innovation plus créatifs et diversifiés en promouvant des idées plus susceptibles de répondre aux besoins des clients et fournissent, selon certaines études, des avantages financiers significatifs.

Si les entreprises développent des politiques spécifiques aux genres, par ex. initiatives d'embauche, de promotion et de rotation - pour aider à briser le plafond de verre, on estime que l'industrie technologique pourrait atteindre 36% de représentation féminine au niveau exécutif en 2020, contre 33% dans le «scénario de base» les tendances sont mises en œuvre.

Différences de genre dans les attitudes envers la technologie et la numérisation

Les différences entre les sexes ne sont pas seulement visibles dans les choix de carrière, mais aussi dans les attitudes des citoyens à l'égard de la technologie et de l'innovation. Les femmes ont une vision plus négative de l'impact des technologies numériques que les hommes en Europe. Par exemple, 70% des hommes, contre 63% des femmes, pensent que les technologies numériques les plus récentes ont un impact positif sur leur qualité de vie. Elles ont également tendance à être moins informées que les hommes sur les nouvelles technologies, ce qui peut contribuer à une plus grande méfiance à l'égard des technologies numériques.

Les défis des femmes à l'ère numérique

Malgré une sensibilisation accrue et de nombreuses initiatives, les femmes font encore face à des défis importants dans le secteur qui affectent toutes les étapes du parcours professionnel des femmes et des parcours de vie dans la sphère numérique. Ces défis comprennent : (1) les partis pris inconscients, (2) le tokénisme, (3) les problèmes liés à la vie professionnelle et personnelle et (4) la faible transparence et le manque d'inclusion

des femmes dans les politiques d'entreprise. En outre, les femmes rencontrent des difficultés spécifiques en ce qui concerne la création et la gestion d'une entreprise, telles que, par exemple, des difficultés d'accès au financement. Les femmes sont également confrontées à divers autres obstacle, tels que : (1) le manque de modèles, (2) les stéréotypes enracinés, (3) les réseaux plus faibles, (4) les difficultés perçues pour concilier la vie professionnelle et personnelle et (5) les différences de genres selon le secteur d'activité.

L'impact potentiel des disparités entre les sexes et des préjugés dans le monde de la technologie

Si nous n'atteignons pas l'égalité dans la sphère numérique, nous manquerons de talent, de vision, de ressources et de richesse. Le manque de diversité, en particulier le manque de femmes, dans les équipes développant des technologies a également un impact sur l'innovation.

Des preuves directes de ce fait peuvent être trouvées dans des exemples des échecs de produits et services. Les avantages indirects liés à la diversité des équipes sont plus complexes à prouver, mais il existe des preuves que la diversité, en particulier dans les industries fortement axées sur le savoir telles que les TIC, augmente les performances et l'innovation.

Si aucune mesure n'est prise, l'impact du manque de diversité dans la technologie peut être extrême compte tenu de l'importance croissante des gros volumes de données et des algorithmes dans nos vies. La technologie reflète les valeurs de ses développeurs, et celle de l'information sur laquelle elle se base. Il est clair que le fait d'avoir des équipes plus diverses travaillant dans le développement de telles technologies pourrait aider à identifier les biais et à les prévenir.

<u>Approches pour améliorer la diversité dans la sphère numérique</u>

La plupart des facteurs restrictifs empêchant les femmes de participer pleinement à l'ère numérique sont basés sur des stéréotypes et des idées préconçues. Les politiques et initiatives visant à renforcer l'égalité des genres dans le secteur numérique devraient accorder une attention particulière aux moments clés qui influencent le plus le cycle de vie des femmes : enfance, adolescence, insertion dans le monde du travail, maternité et retour sur le marché du travail.

Les mesures de prévention et d'atténuation les plus courantes mises en œuvre pour surmonter les obstacles rencontrés par les femmes dans le secteur numérique sont: (1) modèles, (2) formation, (3) alphabétisation numérique et exposition aux technologies, (4) éducation formelle aux TIC, (5) mentorat, (6) transparence et inclusion, (7) réseaux, (8) accès au financement facilité, (9) mesures de flexibilité et de conciliation, (10) quotas et objectifs, (11) parrainage, (12) apprentissage continu, (13) conscience des préjugés inconscients et (14) confiance accrue des femmes dans l'innovation technologique et numérique.

Conclusions et recommandations

Globalement, les chiffres relatifs à la participation des femmes dans les secteurs des TIC et du numérique ne s'améliorent pas de manière significative. Ce n'est qu'en regardant

au niveau micro que nous trouvons des initiatives et des expériences qui montrent le chemin de la transformation. Ces initiatives ont certaines caractéristiques en commun : elles sont basées sur la collaboration et la coopération entre diverses parties prenantes, elles mettent l'accent sur la sensibilisation à la situation et elles s'appuient clairement sur l'éducation et les compétences comme moteur du changement. Nous devons intensifier ces initiatives et innover dans leur mise en œuvre.

L'analyse des cas, les résultats de la consultation et la recherche documentaire soulignent que les progrès réalisés sont le résultat de **changements stratégiques qui ont imprégné toute la culture organisationnelle. L'éducation et la sensibilisation sociale** ont été identifiées comme les principaux outils pour promouvoir l'égalité des sexes. Son exécution nécessite des solutions innovantes et coordonnées, qui peuvent à partir d'une mise en œuvre locale, se propager à une visibilité et un engagement mondial. Les efforts doivent être constants et soutenus car les résultats ne seront visibles qu'à long terme.

Sur la base de ces conclusions, une série de recommandations ont été formulées :

- Considérer l'égalité des sexes comme étant un élément essentiel de la stratégie de l'Union.
- L'éducation et la formation doivent être au cœur des stratégies mises en œuvre pour atteindre l'égalité des sexes à l'ère numérique. C'est pourquoi, les institutions pédagogiques, officielles et non officielles, doivent être considérées comme étant des acteurs prioritaires pour opérer un changement. Des stratégies spécifiques doivent être mises en œuvre pour atteindre les différentes tranches d'âges, tout particulièrement les jeunes filles âgées de 12 à 16 ans, mais également pour adapter les études supérieures.
- Promouvoir des politiques de recrutement et de ressources humaines plus transparentes au sein de ce secteur.
- Créer des plans de certification pour les algorithmes et systèmes d'intelligence artificielle afin de garantir la neutralité et l'absence de biais.
- Apporter davantage de soutien et offrir un appui spécifique à l'entreprenariat féminin dans le secteur numérique.
- Améliorer la disponibilité des données pour l'élaboration de recommandations factuelles approfondies.

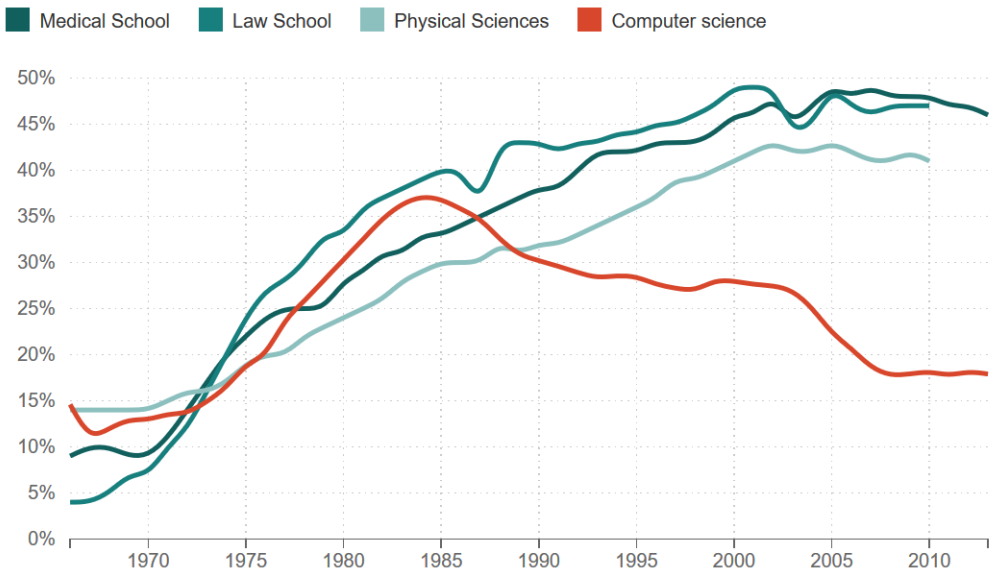
Introduction

The influence of the digital sector is pervasive in all aspects of life. Today, having digital skills, and having personnel with ICT qualifications, is something required in all sectors of the economy, not only in the ICT sector. Gender gap in the digital sector signifies a gap in innovation and in the future of all Digital and Knowledge Economy.

It is not the genes, it's our culture

The number of women who enrol in ICT studies has not always been as low as it is now. Women's participation in computer science majors was similar to their participation in other fields, such as physics, and even higher than in law or medical schools in the 70s, in developed countries like the USA. Women were among the pioneers of computer science. Female participation in computer science majors in the US reached over 35% in 1985, in a rising trend similar to other fields. However, since the mid 80s, women's participation in computer science began to decline, contrary to the trend for the rest of the subjects.

Figure 1 Percentage of women in majors by field in the US, 1970-2015



Source: Steve Henn, 2014[3]

So, what happened in the 1980s to get women to start drifting away from computer science?

3 Steve Henn, 'When Women Stopped Coding'.

In 1981 IBM launched the first PC (Personal Computer); Apple introduced the Lisa computer in 1983 and the Macintosh in 1984; and the Amstrad word processor arrived in 1985. The 80s saw boom in home computers. Computers were no longer machinery for scientists or experts, they entered people's homes and became, in many cases, a "toy", more specifically, a boy's toy. Computers were more often placed in boys' rooms than girls'[4] and the stereotype about computers being "boys' stuff" started[5].

As Margolis and Fisher[6] describe*: "Very early in life, computing is claimed as male territory. At each step from early childhood through college, computing is both actively claimed as "guy stuff" by boys and men and passively ceded by girls and women. The claiming is largely the work of a culture and society that links interest and success with computers to boys and men. Curriculum, teachers' expectations, and culture reflect boys' pathways into computing, accepting assumptions of male excellence and women's deficiencies in the field".*

Being digital is no longer an option

The digital transformation of society and the economy is an unstoppable current phenomenon. In the digital era, having digital skills is essential for any personal or professional task.

The digital revolution will shape the way we live and work in the future, and if women are left behind by not being an active part of this process, patriarchal constructs and structures will be reinforced and perpetuated. Women's participation in shaping digital transformation will bring about social change in the present and in the future.

The Digital Fluency Model, elaborated by Accenture in its study *Getting To Equal; How Digital is Helping Close the Gender Gap at Work (2016),* shows that countries with higher rates of digital fluency among women have higher rates of gender equality in the workplace. Better digital skills help improve productivity because they allow for greater flexibility and more effective time management. The study also reveals that digital fluency increases the opportunities of finding a job and helps balance personal and professional lives.

Furthermore, diversity boosts innovation, and bringing more women into the ICT sector in Europe can improve its competitiveness.

Being part of the digital revolution is not only about having ICT skills, but also about taking a pertinent role in the innovation process. This can be done through R&D activities and also through entrepreneurship. In fact, innovation has been defined as the "combination of an inventive process and an entrepreneurial process to create new value for defined stakeholders" (Hindle, 2009). Innovation is pivotal to achieving sustainability, productivity, growth, jobs and, of course, social inclusion[7].

---

4 Margolis and Fisher, *Unlocking the Clubhouse*.

5 Steve Henn, 'When Women Stopped Coding'.

6 Margolis and Fisher, *Unlocking the Clubhouse*.

7 Robert Madelin, 'Opportunity Now: Europe's Mission to Innovate'.

Methodology

This study aims to identify key factors and main trends related to the participation of women in the ICT sector, as well to analyse the state-of-the-art practices enabling women's participation in the digital world in their work and life environments.

The methodology combines a qualitative and quantitative approach. The qualitative analysis is based on: (1) desk research using different sources of information from the industry, public bodies, consultancies and research firms; (2) the analysis of the contributions received through an open public consultation; and (3) the elaboration of case studies.

The main goal of the quantitative analysis was to support the findings with evidence.

Open consultation

An online consultation "Women in Digital Age" was opened from 3 April to 2 June of 2017 in EUSurvey, the online tool supported by the European Commission's ISA programme. The Consultation was aimed at reaching out to stakeholders and gathering insights into the role of women in the digital age in Europe.

The stakeholder consultation, available in three different languages (English, French and Spanish) and open from 3 April to 2 June of 2017, was based on a single questionnaire. The questionnaire was composed of open-ended questions, multiple choice questions and simple choice questions. The number of contributions to the survey was 203 and included responses from stakeholders from academia, the industry, NGOs and public administrations.

Case studies and experiment

Three case studies have been looked at in order to improve understanding of the evolution of the indicators analysed. An analysis of these cases was done to shed light on some of the elements present that lead to the success of these initiatives in their respective fields, or on how certain phenomena can actually work. A case study of the Ironhack initiative, a programming school, was analysed. This initiative was aimed at reaching a female audience through collaboration with an e-commerce application. The case of Harvey Mudd College (HMC) in the United States, which has managed to have a 5 times increase in the presence of women in the school’s computing science grade within a period of 10 years, has also been analysed. Finally, in the field of entrepreneurship, the case of Telefónica Open Future, and particularly its initiative in the United Kingdom, Wayra, has made it possible to analyse an exceptional case in Europe where 45% of the start-ups measured had at least one woman among their founders.

Data on the digital competences of European teachers were also analysed to find that female teachers are less motivated to study technology-related subjects than male teachers. Once in the workplace, however, where these competences are needed, female teachers try to catch up to their male counterparts. The detailed results are presented in Annex I.

In addition, an experiment was conducted to test the existence of gender biases on Facebook, the social networking platform.

Quantitative analysis

The quantitative analysis was based on the following datasets provided by European and international organizations and private associations: (1) yearly microdata of the Eurostat European Labour Force Survey (LFS) of 2011 and 2015 to describe the current status of the main trends; (2) the European Survey on Working Conditions of 2015; (3) the European Institute for Gender Equality (EIGE) 2016 database; (4) the special Eurobarometer 88.2 of 2014 on cybersecurity; (5) the special Eurobarometer 460 of 2017 on attitudes towards the impact of digitisation and automation on daily life; (6) the Stack Overflow Developer Survey of 2016[8], a comprehensive survey of 45 questions given to 56.033 coders in 173 countries; and (7) the 2013 TALIS dataset from the OECD on the learning environment and working conditions of teachers in schools[9].

A detailed description of the methods and results of the quantitative analysis is included in Annex II. A descriptive analysis using univariate, bivariate and multivariate statistical methods has been performed to summarize the findings. The main goal was to assess whether there are differences about perception, skills, knowledge and use of ICT-related technologies and innovation by gender. We further analysed the opting out phenomenon which is the percentage of people with tertiary education who, for different reasons, have been forced to leave and have not pursued their career in the ICT sector mostly determined by gender. The annual loss in productivity for the EU caused by women leaving digital jobs has also been estimated.

The quantitative analysis was conducted using the open source statistic program R and the R-studio environment[10].

Clarification on terms used

Finding a clear definition on what the digital sector is quite difficult. Digital tools are now used in all sectors of activity. Different existing data sources use different definitions to define what the ICT sector and what the digital sector are.

The following is a brief description of the terms most commonly used throughout this study and the conceptual or methodological differences that justify the use of each of them:

- STEM: Under the term STEM the following fields have been included: natural sciences, mathematics and statistics, information and communication technologies and engineering (excluding manufacturing and construction), as defined by Eurostat in *Tertiary education statistics.*

8Stackoverflow, 'Developer Survey Results 2016'.

9OECD, 'Talis 2013 - Complete Database'.

10R Core Team, R: A Language and Environment for Statistical Computing; Studio, 'RStudio: Integrated Development Environment for R'.

- ICT studies or "purely ICT studies" refers to ISCEDF13: Information and Communication Technologies, as defined by Eurostat.
- For data elaborated for this study on the ELFS, ICT-related studies have been defined as: mathematics, statistics, computing and engineering. This concept excludes natural sciences, but includes more fields than ICT studies as defined by Eurostat.
- Following the recommendation of "ICT Employment Statistics in Europe: Measurement Methodology"[11], ICT jobs have been defined for the purpose of this study in a wide sense by mixing the following taxonomies, industry, occupations and skills. The use of the different terms depends on the data source and the possibilities it offers to carry out a more or less detailed analysis.
    - People employed with ICT-specific skills. The following educational fields have been included:
        - Physical Sciences (441 in Eurostat Codes)
        - Mathematics and Statistics (46, 461 and 462 in Eurostat Codes)
        - Computing (48, 481 and 482 in Eurostat Code)
        - Engineering and Engineering Trades (52, 521, 522, 523 and 524 in Eurostat Codes).
    - Employment in the ICT sector
        - J sector as the ICT sector (according to NACE Rev. 2)
    - Digital jobs or digital workers are defined as those employed in ICT-intensive occupations (based on the ISCO-08 classification[12]), and include:
        - ICT jobs in any sector of activity (such as "Information and communications technology services managers" or "Software developers")
        - Skilled jobs in the ICT sector (NACE Rev. 2, J sector), that includes most of the workers of the sector, such as CEOs, managers or salespersons working in ICT organizations.

    Depending on the data source different concepts have been used. For example, for data from the ESWC, workers of the ICT sector have been considered (J sector), since this database doesn't provide details on the type of occupation of the worker. Data elaborated from the ELFS refers to digital workers.
- ICT specialists: data from Eurostat's "ICT specialists in employment" statistics defines ICT specialists as those who *have the ability to develop, operate and maintain ICT systems and for whom ICTs constitute the main part of their job*[13].

11 Sabadash, 'ICT Employment Statistics in Europe'.

12 A complete list of occupations is included in Annex II, Tables 7 and 8.

13 More information on this statistics: http://ec.europa.eu/eurostat/statistics-explained/index.php/ICT_specialists_in_employment

1. Participation of women in the ICT and digital sector: stagnation and some grounds for concern

1.1 Women and formal ICT education: persistent wide gender gaps

In 2015, 54.3% of all tertiary[14] students, understood as those students attending universities and other higher education institutions, and 57.5% of tertiary graduates in the European Union were women, figures that have remained stable since 2013[15].

From all tertiary graduates in Europe in 2015, 21.2% graduated in STEM (Science, technology, engineering and mathematics) studies, one third of which were women. 33.8% of male graduates obtained their degree in a STEM field, compared to 11.8% of females graduates in STEM studies. The difference in purely technical fields – that is, excluding natural science - was even greater. While the number of women graduating in fields such as biological sciences, for example, included in the STEM concept, doubles that of men in Europe, whereas women are highly underrepresented in engineering and physics [16].

A closer look at purely ICT studies[17] shows that tertiary graduates in ICT fields in 2015 made up 3.6% of all graduates, of which only 19% were females. This means that from all female graduates in 2015 only 1.2% undertook ICT studies, compared to 6.9% of males. Men graduate 5.7 times more than women in ICT studies in Europe [18].

Although there are significant differences among countries (see Figure 2), the gap between men and women who have graduated in ICT fields is persistent throughout the EU[19]. The biggest differences between the number of men and the number of women graduating in ICT fields are found, in absolute terms, in Malta and Finland. In relative terms, the gaps are widest in Belgium, Slovakia, Luxembourg and Lithuania, where the number of male ICT graduates is more than 10 times higher than that of females. The gap is relatively the smallest in Bulgaria, Romania and Cyprus, where male ICT graduates are three times more than women.

---

14 Tertiary education refers to ISCED levels 5-8.

15 Source: Tertiary education statistics from Eurostat, extracted in August 2017.

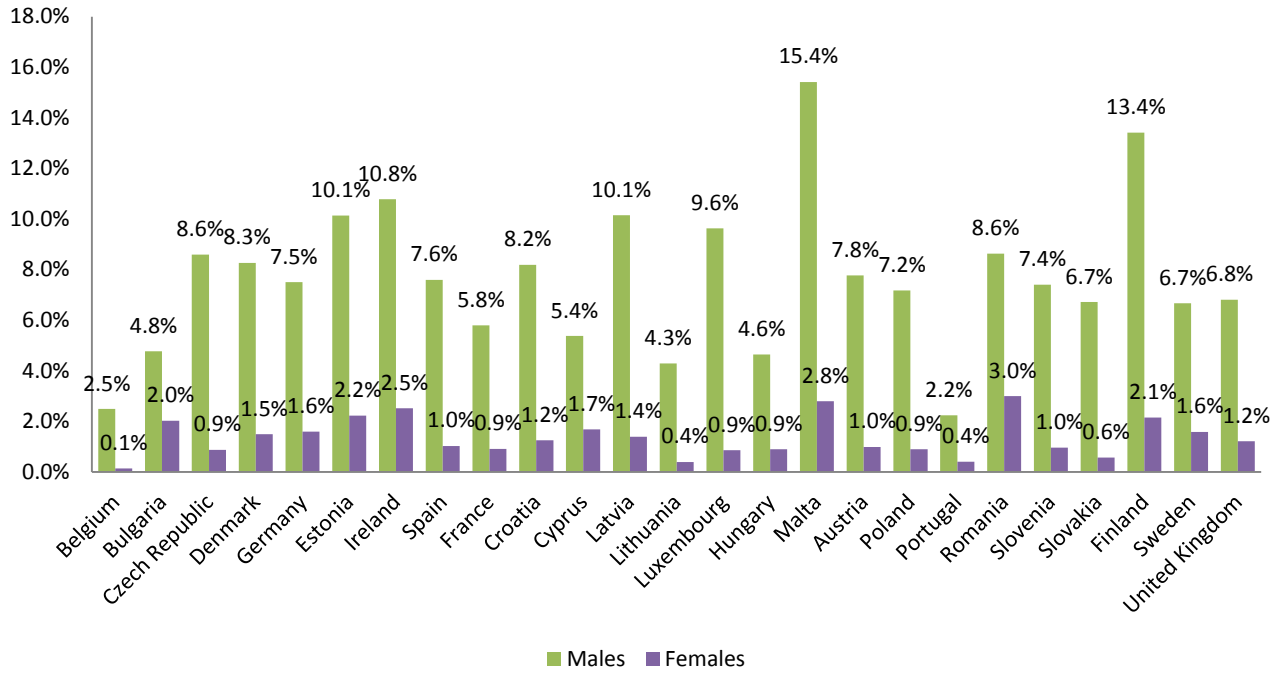
16 Source: Tertiary education statistics from Eurostat, extracted in August 2017. STEM graduates include tertiary graduates from the following fields: Natural sciences, mathematics and statistics, Information and Communication Technologies and Engineering (excluding manufacturing and construction).

17 Purely ICT studies refers to ISCED11: Tertiary education (levels 5-8) and ISCEDF13:Information and Communication Technologies, as defined by Eurostat.

18 Source: Tertiary education statistics from Eurostat, extracted in August 2017

19 Data by educational field is not available for the year 2015 for Italy, Greece and the Netherlands.

Figure 2 ICT graduates out of total graduates in 2015 by sex and country



Source: Eurostat, 2017

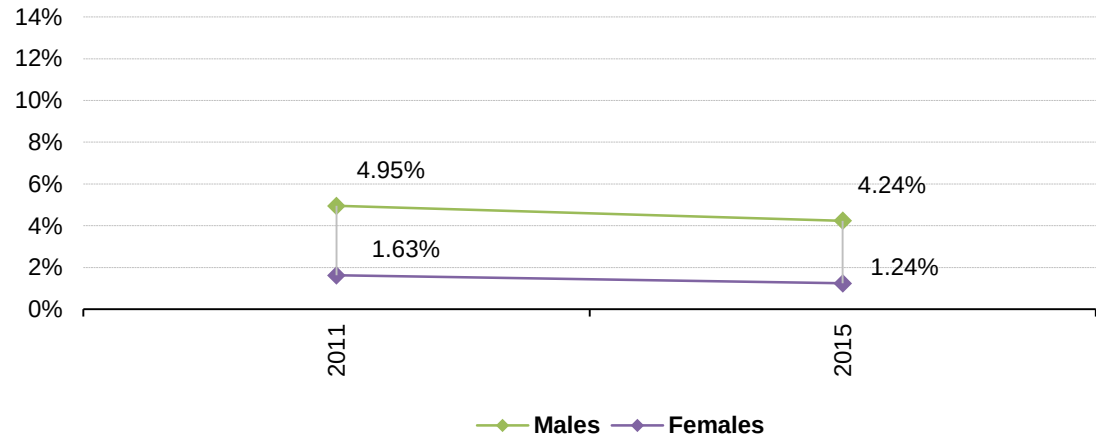
For the purpose of this study, ICT-related fields have been considered in a wider sense - including mathematics, statistics, computing and engineering- and we have found that, despite the growing demand for ICT specialists and digital profiles derived from technological change, the percentage of Europeans with ICT-related education, at all educational levels, is actually decreasing.

In 2011, 3.3% of Europeans[20] had studies in ICT-related fields opposed to 2.7% in 2015. If only those with tertiary studies are considered, the figures are higher but the downward trend still persists: 5.8% of university students in 2011 were in the ICT-related field compared to 5.4% in 2015.

This trend is shared by both genders, and the gap between them has minimally widened. There are still four times more men with ICT-related studies than women in Europe.

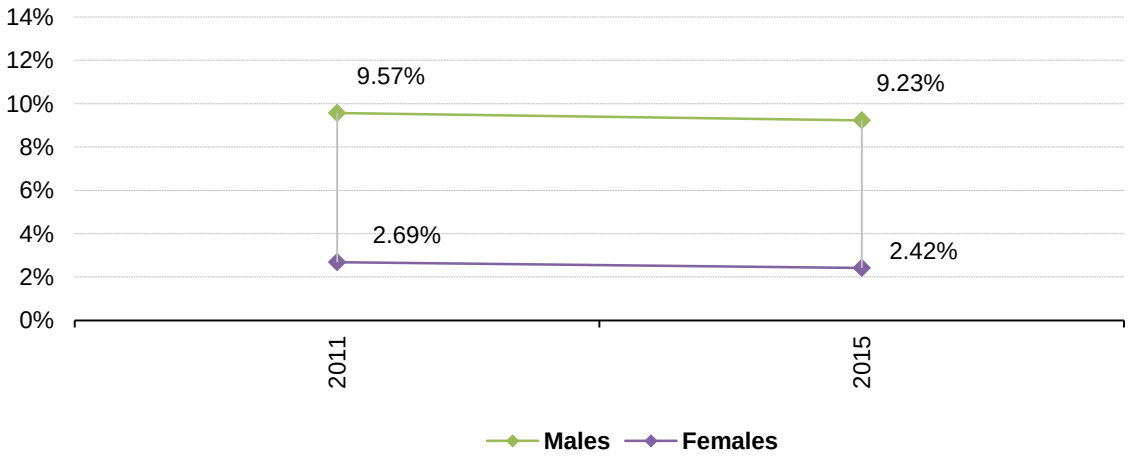
20 Data elaborated in house based on the ELFS. The educational background is only available in the last EFSL wave (2015) for population between 17 and 34 years old or those who had finished their studies within the last 15 years. Data for the year 2011 includes 25 European countries and data for 2015 includes all 28 Member States. Areas included as ICT-related are: Physical Sciences (441 in Eurostat Codes), Mathematics and Statistics (46, 461 and 462 in Eurostat Codes), Computing (48, 481 and 482 in Eurostat Code), Engineering and Engineering Trades (52, 521, 522, 523 and 524 in Eurostat Codes). More details on the methodology and all data can be found in Annex II.

Figure 3 Gender gap in the % of individuals with ICT-related studies, 2011-2015 *(as the % of the total population)*



Source: own calculation based on ELFS, 2017.

Figure 4 Gender gap in the % of individuals with tertiary ICT-related studies, 2011-2015 *(as the % of the total population with tertiary studies)*



Source: Source: own calculation based on ELFS, 2017.

In 2011, 9.6% of men with tertiary education had undertaken ICT-related studies, while only 2.7% of females had done the same. The gender gap in 2011 was 6.9 percentage points. The percentage of men with these studies was three and a half times higher than the percentage of women with the same studies (355% higher).

Four years later the figures for males had slightly fallen, reaching 9.2% of those with tertiary studies. For females, the figure dropped to 2.4%. The gap was 6.8 pp., but in

practice the gap between men and women was increasing (the share of men was 381% higher in 2015).

Women with ICT-related studies tend to have higher levels of education than their counterparts. The evidence shows that 70% of women with ICT-related studies have university or higher education, while only 62% of men do.

Harvey Mudd College: Female participation in Computer Science tertiary education

Harvey Mudd College (HMC) is a small college set up in Claremont (California, U.S.A) in which around 800 students are enrolled in engineering, science and mathematics.

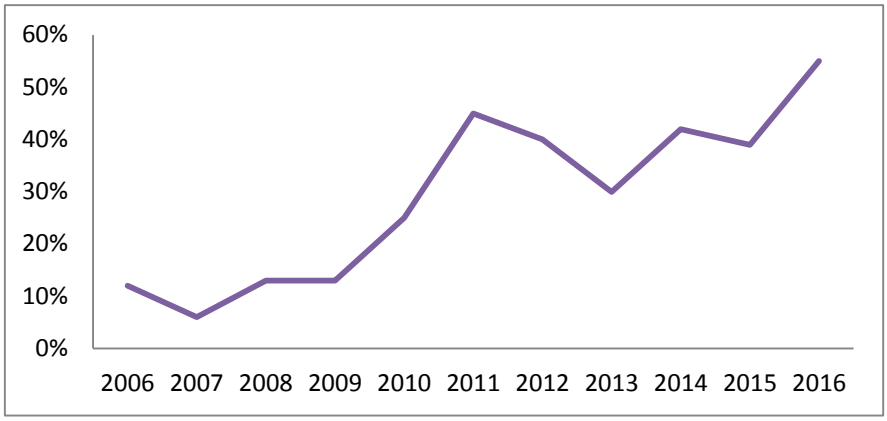
In the United States, women represent about 18% of undergraduate computer science majors and 20% of engineering graduates. In this context, the HMC has stood out, for the first time in 2016, with more women than men in their degree program for computer science. Their efforts to attract female students started a decade ago, when only 10% of computer science majors were women. Since Maria Klawe was appointed Director of the HMC in 2006, the Computer Science department has been reformed on the base of three main pillars:

- **An introductory course on computer science**, required for all first-year students and **the revision of the grade's syllabus**. The new course was designed with the following considerations:
    - The course is not designed only towards increasing the number of female students but it also targets those that, in general, have not been previously familiarized with programming. Students are grouped by experience and inexperience so as to minimize the impact of experience and confidence gaps
    - The new course, as well as the new syllabus, was designed to make content more appealing, engaging and less intimidating. Computing concepts are to be expressed in a contextual manner in order to reduce entry barriers and to demystify stereotypes created around computer science.
    - The course has a stronger practical approach and emphasizes more interdisciplinary team based-projects, closer mimicking a real work environment.
- **Innovative teaching.** More modern teaching styles with a problem solving approach were introduced, with a stronger focus on the application of knowledge taught and the acquisition of skills.
- **Role models.** More gender balance on faculty, staff and management positions has served as a catalyst to create a more inviting and supportive environment for female students. A departmental culture which seeks a more inclusive climate creates a sense of belonging that fosters multicultural and diverse relationships.

Additionally, the organization is carrying out awareness campaigns and collaborations with other institutions such as the BRAID[21] (Building, Recruiting, And Inclusion for Diversity) initiative.

In 2016, female graduates were 55%. Graduates at HMC, regardless of gender, are highly valued by the top tech companies in the USA. As a result, 64% of those female students who graduated in computer science obtained a job in a technology company in 2016, over 30 pp. more than in 2011. This shows that the changes introduced in the course have not affected the quality of the program nor its reputation.

Figure 5. Percentage of female computer science graduates at HMC



Source: Harvey Mudd College

The results obtained by HMC are the product of a profound cultural change and commitment at the highest level within the organization.

After launching the new introductory course, with subjects adapted to the computing levels of the students, and modifying the curriculum, with more appealing content descriptions and with a greater hands-on approach, it is more likely that women get a positive impression of the courses and enrolment increases. Additionally, the higher number of female students has a positive effect on the confidence of other girls, causing a domino effect that progressively might lead towards the desired cultural change. In light of the information above, it seems that the keys to the success of the HMC initiative are those measures addressing the confidence and experience gap of girls versus boys with computers.

In summary, the key success factors of this case are:

- Full management commitment.
- Awareness raising within the whole organization to achieve cultural change.
- Female role models and a communication strategy that takes into account

21 For further information: https://anitaborg.org/braid-building-recruiting-and-inclusion-for-diversity/

women specifically.

- Rethinking the way computer science is presented to girls, providing more innovative teaching techniques and stressing the usefulness of computing and its real world applications.
- Implementing actions to mitigate confidence and experience gender gaps

HMC is comparatively a small organization, but its experience could be replicated in other institutions, since the barriers preventing girls from enrolling in STEM studies are commonly shared.

The 2013 study of the European Commission analysed the case of the Leibniz Universität Hannover (Germany). Since 1991, this university set an example in implementing gender policies to help its female students[22]. Their initiatives were focused on raising awareness of the issues and helping balance personal and academic life, with childcare support for students and professors. Some measures had a positive impact, especially those addressing post-doctoral students; however, the objectives regarding female participation in STEM studies have not been achieved yet.

Comparing different experiences with different levels of success allows us to identify those measures that seem to produce results. Thus, from the cases analysed it seems that initiatives aimed at "convincing" women to opt for STEM careers through awareness campaigns and direct communication are less effective than those aimed at adapting content and the ways in which this content is transmitted. Therefore, it is not a question of how to transform women's mindsets so that they opt for certain subjects, but rather how to transform the way subjects themselves are taught so they are more relatable to women's preferences and/or needs. In addition, introductory courses that help equalize skill levels and reduce the impact of cultural factors, such as the confidence gap, seem to be particularly relevant to success.

The European Union could play a very important role in promoting curriculum changes.

1.2 Women in digital professions: gender differences widen

Very few women choose technical studies related to ICT fields, either secondary or tertiary levels, and the figures are not improving over time.

This trend persists in spite of the evidence of the positive economic and social impact of these types of studies. Research shows that earning a STEM degree increases women's'

22 Commission, DG Communications Networks, Content & Technology, and Iclaves S. L, Women Active in the ICT Sector Final Report ; a Study.

chances of entering high-paying industries by 19% as well as the chances of advancing in the workplace[23].

There is a widespread belief that holding a STEM degree increases employability. The demand for jobs in the ICT sector is expected to reach at least 500.000 vacancies by 2020 in the EU[24]. ICT and digital employment is growing slowly, and digital jobs[25] represent a rising share of total employment in the EU.

In 2015, 5.8% of European workers were employed in digital jobs[26], and 5.4% in 2011. The slight growth occurred for both men (2011:7.8%; 2015: 8.5%) and women (2011: 2.6%; 2015: 2.7%), but was greater among male workers, increasing the already existing gender gap (2011: 5.15 pp.; 2015: 5.78 pp.). The share of men working in the sector is 313% greater than the share of women.

Women represented 21.5%[27] of all workers in digital jobs in 2015.

The gender gap is even greater if only the working population with university studies or more is considered. On average, there are 9.3% of people with tertiary studies working in digital jobs, of which 14.8% being men and 4.1% are women, creating a gap of 10.7 pp. This means that the share of men with university studies working in digital jobs is 3.6 times bigger than the share of women. And the gap continues to widen; in 2011 it was 9.5 percentage points (13.5% of men; 3.4% of women).

---

23 Accenture, 'Getting to Equal 2017'.

24 The official estimations of the EU talked about 750.000 unfilled ICT jobs in 2020 but more recent estimation have adjusted the figure to 500.000. See: European Commission, 'Human Capital: Digital Inclusion and Skills'.

25 Following the recommendation of "ICT Employment Statistics in Europe: Measurement Methodology" Sabadash, 'ICT Employment Statistics in Europe'., digital jobs refer to ICT employments defined in wide sense by mixing the following taxonomies, industry, occupations and skills. It includes:

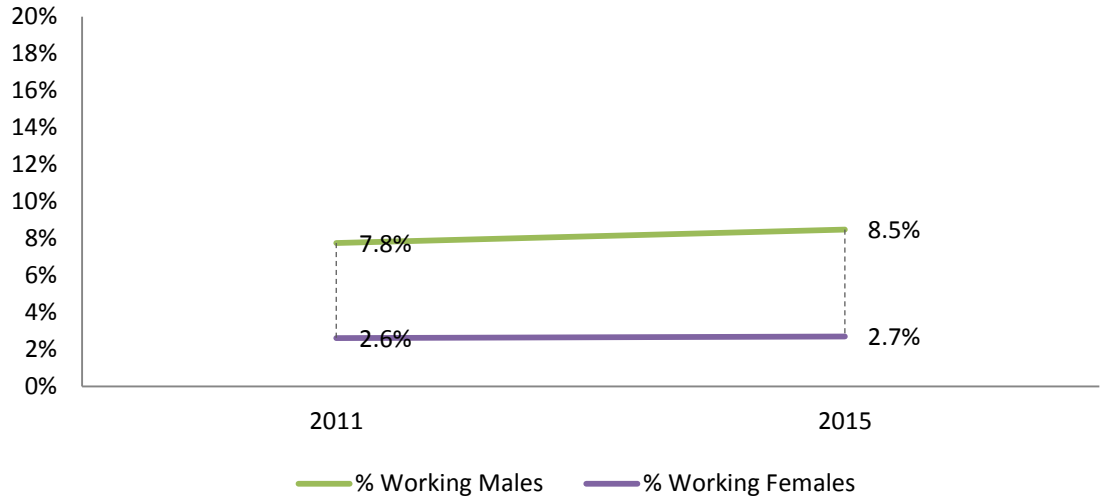
Employment in ICT-intensive sectors: J sector (according to NACE Rev. 2)

Employment in ICT-intensive occupations (ISCO-08 classification): ICT specific jobs in any sector of activity (such as "133 Information and communications technology services managers").

26 It should be noted that we have considered digital jobs in a wide sense, including workers in the ICT (J) sector but also workers with ICT-related occupations in any given sector. This fact explains the differences with other existing data, for example data from PREDICT - Prospective Insights in ICT R&D 2017- that indicates that the ICT sector in 2014 represented 2,51% of the total economy employment in the EU28. More information in https://ec.europa.eu/jrc/en/predict/ict-sector-analysis-2017/data-metadata

27 This data come from the ELFS of Eurostat, includes 28 EU countries.

Figure 6. Gender Gap in the Percentage of Individuals who work in digital jobs *(as % of the whole working population)*



Source: Source: own calculation based on ELFS, 2017.

Figure 7. Gender Gap in the Percentage of Individuals with tertiary education who work in digital jobs *(as % of the whole working population with tertiary studies)*

Source: Source: own calculation based on ELFS, 2017.

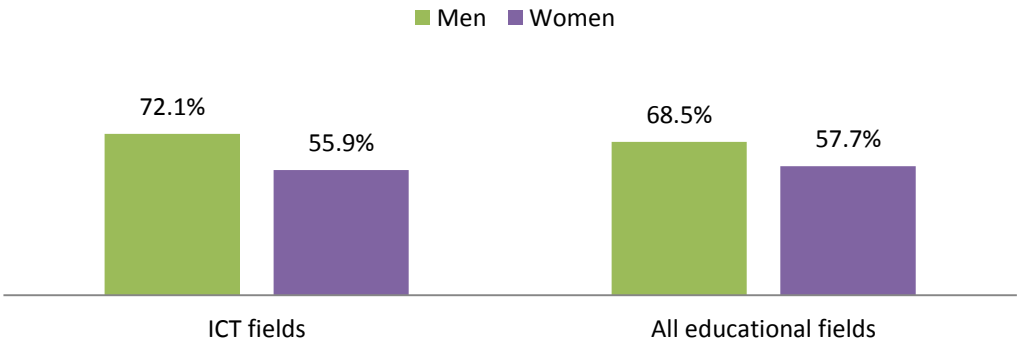
In light of this data it seems that women in the EU are not taking full advantage of the opportunities created by the ICT and digital sectors in the labour market.

In fact, the alleged positive effect of digital-related studies on employability is small and it seems to exist only for men.

If the entire population with any level of ICT-related education is considered, 80% of them have a job. The rate of employment is 82.1% for men and 71.2% for women (a 10.9 pp. gap). The average for the total population, with any field and level of studies, is much lower at 65.5%.

When workers with the same level of education are compared, the positive effect of ICT-related studies, both at secondary and tertiary levels, is very small and only affects men.

Figure 8. Population with education under university level working by field of studies, 2015



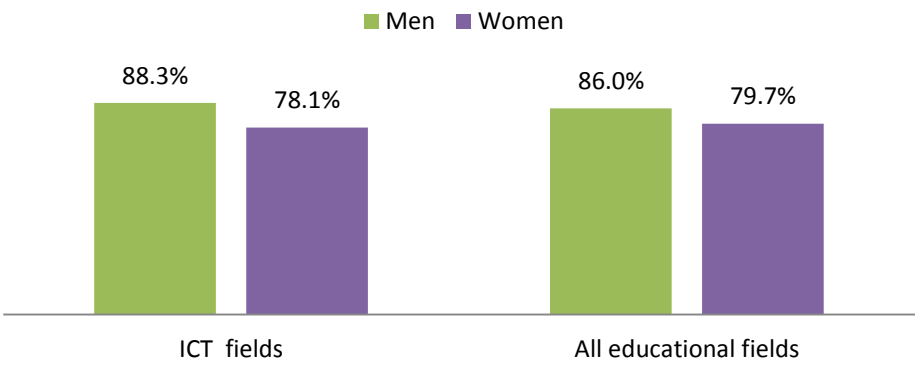
Source: own calculation based on ELFS, 2017.

At educational levels below university, 72.1% of men with ICT-related studies work while the average for all types of studies is 68.5%. For women, the figures are 56% for those with STEM studies and 57.7% for all fields of studies. Having ICT-related studies at the university level improves employability for men by 5% while it decreases females' employability by 3%.

Among men with tertiary ICT-related education, 88.3% work, and for women with the same academic background the number is slightly less at 78.1%. While the share of these men has slightly increased since 2011 (it was 87.1% then), the share of women with ICT-related studies working has slightly decreased (it was 79.8%) and the gender gap has passed from 7.3 percentage points to 10.2.

If these figures are compared with the professionally active population with tertiary studies in any field, for men the figure is 86%, 2.3 pp. less than for those with ICT-related studies, and for woman it is 79.7%, 1.6 pp less. Men with tertiary studies in ICT fields are 3% more likely to obtain employment than graduates in general, while women are 2% less likely to have a job if they have these type of tertiary studies.

Figure 9. Population with tertiary education working by field of studies, 2015



Source: own calculation based on ELFS, 2017.

In fact, gender gaps in employability are lower when all the fields of education are taken into. However, the gap is greater when ICT-related fields are exclusivel considered y (6.3 pp. and 10.2 pp., respectively).

Tech profiles

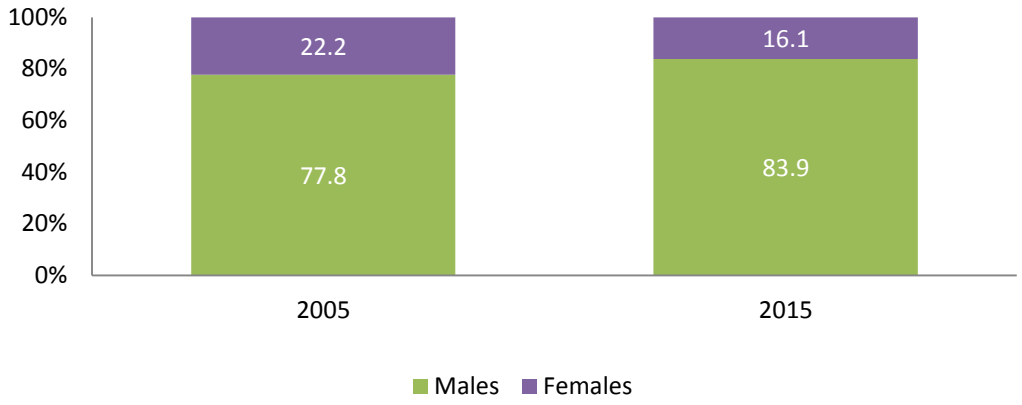
The digital sector employs more people than four years before, particularly more men, but all digital occupations are not necessarily technical occupations. Many jobs in the ICT and digital fields are not technical, such as clerks or legal jobs, which, although very important for the organization, are less related to innovation and technical development.

In fact, despite the demand for ICT and digital professionals with technical backgrounds[28] and the positive trend of the sector as a whole, the share of technical employees in digital jobs does not increase to the same extent and the gender gap is increasing.

According to Eurostat, in 2005 22.2% of all ICT specialists were women, but by 2015 that number dropped to only 16.1%.

28 See, for example: https://ec.europa.eu/digital-single-market/sites/digital-agenda/files/digital_skills_and_jobs_coalition_members_charter_0.pdf

Figure 10. ICT specialists by gender 2005-2015



Source: Eurostat, 2017

Data from the ELFS show that women make up 11.8% of workers from the digital sector with ICT-related studies, that is, those workers at digital jobs with technical educational backgrounds. In 2011, women represented around 14% of these workers.

Figure 11. Population working in digital jobs with ICT-related studies by gender, 2011-2015

(as % of total population with the selected studies (all levels) working in digital jobs)

Source: own calculation based on ELFS, 2017.

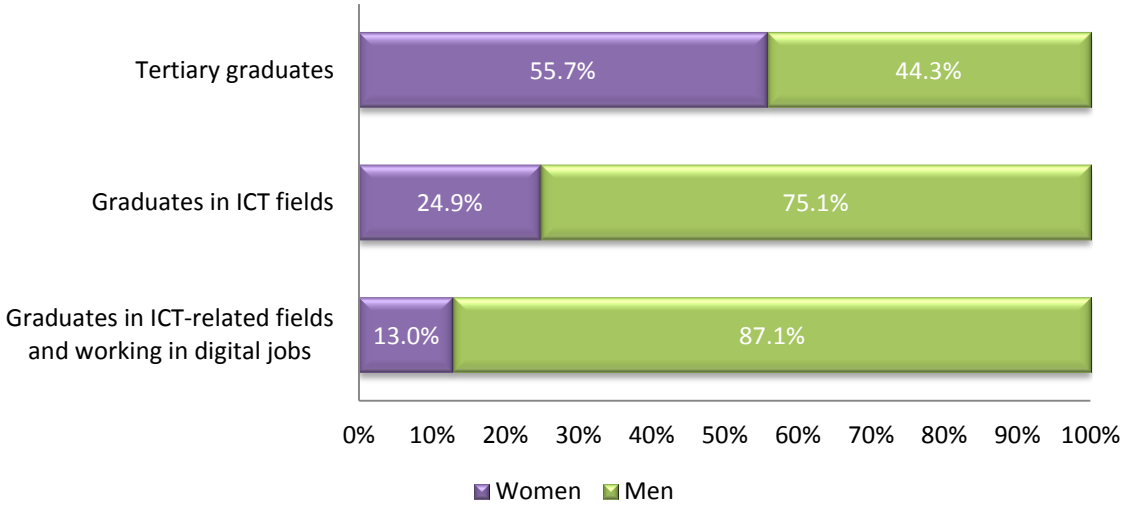
This data includes a wider variety of positions in the digital sector than statistics on ICT specialists since it also considers, for example, upper management and strategic positions in the Information and Communications sector. The trend, however, is consistent with the former and shows a clear decline of female participation in technological jobs.

1.3 Women along the digital sector career path: work–life balance remains critical for women

Women form over 57% of total tertiary graduates in the EU, but only 24.9% of all graduates in ICT-related fields are women.

Even when women have chosen ICT-related studies and graduate in such subjects, very few enter that sector for their career. Females currently make up 13% of tertiary graduates in ICT-related fields that are working in digital jobs, which is a negative change from 15% of graduates only four years earlier.

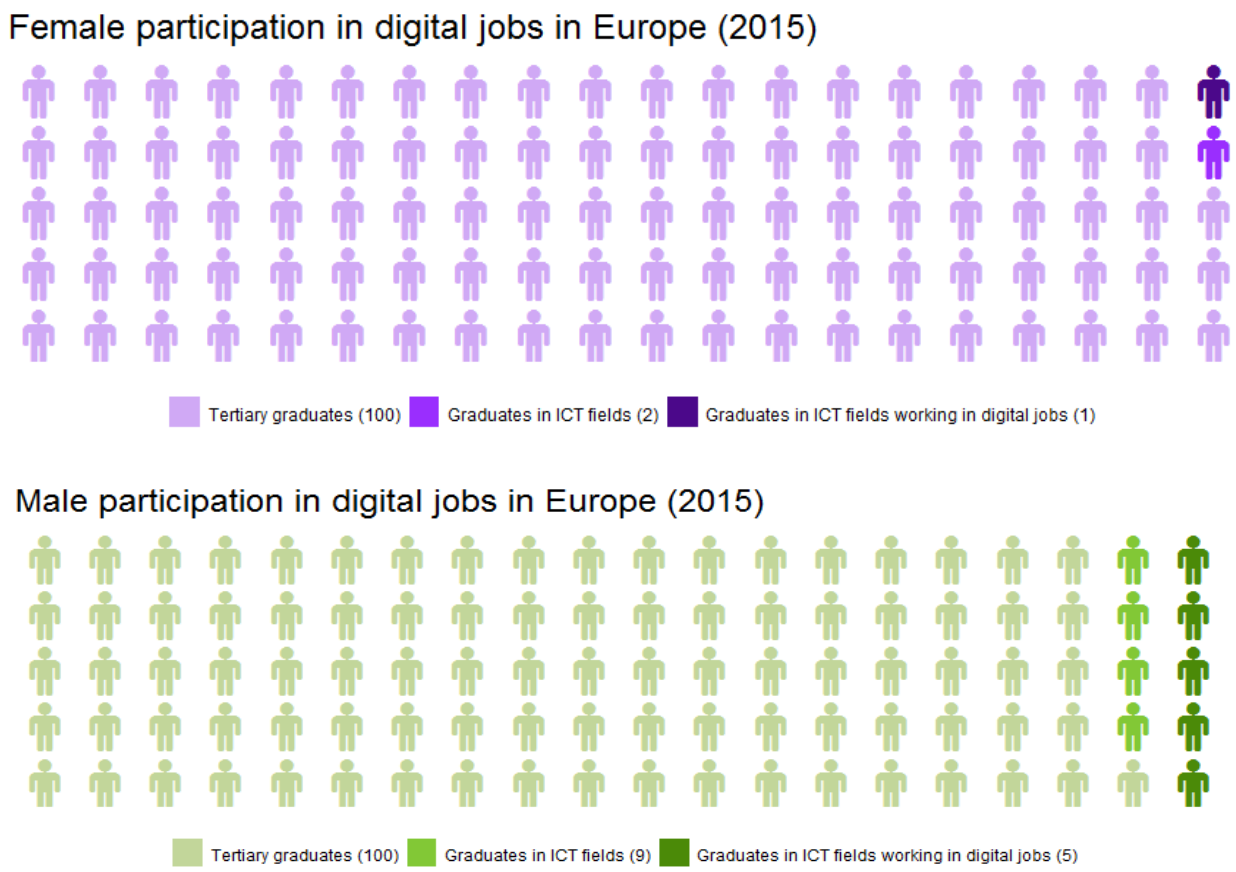
Figure 12. Share of men and women along the digital career path, 2015



Source: own calculation based on ELFS, 2017.

In the EU, out of every 1,000 women with tertiary education, a mere 24 graduate in ICT-related fields, of which only 6 go on to work in digital jobs. However, out of every 1,000 men. 92 are graduates with an ICT-related degree and 49 of them go on to work in digital jobs.

Figure 13. Number of people graduating from tertiary education in ICT-related fields and working in digital jobs, 2015 *(number per 100 tertiary graduates)*



Source: own calculation based on ELFS, 2017.

These figures refer to the year 2015, and the gap between men and women in digital jobs has worsened further in recent years.

In 2011, out of every 1,000 graduates only 27 women and 96 men graduated with ICT-related degrees. In 2015, the numbers diminished for both genders, with 24 for women and 92 for men. Of these graduates, 7 women and 48 men worked in digital jobs in 2011, while in 2015 one less woman and one more man worked in digital jobs. From the data, it shows that a man is 8 times more likely to have a technical job in the digital sector than a woman, even with the same level of studies.

Once women are in the digital sector, regardless of their background, they tend to leave their job early in their career to a greater extent than men. The ICT and digital sectors present specific obstacles for the professional development of women[29]. The existing organizational barriers combined with personal life events often force women in the

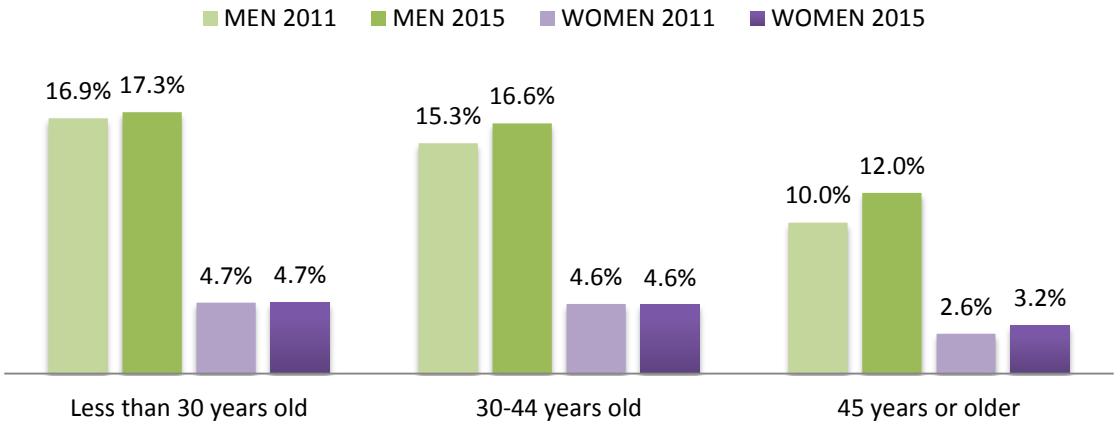
29 Commission, DG Communications Networks, Content & Technology, and Iclaves S. L, *Women Active in the ICT Sector Final Report ; a Study*.

middle of their careers to bring an end to their digital professional trajectories, either moving to a different sector or becoming inactive[30]. Trends do not show any improvements of this situation.

Analysis of the percentage of workers employed in digital jobs by age group, and its evolution in these last few years, it is observed that it is more common for younger workers to be part of the digital sector and that the number of workers decreases considerably among those 45 years and older.

The following graph shows the percentage of workers with tertiary education with digital jobs by age and gender in 2011 and in 2015.

Figure 14. Labour market distribution of individuals in digital jobs by age and gender *(as % of working population with tertiary education)*



Source: own calculation based on ELFS, 2017.

Changing sectors is common among workers in digital jobs, particularly among people above 45 years[31]. Moving from and to different fields along ones' professional trajectory is characteristic of ICT and digital careers[32] among both genders. The effect of certain

30 Castaño and Webster, 'Understanding Women's Presence in ICT'.

31 According to the EPSC Strategic Note "The Future of Work. Skills and Resilience for a World of Change" the evolution of work patterns in Europe is making the linear pattern that predominated in most sectors after World War II increasingly rare. Job mobility, which is commonplace as we have seen in the ICT sector, is spreading more and more to other sectors. "As for the EU 28, the changes for the 25-34 year olds between 2000 and 2014. Job tenure of 10 years and over decreased from 17.5% to 12.5%, while job tenure for 3-5 years increased from 17.7% to 19.4%.This shorter tenure is not just the result of shorter time spent on the job market, it is also a conscious choice. It follows that one might soon have 15-20 different jobs in a lifetime". Source: European Political and Strategy Centre (EPSC), 'The Future of Work. Skills and Resilience for a World of Change'.,

32 Castaño and Webster, 'Understanding Women's Presence in ICT'.

life events, like having children and taking care of the elderly, significantly affects women's professional trajectory in digital jobs and often results in them leaving their jobs, not to work in another sector, but to stay at home.

Women leave the sector and become inactive in their professional life to a much greater extent than men. This is particularly clear in the age range between 30 to 44 years, the prime working age and the key stage of one's professional development. This is also the period when most Europeans have their first child and/or have to take care of small children[33].

8.7% of women working in the digital sector with tertiary education left their jobs in 2015, 1.5 p.p more than in 2011, and are professionally inactive compared to a much lesser percent of men.

Figure 15. Percentage of individuals who previously had a digital job and are now inactive

(as % of working population in digital jobs with tertiary education (16-64 years))

Source: own calculation based on ELFS, 2017.

Older workers tend to withdraw from jobs in larger numbers than other age groups, particularly during an economic crisis. This is due to early retirement incentives used by companies to reduce their workforce and/or the difficulties for those above 50 to re-enter the labour market. Between 2011 and 2015 the percentage of workers over 44 years old becoming professionally inactive after having held a digital occupation has slightly decreased. Among women, the reduction has been 1.2 pp. and among men, only 1 pp. Still, women become professionally inactive to a greater extent than men also among those aged 45 or older.

33 The average age for European women to have their first child was 29 years old in 2015. Source: Eurostat, Fertility statistics, 2017.

When looking at those Europeans[34] who worked the digital sector and are now inactive - not unemployed - figures among men have hardly changed between 2011 and 2015, while the rate of women becoming inactive continues to grow. This rate particularly grows when it comes to women who are between the ages of 30 to 44, the years when most European women commonly become mothers.

The "opt out" phenomenon is common in all sectors of the economy, but it is generally less frequent among those working in digital jobs. This is probably due to the fact that ICT and digital jobs generally pay better than other jobs and that workers in these occupations have, overall, better working conditions.

Data shows that men abandon digital jobs to become professionally inactive to a lesser extent than the rest of the male workforce. Male digital workers leave their jobs less, regardless of age but particularly when they are young, as was the case both in 2011 and 2015.

Figure 16. Men who previously had a job and are now inactive by type of job and age, 2011 *(as % of men with tertiary education)*

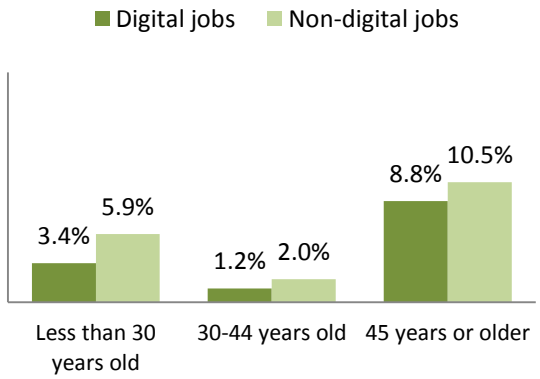
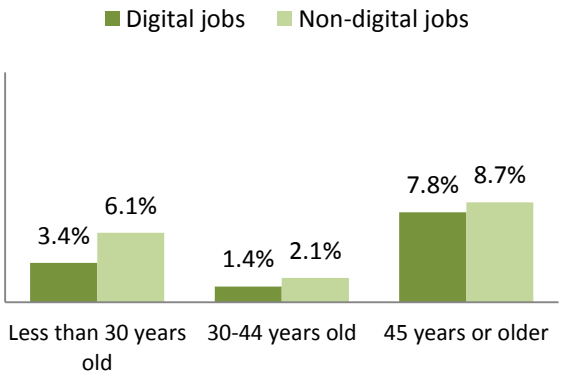


Figure 17. Men who previously had a job and are now inactive by type of job and age, 2015 *(as % of men with tertiary education)*



Source: own calculation based on ELFS, 2017.

However, this pattern changes for women between 30 and 44 years of age. Taking into account data of women from all age groups, they leave less from digital jobs than they do when they work in other occupations and sectors. This trend changes in 2015 when the data showed that 8.67% of women ages 30 to 44 left their jobs and became inactive compared to 7.3% of women working in other jobs. This fact seems to support the widespread view that this sector is particularly difficult for women who are trying to

34 Only those with medium or low levels of education have been considered for this analysis. More details in "Methodology".

balance their professional and personal lives and, even more so for women with high skillsets.

Figure 18. Women who previously had a job and are now inactive by type of job and age, 2011 *(as % of men with tertiary education)*

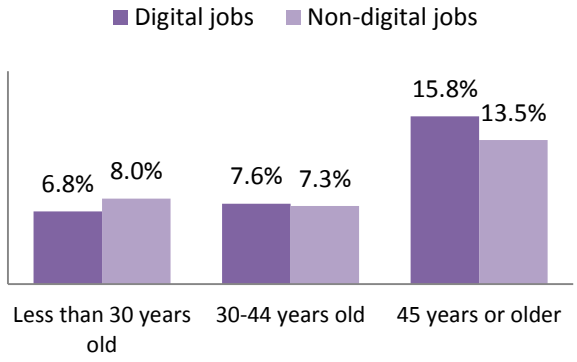
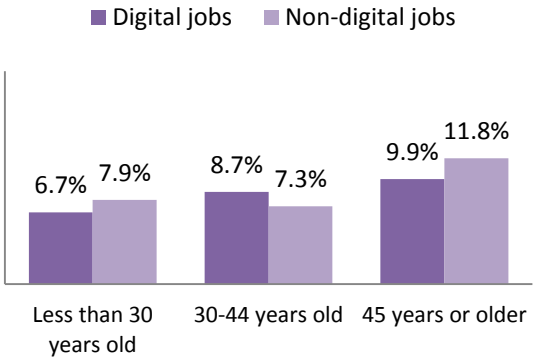


Figure 19. Women who previously had a job and are now inactive by type of job and age, 2015 *(as % of men with tertiary education)*



Source: own calculation based on ELFS, 2017.

These findings are consistent with existing literature on the topic. An international study[35] based on a survey to MBA graduates working in tech-intensive[36] business roles[37] found that:

- Men were less likely to leave tech-intensive business roles than women for a position in another industry. 31% of men versus 53% of women had left their positions to take another one in a different activity sector.
- The reasons to leave are different for both genders. 67% of men, in comparison with 52% of women, left their positions for faster career advancement, more money or to start a business. Women tend to be motivated by personal reasons; 21% of women compared to 12% of men left their business roles based on individual motivations such as raising children or the relocation of their partners.

The economic impact of the opt out phenomenon

In 2013 the European Commission estimated that the European Union would add **9 bln Euro to its GDP** every year, if women were incorporated into the ICT sector at the same

35 A. Beninger, 'High Potentials in Tech-Intensive Industries'.

36 Tech-intensive industries include high tech, telecommunications, resources (including oil and gas), chemical and energy, utilities, automotive and manufacturing.

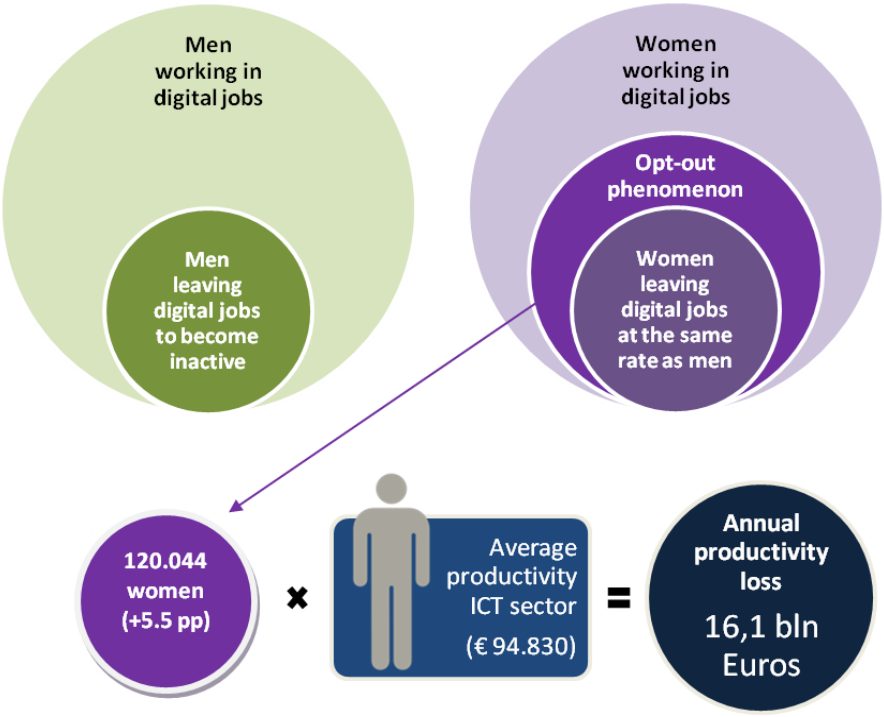
37 Business roles include administration, general management, consulting, consumer affairs, public relations, finance, accounting, purchasing, healthcare delivery, human resource management, marketing and sales, policy, legal, and teaching/training.

rate as men[38]. This figure was the result of the analysis of a very conservative scenario, which only considered those who had undertaken ICT-related studies but were not working. It measured the productivity gain if females in that situation were to work in the ICT sector in the same proportion as men.

With updated data from 2015 the economic impact that the opting out phenomenon among women has for the European economy has been measured. That is, the impact of those women leaving digital jobs is now estimated, instead of the impact of women not entering the sector. **The annual productivity loss for the European economy due to women leaving their digital jobs to become inactive is 16.1 bln Euro[39].**

And this figure is, again, conservative, since it only considers women that leave their jobs to stay at home, and not those who move to less productive sectors of the economy. It also considers only the gender gap, since it analyses a scenario under which women and men behave the same and leave the sector at the same rate.

Figure 20 Productivity loss due by the opt-out phenomenon in the digital sector in the EU



38 Commission, DG Communications Networks, Content & Technology, and Iclaves S. L, *Women Active in the ICT Sector Final Report ; a Study*.

39 The gap between men and women leaving their digital jobs to become inactive is 170.044 people. This figure refers to workers with medium or high levels of education If we consider the average per person productivity of the ICT sector according to the 2017 PREDICT Dataset in the year 2014, € 94.830, the total productivity loss is € 16.125.288.451. More information of the methodology used for the calculation in Annex II.

1.4 Evolution of working conditions in the ICT sector from a gender perspective: conditions tend to equalize

The ICT sector is generally associated with better economic conditions and greater flexibility, but at the same time contains high levels of stress and major problems in balancing work and family life.

It is still a strongly male-dominated work environment that presents significant challenges and barriers for women, as in other equally male-dominated sectors. In addition, this sector, as existing studies show, has certain characteristics that are particularly detrimental to women since they directly affect the ability to find a work-life balance. It requires long hours of work outside normal working hours or the need to update their knowledge on an ongoing basis[40].

It was noted that in recent years there has been some improvement in women's perception of their working conditions in the sector. Regardless, women continue to be a minority in the sector which indicates that the problems women face while working in a highly male-dominated environment still affect them.

Based on the analysis of the data provided by the European Labour Force Survey, the working conditions of women and men in the sector and in other service sectors have been analysed.

The main findings regarding the socio-demographic and socio-economic characteristics of men and women in the sector from a comparative point of view are as follows:

- Women are still highly represented in non-ICT sectors whereas its prevalence in ICT sectors remains clearly smaller.
- When comparing demographic characteristics between women in the ICT and non-ICT sectors, it is evidenced that women in the ICT sector are younger and their educational level is clearly higher.
- When job characteristics between women in the ICT versus non-ICT sector are compared, the following is observed:
    - Average monthly earnings are clearly higher for women in the ICT versus non-ICT sector
    - Women in the ICT sector generally work in larger firms than their counterparts in the non-ICT sector.
    - Women in the ICT sector occupy higher positions in the hierarchy of their companies, with over half of them being managers or professionals.
- When females in the ICT sector with their male counterparts are compared, it is observed that:
    - Men are as an average around four years older than women

40 Commission, DG Communications Networks, Content & Technology, and Iclaves S. L, *Women Active in the ICT Sector Final Report ; a Study*.

- Women tend to work in larger companies than men
- Women's level of education is slightly lower than men's.
- Average monthly earnings are clearly higher, over 30%, for men than women in the ICT sector.
- Men still occupy technical and professional positions at a higher rate while women in the sector tend to occupy clerical, service or manual occupations more.
- It is interesting to highlight that it seems that women, almost 25%, tend to work in more feminized[41] working environments, since only around 3% of men have mainly female co-workers and do work in a more feminized environment. This fact is consistent with the existence of relevant in-group biases[42] in the sector.

When comparing women in the ICT sector with their male counterparts regarding their working conditions within the ICT sector trends suggest that gender differences are diminishing, and men and women perceive their situation in the sector in a similar way.

Only three aspects show statistically significant differences between genders in the ICT sector:

- Motivation
- Capability of applying own ideas
- Discrimination on the basis of gender

The following is a summary of the most relevant aspects related to working conditions in the digital sector from a gender perspective, compared to the situation of women in other service sectors, in order to know the peculiarities that characterize this sector and if they may be influencing the professional careers of women.

- **Training**

There are no statistically significant differences between men and women in the ICT sector when it comes to receiving paid training on behalf of the employer. In the ICT sector both genders are trained to the same extent. In general, training is less common than in other non-ICT service sectors, but gender doesn't seem to be a factor for being trained in the ICT sector.

- **Flexible schedule**

The perception of women in the ICT sector regarding the flexibility of their schedule to arrange personal or family matters has improved in recent years when compared to the perception of men in the sector. Although there are still differences - women still perceive

41 Feminized in this study referes to working environmnents with a majority of women

42 The so called in-group biases or groupthink phenomenon and its effect on female participation in the ICT and digital sector is discussed in Chapter 6. "Women's challenges in the Digital Age".

that they have flexibility to a lesser extent than men - in the sector, the difference is not statistically significant. What is significant, however, is the difference between women in the ICT sector and women in other service sectors. Women in the ICT sector are significantly more likely than women in other service sectors to answer that it is easy for them to arrange their time during working hours to take care of personal or family matters. In those other service sectors, additionally, men perceive flexibility to a greater extent than women in the ICT sector.

- **Satisfaction**

The level of satisfaction of women with their working conditions in the ICT sector has slightly improved since 2010 and, although there are still differences with the level of satisfaction for men, the gap is diminishing and the 2015 data has nothing statistically significant in this regard. The gap is also narrowing with respect to other sectors, where women feel slightly more satisfied in general.

When asked if they feel well paid for their job, women in the ICT sector agree at the same rate as their male counterparts in the sector, and to a greater extent than women in other service sectors.

- **Work environment**

Women in the ICT sector are significantly more motivated to give their best at work than both men in the same sector and women in other service sectors. The motivation of ICT female workers has increased significantly in the last few years when compared to that of their male counterparts.

When asked about their ability to apply their own ideas at work, the differences between men and women among ICT workers is narrowing, even though women still believe that they can apply their own ideas to a lesser extent than their male counterparts. This trend is also the case in other service sectors, although the gap between genders is smaller than in the ICT sector.

The levels of stress that women experience in the ICT sector have not significantly changed in recent years. Women are more stressed than men in all sectors, and in particular in the ICT sector, where women are slightly more stressed than women in other service sectors.

- **Discrimination at work**

The main difference analysed regarding the working environment's discrimination on the basis of gender is, by far, the aspect where more differences appear between male and female workers. Although the percentage of women that affirm that they have experienced discrimination in the ICT sector has decreased compared to previous years, the gap between men and women who have experienced discrimination on the basis of their gender has increased. This is also the case with workers in the other sectors analysed; however, it is larger in the ICT sector.

Summing up, when comparing women and men in the ICT sector regarding their working conditions it can be noted that women are more motivated than men to give their best job performance, they feel that they can apply their own ideas at work less than their male counterparts and have experienced discrimination on the basis of their sex to a

much greater extent. Moreover, they claim to be more stressed, although results at this regard are not statistically relevant. When comparing female workers of the ICT sector and female workers from other service sectors, it is observed that ICT workers received less training - both men and women - but female ICT workers have much more flexibility than female workers in other sectors. Other differences, although statistically less relevant, are that women in the ICT sector feel they are well paid and are motivated to a greater extent than women in other sectors; though, they still experience more discrimination.

The trends, when comparing data from the year 2010 and 2015, show that most of the gaps between men and woman in the ICT sector are narrowing; however, there are two aspects in which the gap between genders has widened: women are significantly more motivated than men in their ICT jobs and, on the other hand, women experience discrimination to a greater extent than men.

2. Digital skills and gender: the gaps narrow among the youngest group

The digital transformation of the economy taking place has created a rising demand for skilled workers that are able to keep up with innovations and technical developments.

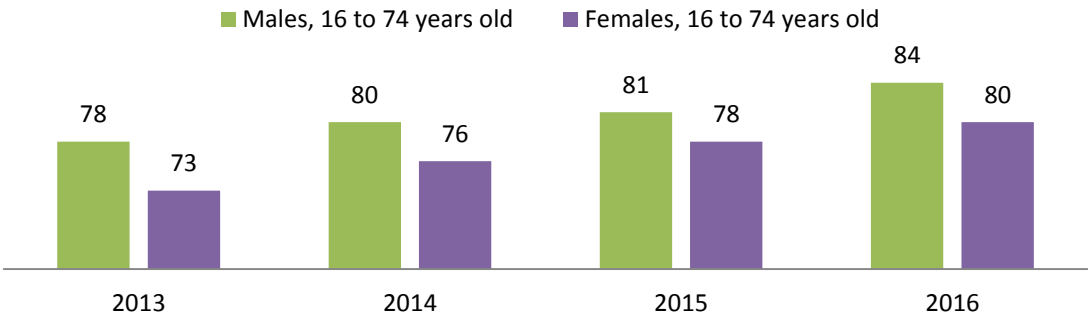
It is a fact that almost all jobs in modern economies require a certain level of digital skills. For instance, the UK has estimated that only 7% of jobs in the British labour market do not require any digital skill.

> *For Europe to flourish in the present age, we must focus more attention on all those individuals who make their lives in the EU. Europe no longer enjoys the old monopolies of know-how and technology or dominates the ownership of planetary resources. Europeans have yet to fully internalize what this means for Europe's choices. In the decades ahead, (...), Europe will flourish and thrive only by the relentless development of creative people. Europe has no other asset.*
> *(...) To be resourceful and effective in the 21st century, every individual must be nurtured, in mind and body, in know-how and creativity.*
> *(Robert Madelin, 2016)*

Despite the higher rates of unemployment in Europe and the growing demand for workers with high digital skills, a gap between the demand for skills and the actual digital skills of European citizens remains. This digital gap is mainly a competence gap[43], since connectivity and access to basic ICT infrastructure is widely available in Europe: 85.4% of households have access to the internet at home, 86.5% of individuals in the EU are frequent Internet users and there are 83.9 mobile broadband subscriptions per 100 people.

According to ITU, in 2016 the global gender gap between internet users was 12%, and 6.9% in Europe[44]. According to the most recently available data from Eurostat, the gap in the EU28 in 2016 was 5%.

Figure 21. Internet users[45] by gender in EU28 2013-2016 (% of individuals 16 - 74 years old)



Source: Eurostat, 2017

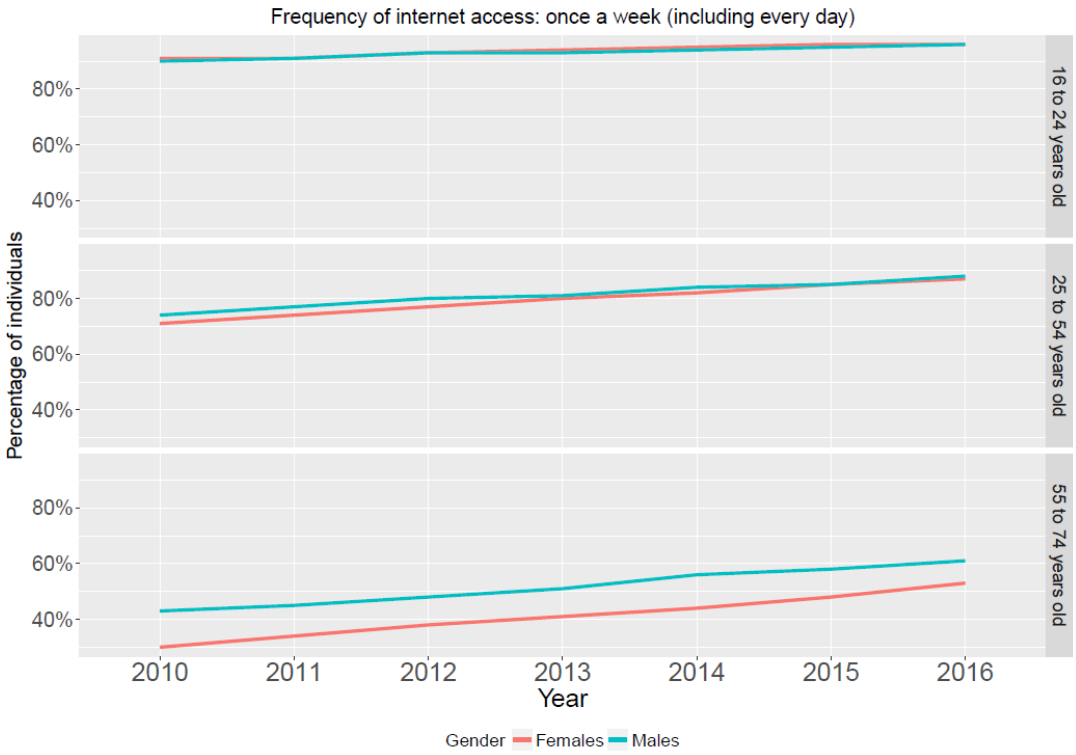
43 European Schoolnet and DIGITALEUROPE, 'The E-Skills Manifesto 2016'.

44 'How Can We Close the Digital Gender Gap?'

45 Internet users are defined by Eurostat as all individuals aged 16 to 74 who had used the internet in the three months prior to the survey.

When examining the data by age, however, the gender gap closes for internet users among the younger generations. In fact, the gender gap in related to internet usage exists only among individuals over 55 years old and it has completely closed among those aged 16 to 25 and 25 to 54 years.

Figure 22. Internet users by age and gender in the EU (at least once a week)



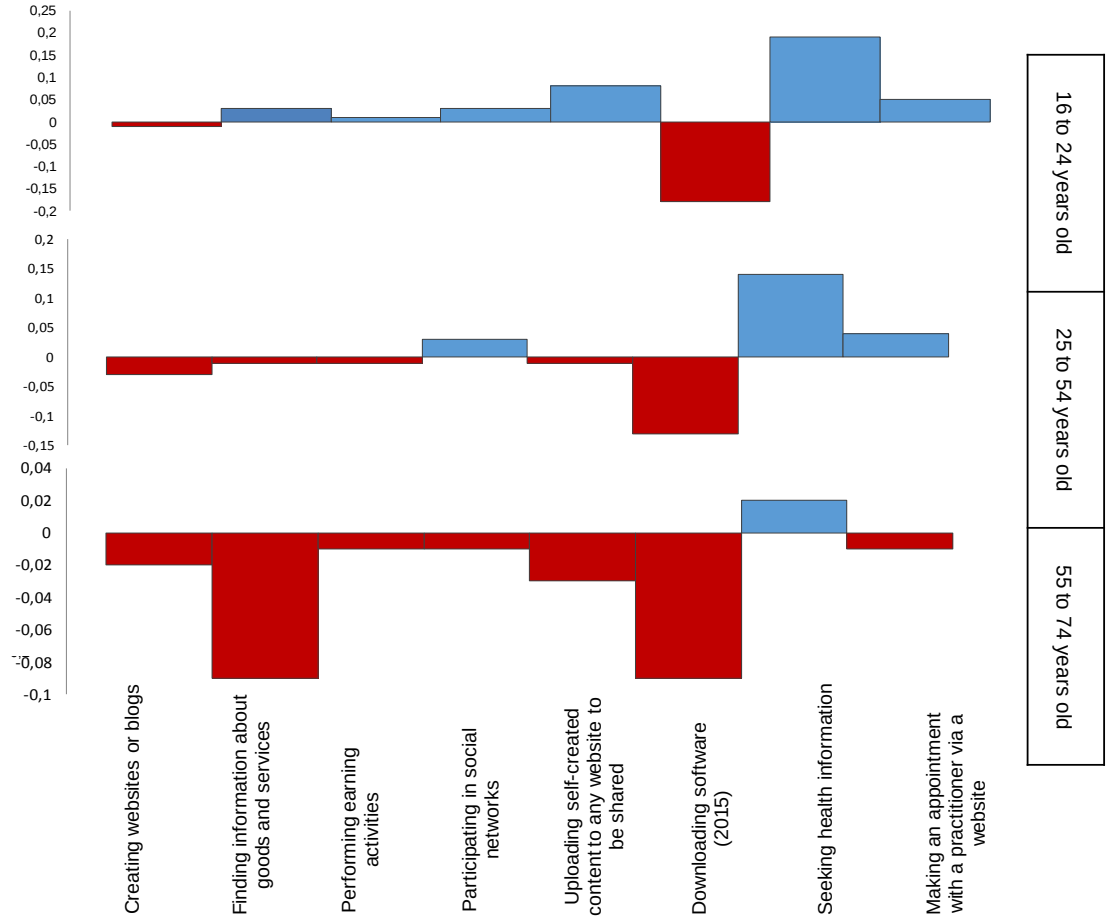
Source: Eurostat, 2017

Gender differences for the type of uses of the internet are also narrowing. The main difference can be found in downloading content[46], particularly software. Men are likely to download twice the amount of content on average than women would. Conversely, women surpass men in all internet uses related to health: searching for information, making an appointment with a practitioner, etc.

Among those individuals above 55 years of age, men surpass women in all uses analysed except for seeking health information. Among the youngest users, women (slightly) exceed men in all uses except for downloading software and creating websites or blogs.

46 The last available data for the action "downloading software" is from 2015.

Figure 23. Gender gaps in internet uses by age (2016)



Source: Eurostat, 2017

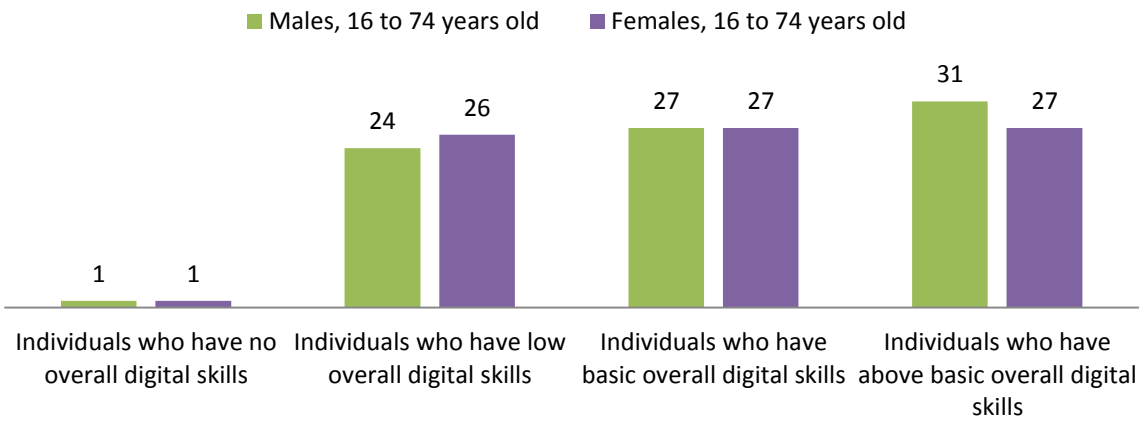
Generally speaking, Europeans have the basic infrastructure but they do not have the digital skills needed to keep pace with the digital transformation that European companies and public administrations face. Cloud computing, big data and collaborative networks are already a reality in most of the economic sectors and in daily life activities. These technologies require certain skills that are still scarce in Europe. Europe faces a shortage of both basic digital skills and IT specialists to fulfil the growing demand[47].

Looking at basic e-skills[48], using the data from Eurostat, one can see that there is no gender gap in Europe; the rate of individuals with basic digital skills is 27% for both men and women.

47 European Schoolnet and DIGITALEUROPE, 'The E-Skills Manifesto 2016'.

48 Since 2015 Eurostat applies a "Digital Skills Indicator" based on the Digital Competence Framework (developed by JRC and DG EAC). According to the Digital Agenda key indicators the definition of this indicator is: "Persons that have been using internet during last 3 months are attributed a score on four digital competence domains: information, communication, content-creation and problem-solving, depending the activities they have been able to do. The scores are basic, above basic and below basic. Individuals not using internet are classified without digital skills. The four digital competence domains are aggregated in four logical groups." For

Figure 24. Level of digital skills by gender in EU28, 2016

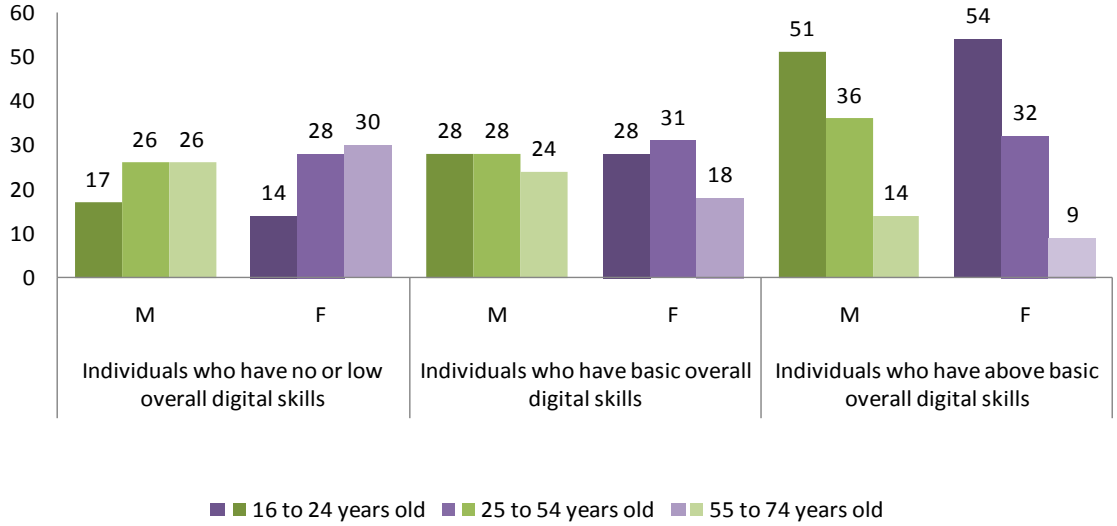


Source: Eurostat, 2017

This data reveals, however, that 25% of European men and 27% of European women have no or low digital skills. There is a gender gap of 12.9% when digital skills above basic are considered because 31% of European men have them compared to only 27% of women.

By age, the gender gap in basic digital skills persists among females over 55 years old, but closes among the younger users.

Figure 25. Level of digital skills by gender and age in EU28, 2016



Source: Eurostat, 2017

more methodological information please visit: https://ec.europa.eu/digital-single-market/en/news/new-comprehensive-digital-skills-indicator

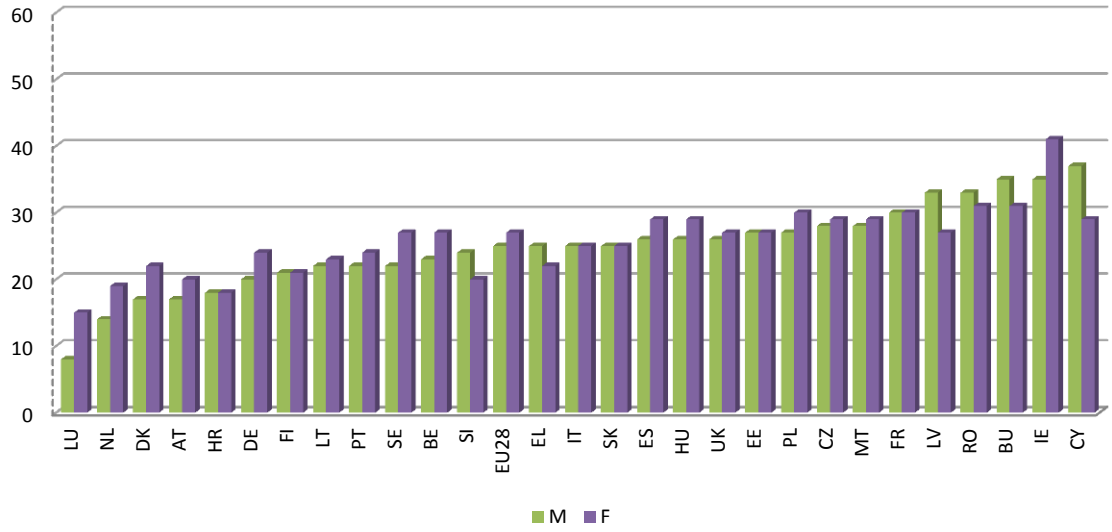
The first clear conclusion is that there is a shortage of digital skills in the EU that affects the whole population, including the youngest generation, miscalled "digital natives", of which almost half don't have advanced digital skills.

When it comes to basic skills, there is no gender gap among those under 55 years old but there is a 6 percentage point difference between men and women over 55.

More girls below 24 years have advanced digital skills surpassing their male counterparts by 3 percentage points. In the other age groups, there is a gap for women: 4 pp. more of men aged 25 to 54 years old have above basic digital skills than women, and 5 pp. in the group over 54 years old.

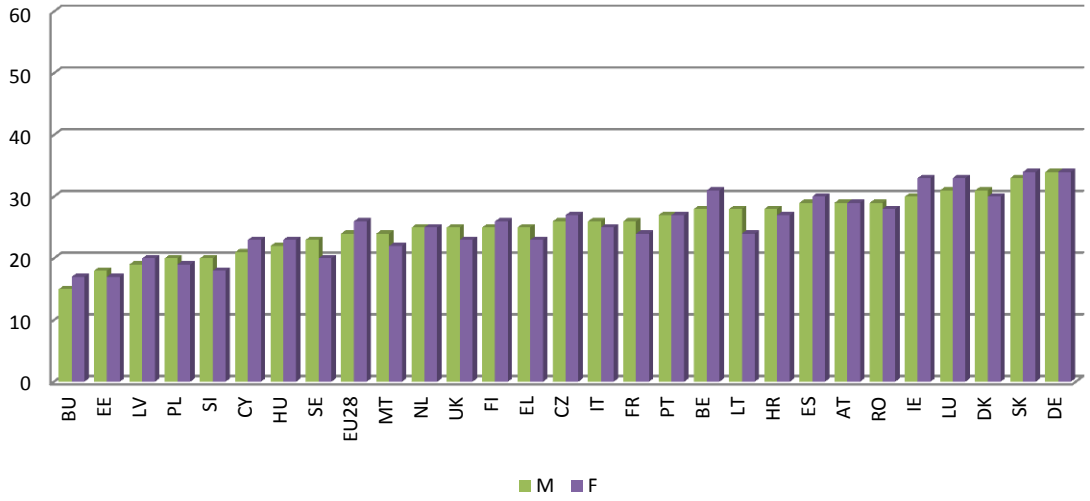
There are significant differences among the EU countries regarding the gender gap of digital skills (see Figure 26). The biggest gaps in absolute terms occur in Luxembourg, the Netherlands and Austria, countries with some of the highest percentage of people with above basic skills. There are no gender gaps between males and females with basic digital skills in Belgium, Denmark and Germany, and between males and females with above basic digital skills in Slovakia and Malta. In France, Bulgaria, Cyprus and Latvia there are more women with above basic digital skills than men - although all these countries are below the EU average for individuals with above basic skills. Relatively speaking, countries with above 20% for their gender gap regarding advanced skills (above basic) are Belgium, Czech Republic, Italy, Luxembourg and Austria. On the contrary, Latvia has a reverse gap of 20.8%, with 29% of females with above basic digital skills compared to 24% of males.

Figure 26. Individuals who have no or low overall digital skills by gender and country



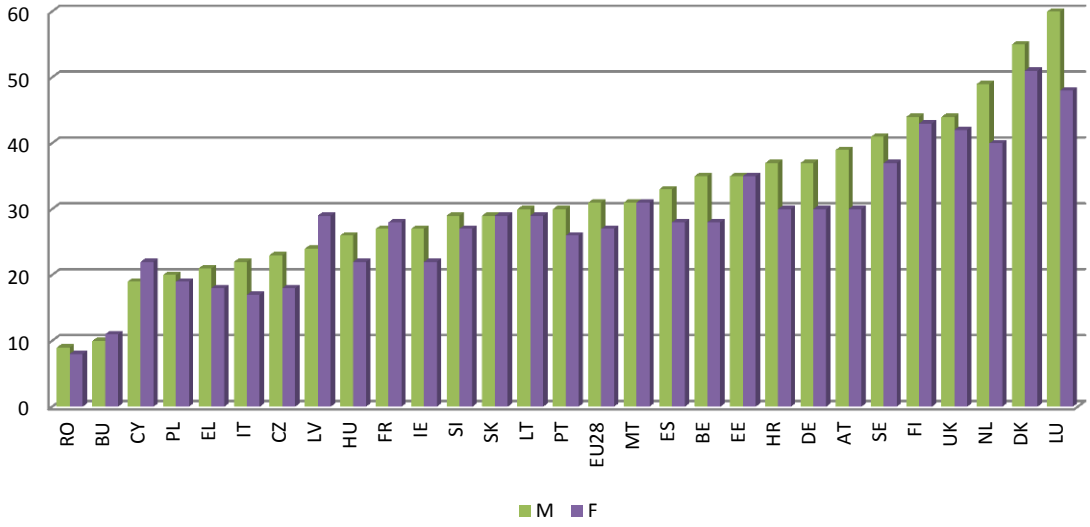
Source: Eurostat, 2017

Figure 27. Individuals who have basic overall digital skills by gender and country



Source: Eurostat, 2017

Figure 28. Individuals who have above basic overall digital skills by gender and country



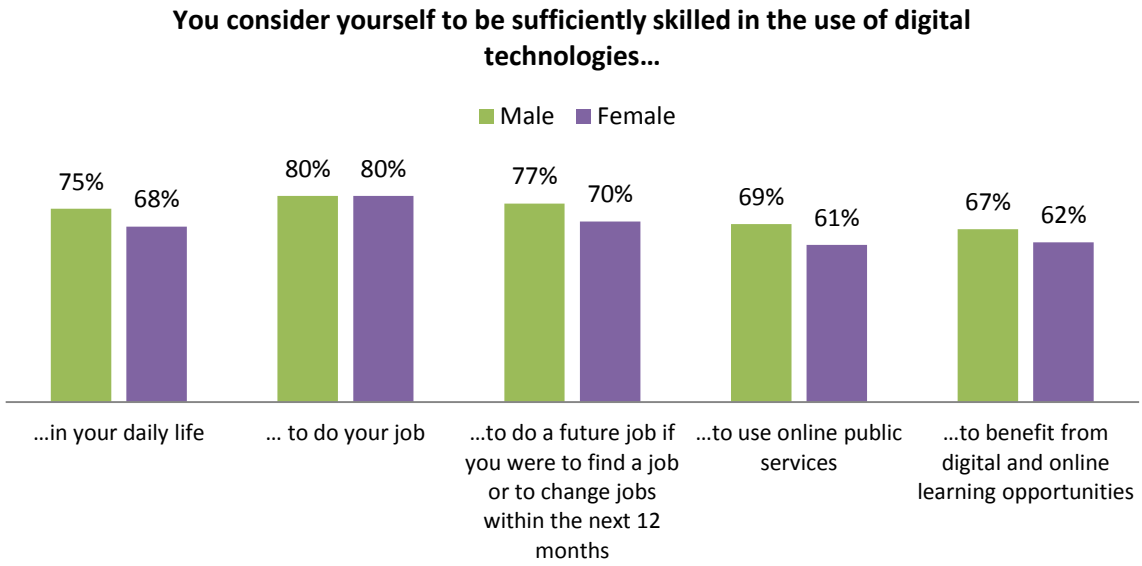
Source: Eurostat, 2017

Considering that in the next few years it is expected that 90% of jobs will require above basic digital skills, upskilling the population and reducing gender gaps at all age groups, especially for the working age group, are critical for European social and economic progress.

Although almost 70% of the European population lack advanced digital skills (see Figure 29), 73% consider themselves sufficiently skilled in the use of digital technologies to do a future job and 80% consider themselves sufficiently skilled for their current job.

From a gender perspective, the self-perceptions of women and men about their own digital skills show that women question with their own skills more than men. As a result, women consider themselves to be sufficiently skilled for their daily life, a future job, the use of public online services and performing online learning activities at a lesser extent than men do. Nonetheless, some of these activities, such as daily life activities or using public services, require basic digital skills in which, as previously shown, there is no gender gap. There are no gender differences when it comes to considering oneself sufficiently skilled for the current job one has.

Figure 29. Self-perception of digital skills by gender



Source: Special Eurobarometer 460

These data are consistent with existing literature[49] that shows that women tend to undermine their own capabilities and skills to a greater extent than men. In fact, men tend to overrate their performance and abilities while women underestimate both.

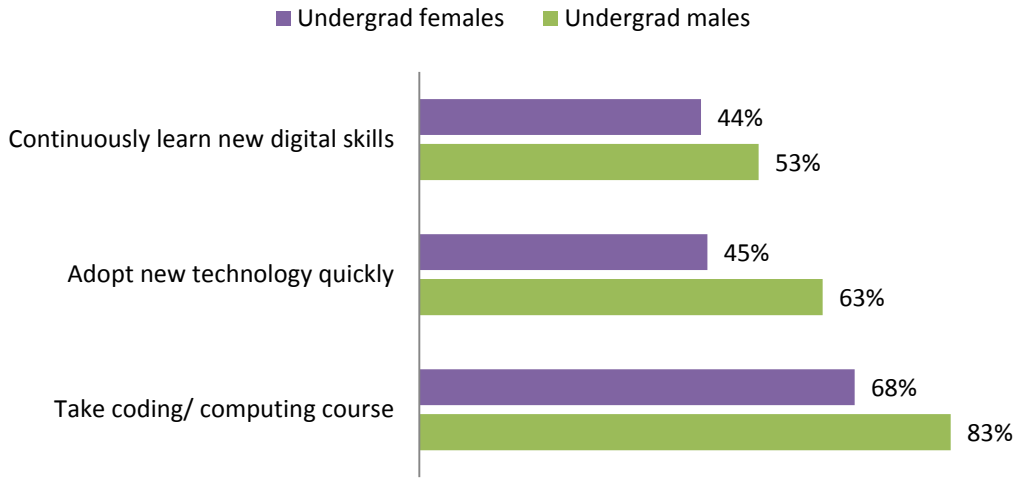
A study recently published by Accenture[50] has identified the gender digital skills gap as one of the main factors affecting the gender payment gap and the ability to break the glass ceiling nowadays. The lower number of women taking STEM studies is one of the

49 See, for example: Ross, J. A., Scott, G. and Bruce, C. D. (2012), The Gender Confidence Gap in Fractions Knowledge: Gender Differences in Student Belief–Achievement Relationships. School Science and Mathematics, 112: 278–288. doi:10.1111/j.1949-8594.2012.00144.x; Commission, DG Communications Networks, Content & Technology, and Iclaves S. L, *Women Active in the ICT Sector Final Report ; a Study*.

50 Accenture, 'Getting to Equal 2017'.

causes, but lower digital skills not necessarily linked to a formal education in STEM studies, such as coding, is also at the root of the problem.

Figure 30. Actions and attributes that affect work and pay by gender



Source: Getting to Equal 2017, Accenture

According to Accenture's study 68% of female undergraduates have taken coding or computing classes, compared to 83% of male undergraduates, which could possibly hold back the development of those women's careers (see Figure 30).

2.1 Women and coding

Programming and coding, together with computational thinking, are very relevant competences in the digital era. Coding is considered the "new literacy" and is part of basic eSkills[51]. As a result, coding is currently being established as a key educational priority in most educational systems in Europe[52]. Inclusion of coding in the curricula for schools aims at increasing the level of digital competencies for the whole population and, therefore, should help reduce the existing gender gap in this particular digital competency.

Although there is no data at the European level on the coding knowledge or expertise of the population as a whole and, of course, on gender gaps in this regard, the underrepresentation of women among the international community of coders and developers is well known. Stack Overflow, the international online community which is the world's largest community for software developers, carries out an annual survey among its members that includes gender as a variable when analysing results. This

51 'The E-Skills Manifesto'.

52 Balanskt, A. and Engelh, K., 'Computing Our Future'.

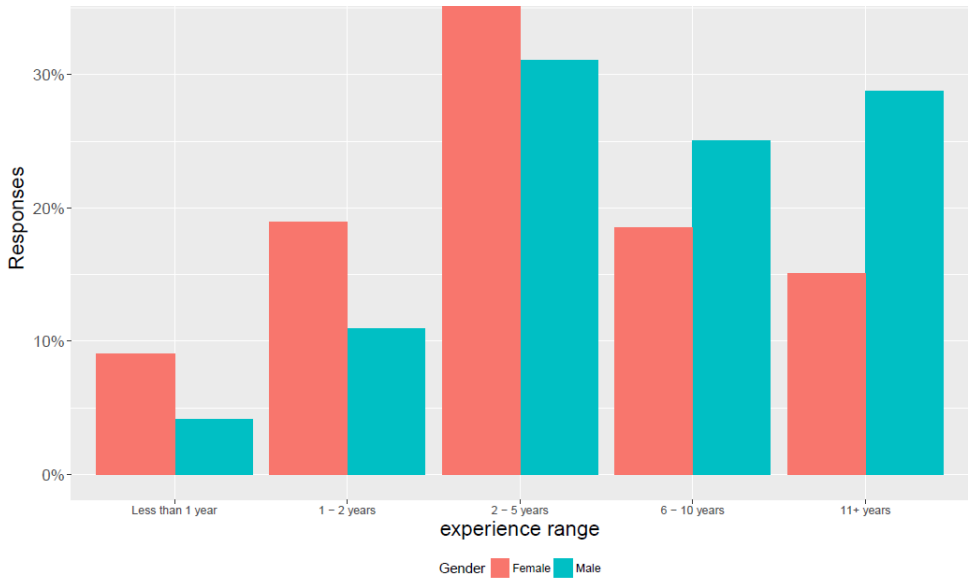
added variable allows us to gather a gender perspective when it comes to who is in the software development sphere.

The most up-to-date results available are those from 2016. That year, 56,033 coders from 173 countries participated in the survey and 5.76% of them were women. Considering that around 10% of their 40 million monthly visitors are women, they are even less represented in the survey than in the community. Since the sample is very wide and quite representative of the developers' community, it seems worth analysing the results by gender[53].

An analysis using data from EU28 has been made. This data includes results from 998 women out of a total of 22.786 coders and software developers (4,4%)[54].

When analysing the results of the survey from a gender perspective, some differences arise. On average, female coders have less years of experience than males. A great majority of the female participants in the survey had 5 years or less of programming experience, while more than half of the male respondents had 6 years or more experience.

Figure 31. Experience range of developers by gender



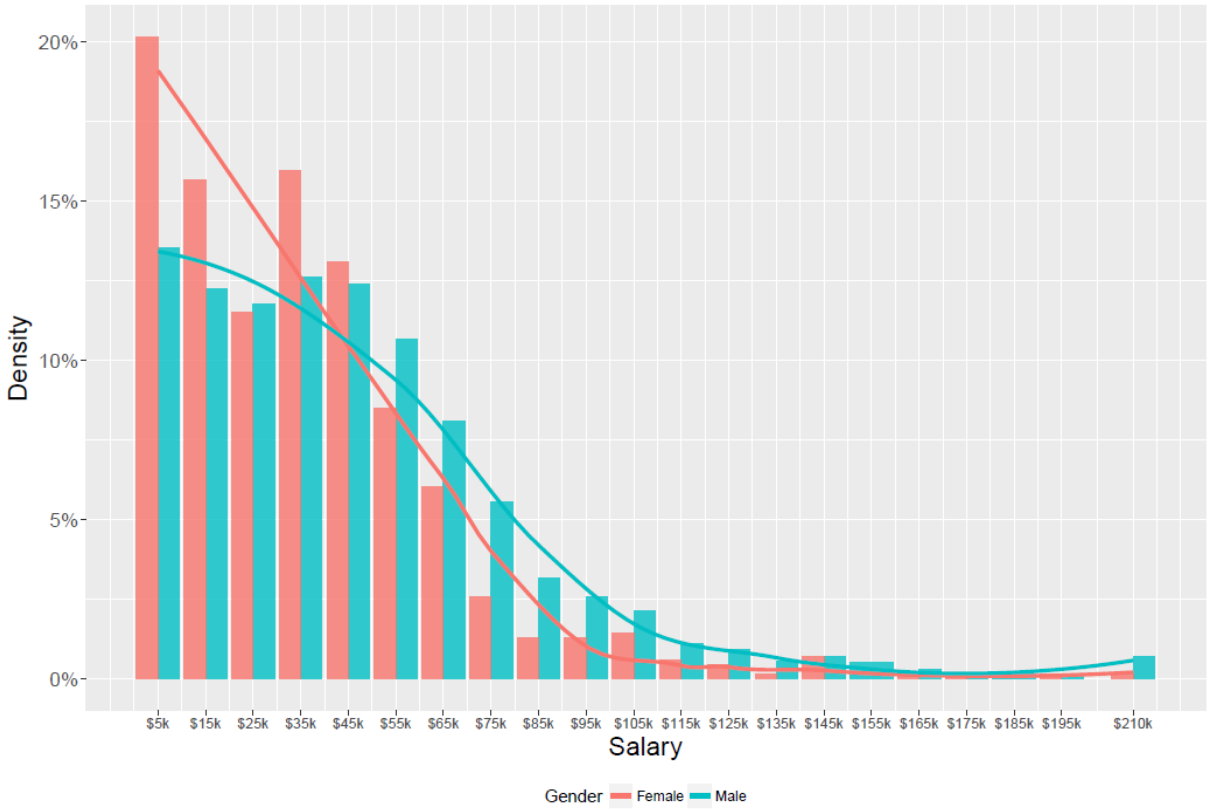
Source: prepared in house based on Stack Overflow Developer Survey 2016

53 The effect of the so-called self-selection bias should also be taken into consideration, as well as the fact that the survey was only available in English what results in a bias against those developers who don't speak this language. For that reason we will focus more on the trends identify than the concrete figures.

54 1,16% of the respondents preferred not to disclosure their gender and 0,4% selected the option "Other".

The lower levels of experience of female programmers are reflected in their salaries. Women's annual gross earnings are mostly below 40,000 US$, and the percentage of women with earnings below 20,000 US$ a year is 10 percentage points higher than that of their male counterparts.

Figure 32. Salary of developers by gender

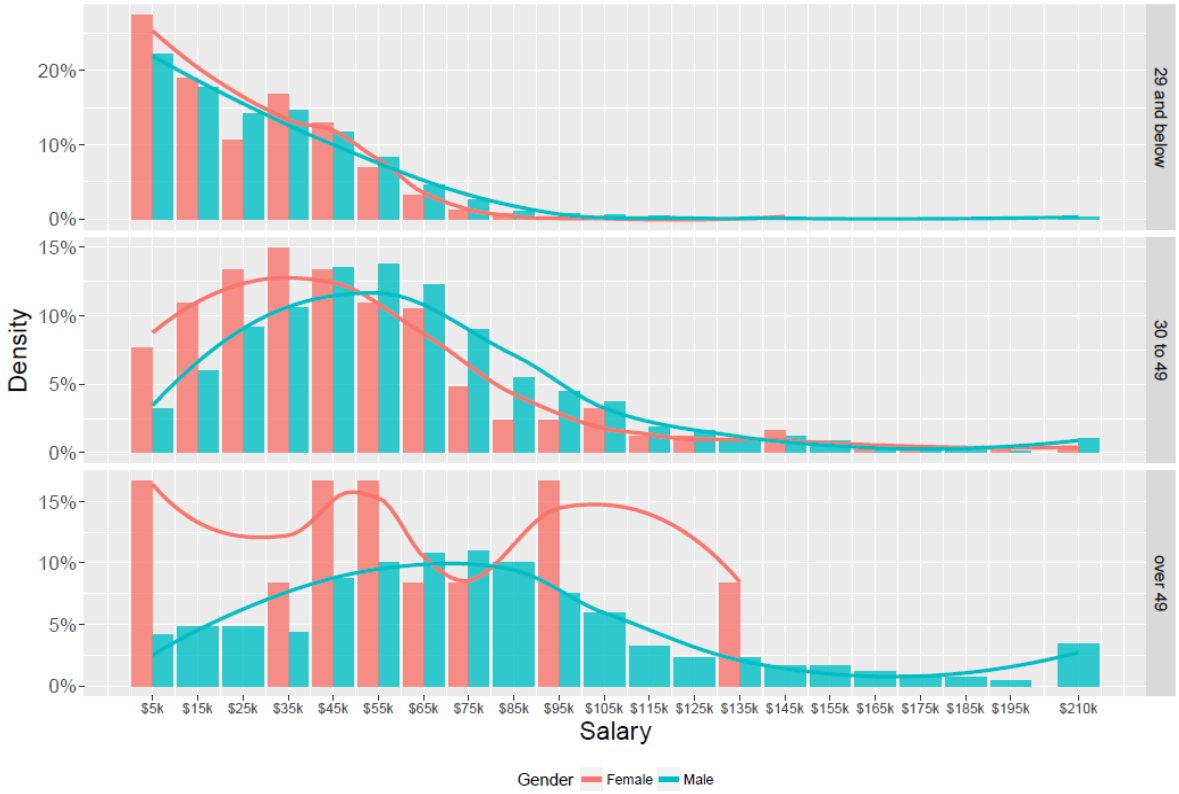


Source: prepared in house based on Stack Overflow Developer Survey 2016

Here an OLS regression was performed in order to calculate the gender payment gap among coders in Europe. The unadjusted payment gap is 26.5%, but the adjusted payment gap is 4.8%. By just using the unadjusted payment gap one is not taking the impact of comparing the gender gap between coders with lower levels of experience into consideration to see if there is still a gap, which is why the adjusted payment gap was calculated. For the adjusted payment gap the following variables were controlled: age, occupation, employment status (student, self-employed, unemployed, employed full or part time, etc.), the industry they work in, experience and the size of the company they work for. That means that even when comparing similar women and men in all those aspects, women’s average earnings are still 4.8% less than their male counterparts.

Using again a descriptive analysis of the results by age group, most significant differences appear in the group of 30 to 45 year olds[55].

Figure 33. Salary of developers by gender and age group



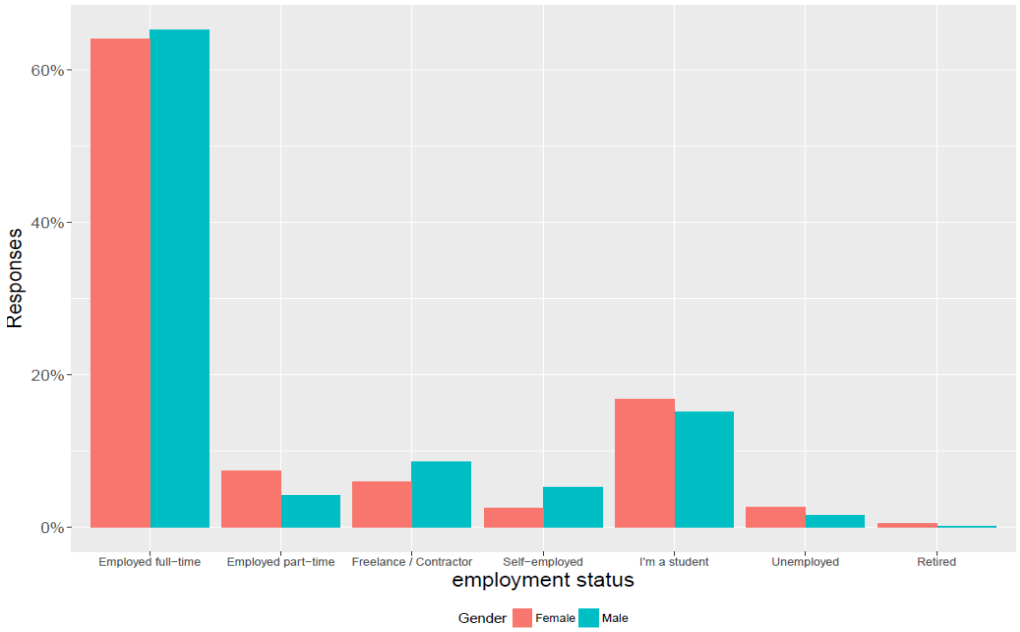
Source: prepared in house based on Stack Overflow Developer Survey 2016

Female and male programmers do not show significant differences regarding the type of technology they use for coding, their field of occupation or the industry they work for.

When looking at employment status, the differences between men and women are small and most respondents replied that they are employed full-time. Women surpass men in the percentages for employed part-time, students and unemployed. Men are slightly more likely to be self-employed or freelance than women.

55 We have excluded from the analysis those over 49 years old because the low number of female observations in Europe in that age range reduces the reliability of those particular results.

Figure 34. Employment status by gender

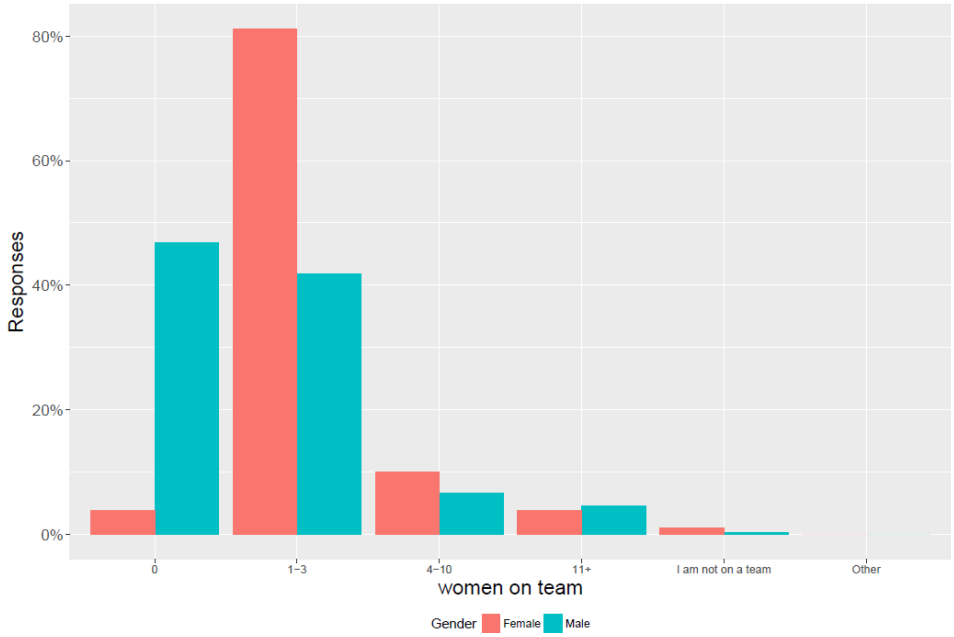


Source: prepared in house based on Stack Overflow Developer Survey 2016

Female and male coders tend to work in companies of similar sizes, mainly small and medium size enterprises, and within teams of similar sizes, normally teams of up to ten people. The difference begins to show when one looks at the levels of gender diversity within the teams that these female and male coders work in.

Around 95% of female coders and software developers in the EU report to working with at least one other woman, while almost half of men work in teams with only male colleagues.

Figure 35. Number of women in the working team of the respondent

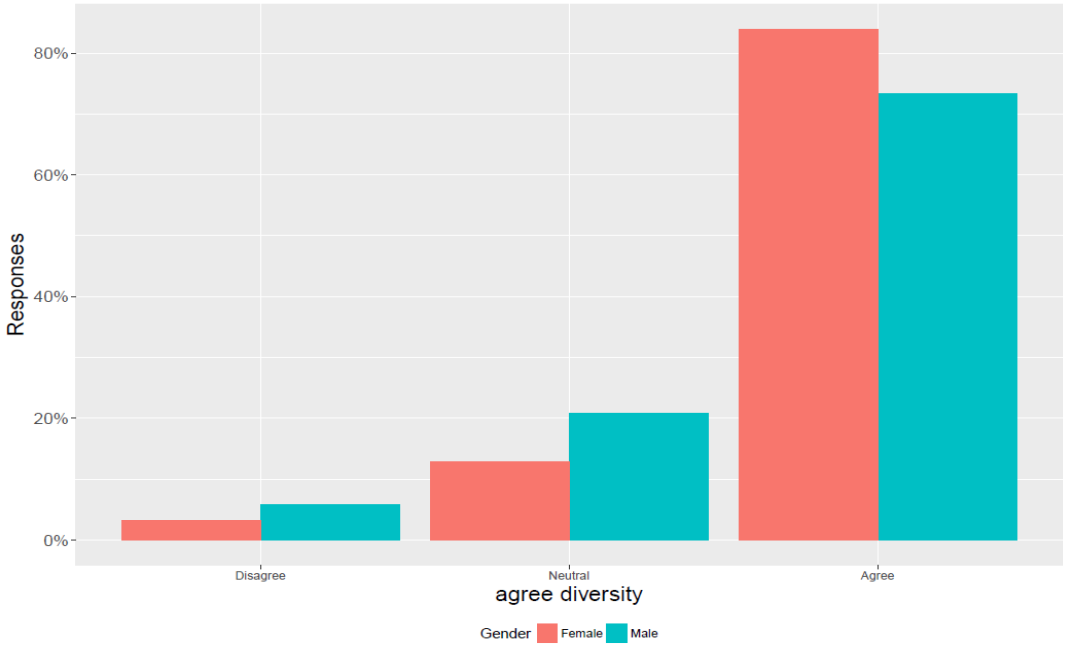


Source: prepared in house based on Stack Overflow Developer Survey 2016

These data confirm these findings that women in the ICT sector tend to work in working environments with a high female presence

Interestingly enough, the report indicates that diversity is an important matter for developers, with 73% of them underlining diversity in the workplace as at least somewhat important and 41% responding that diversity is very important. By gender, diversity is more important for women than men, even though over 70% of men also agree that diversity in the workplace is important.

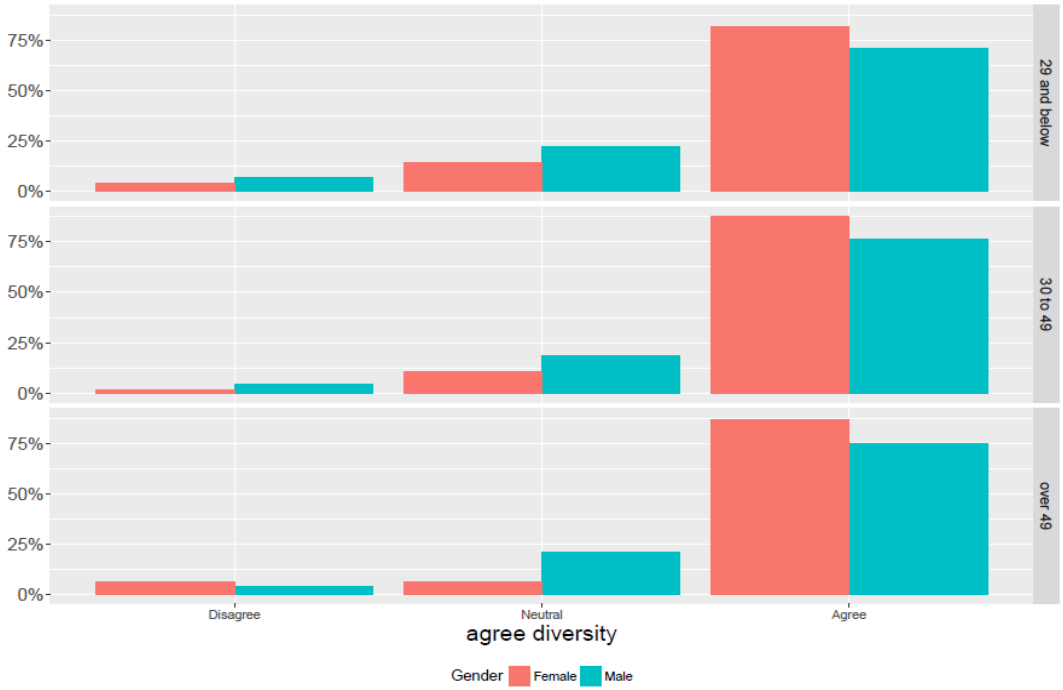
Figure 36. Respondents who agree that diversity in the workplace is important by gender (%)



Source: prepared in house based on Stack Overflow Developer Survey 2016

The importance of diversity in the workforce increases slightly with the age of respondents.

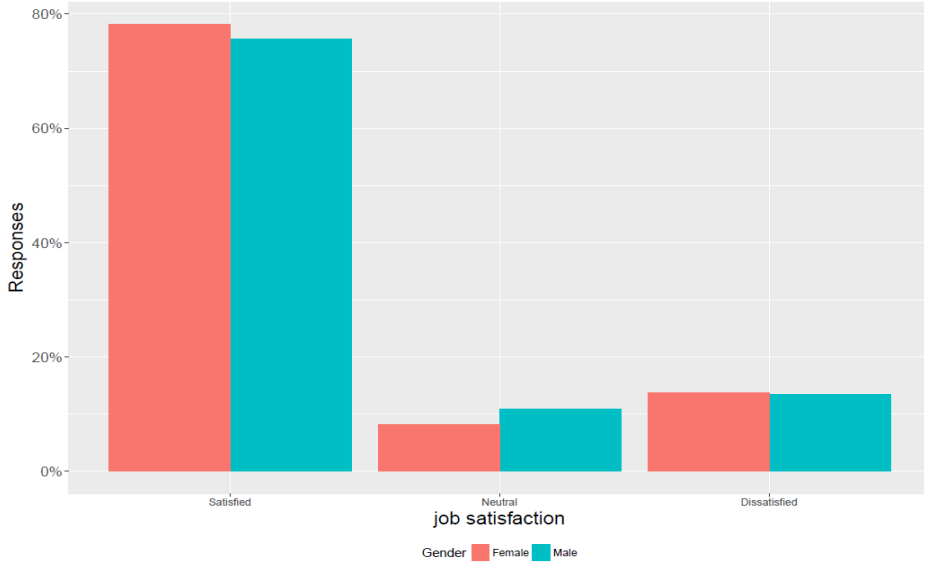
Figure 37. Respondents who agree that diversity in the workplace is important by gender and age group (%)



Source: prepared in house based on Stack Overflow Developer Survey 2016

No significant gender differences have been found when it comes to job satisfaction. Over 75% of coders report to be satisfied with their job, with females reporting being slightly more satisfied than men.

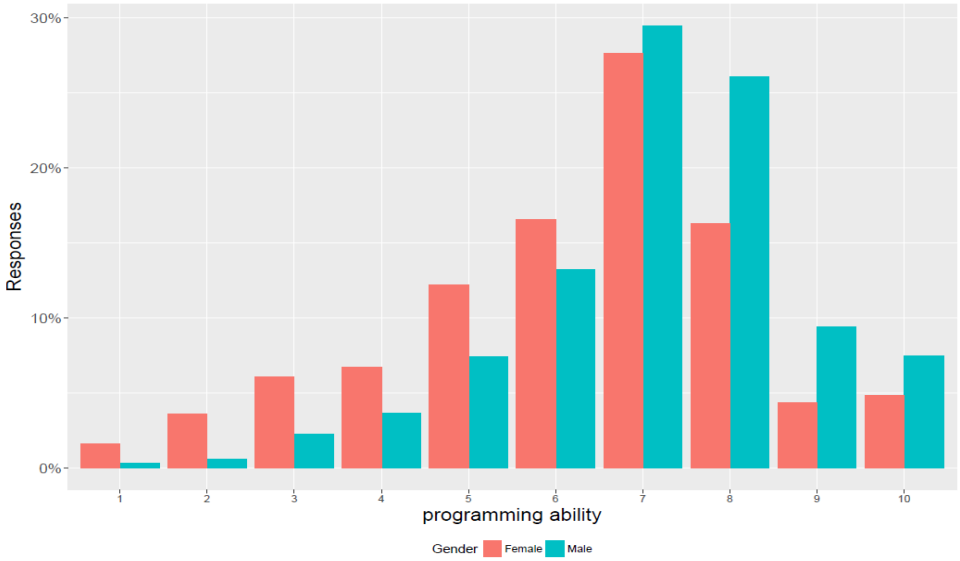
Figure 38. Level of satisfaction with current job by gender



Source: prepared in house based on Stack Overflow Developer Survey 2016

Differences arise again when it comes to how female and male coders rate their programming ability. Using a 1 to 10 scale, over 70% of the male respondents rate themselves as having a 7 or higher programming ability while only around half of the women respondents did.

Figure 39. Self-reported programming ability by gender



Source: prepared in house based on Stack Overflow Developer Survey 2016

The fact that females in the survey have less coding experience than men could lead one to think that this is the reason why women have a lower self-perception of their own abilities. However, when looking at the analysis on the effect of gender on the self-perception of coding abilities, the results show that women give themselves lower rates than men do with the same years of experience[56]. Even when holding the variable "experience" constant, women still tend to underestimate their programming abilities compared to their male counterparts. These results confirm the so called "confidence gap" that clearly affects women in the ICT sector and the digital sphere. Women are less self-assured about their digital skills than men.

56 We have performed two different analysis to control the effect of the variable "experience" in the rating of their own programming ability. We first applied a OSL lineal regression model. The resulting coefficient is -0.88 without controlling for experience and -0.496 with control, meaning that although the gender difference is lower when the control is applied, women still show statistically significant less confidence on their abilities than men for the same level of coding experience. The second analysis aimed at calculating the semi-elasticity of the regression. The result pointed also in the same direction, women rated as average their skills -16.9% compared to men without control and -10.4% controlling for experience.

The case of IronHack

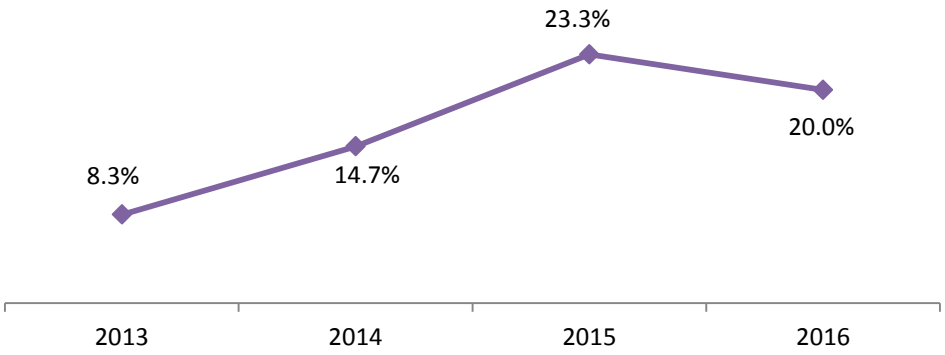
IronHack[57] is an educational start-up founded in 2013 in Spain. Today it is one of the world's top-ranked coding and design schools that offers accelerated learning experiences in Madrid, Barcelona, Miami and Paris. They help motivate students who are changing careers or want to turbo-charge their professional trajectory through courses in web development and UX/UI that range in length from 3 to 6 months. Their courses are known for having an innovative educational approach and the curriculum focuses on teaching programming using best practices and agile methodologies that are applicable in real-world settings.

Wallapop[58] is a virtual marketplace, an app where people buy and sell products nearby, through geo-positioning technology. It is a start-up that was born in 2013 and today has more than 30 million users that have given second homes to more than 3,523,489 items.

Problem addressed

The gender gap in the developer community shows a striking difference. This gap was clear from the beginning of Ironhack's program and the global trend mentioned earlier was reflected in the female participation ratios for the company courses. The proportion of women has been less than a quarter of all enrolled students since the firm was founded.

Figure 40. Evolution of women's participation in IronHack courses



Source: prepared in-house, based on Ironhack data (2016)

At Wallapop, a tech start-up, more than 90% of the applications received for technical positions in the company, such as mobile or back-end developers, were submitted by

57 www.ironhack.com/en

58 www.wallapop.com

men. The fact that so few women are applying to this start-up is affecting the diversity of Wallapop's workforce; less than 5% of technical positions are filled by women.

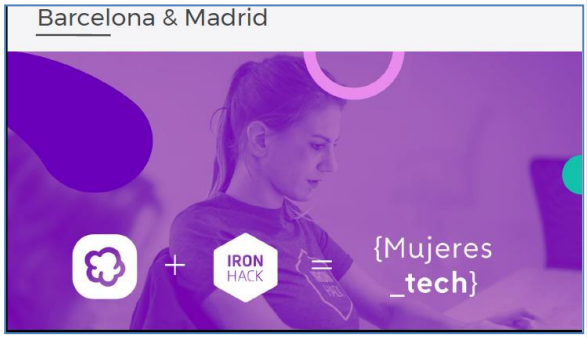
The initiative

Ironhack is an educational company with no specific focus on women; however, they are aware of the gender gap in the sector and are looking for innovative ways to solve it. Since 2013 they have offered partial and full scholarships for women and girls for the company's coding and development courses. Even with the scholarships, though, the company is still facing problems increasing female participation. For 2017, the company has set a **goal of 30%** female participation in their training programs.

In search for innovative ways to connect with/motivate women that might be interested in developing and/or improving their digital competencies, the people at Ironhack looked for specific means to help reach females.

In 2015 it implemented a promotional campaign in Miami that consisted of offering a number of scholarships, for both men and women, together with Uber. Based on this experience, Ironhack proposed that Wallapop launch a campaign targeting only women.

Wallapop has more than 20 million registered users in Spain which provides a higher ratio of possibly interested women that Ironhack could reach. In this sense, the alliance with Wallapop was particularly attractive because ecommerce apps are among the most used applications by women.



As a result of the cooperation agreement of both start-ups a campaign was launched on Women's Day, March 8th 2017 on Wallapop, which advertised the initiative during 14 days.

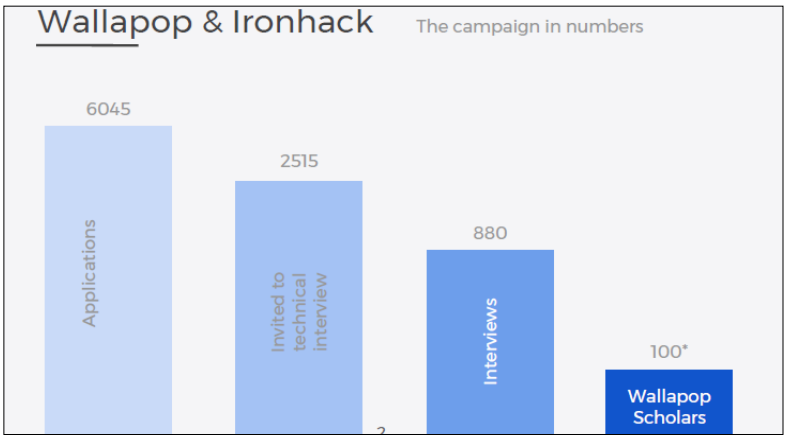
The agreement included the following actions:

- Scholarship of 1.000 € for all women participating in their programs
- Communication campaign with Wallapop consisting of:
    - On International Women's Day, March 8th, a joint campaign was launched (open only in Spain until March 22nd 2017 for women over 18 years of age) that was promoted both by Ironhack and Wallapop though the app. It consisted of:
        - Full Scholarship: 10 scholarships of 6.500 € for a Bootcamp or Part time course on Web Development or Bootcamp UX/UI Design during 2017.
        - Partial Scholarship: 90 scholarships of 1.500€ for a Bootcamp or Part time course on Web Development or Bootcamp UX/UI Design in 2017.

Results and lessons

6,045 applications were received after the initial advertising appeared on the Wallapop app. From those, 880 women were interviewed and 100 Wallapop scholarships were awarded.

Figure 41. Women's Day Wallapop & Ironhack campaign in numbers



Source: Ironhack, 2017

The initiative surpassed the expectations of its promoters. Ironhack had previously carried out other similar strategies in collaboration with other startups (Uber) in order to increase the number of students. On that occasion, around 4,000 applications were received. Although this earlier initiative was not focused on recruiting women specifically, but rather addressed both men and women, the figures for the Ironhack-Wallapop initiative give evidence on how successful it was, in light of the fact that the target group was more limited (only one gender).

According to Ironhack, the profile of applicants and awarded students is mostly that of women with higher educational background who are interested in complementing their regular training with digital skills to help improve their career prospects.

In fact, according to its data on alumni, the courses are not only positively affecting the average annual salary (23,600 €) and employability ratio (91.4%) of those who have been trained, but they have also helped reduce the gender pay gap and provided a better work-life balance. As an example, the company mentions the flexibility of being able to work at home as one of the advantages enjoyed by experienced developers.

Many of the students that applied for the scholarships had never heard of Ironhack before, and in many cases they hadn't considered attending a coding course before. Since Ironhack has a strict selection process for candidates, aimed at guaranteeing the success of the student in the course and the finalization of the program, students that finally got the grants already had, to a certain extent, some design or coding experience[59]. The large number of people interested in the courses showed that the

59 Although Ironhack does not include previous coding experience among its pre-conditions for selecting a candidate, they do look for certain characteristics of the students, such as motivation and logical thinking.

use of new channels like apps can improve the awareness and participation of women in coding and design courses.

Additionally, the media were highly interested in this initiative[60]. Media impact was a supplementary benefit of this initiative because with each strong outcome from an initiative like the Ironhack-Wallapop one, the more likely the media is going to cover other initiatives by tech companies which will increase awareness of these companies to a larger audience.

The level of commitment of the companies involved in this initiative could leave one to think that other firms in the tech sector could be interested in testing new communication channels to reach females and close the gender disparity on this matter. By doing so it can help companies enhance their talent pools and reduce the lack of diversity in the design and development of newer, cutting-edge products and services.

60 CincoDías Newspaper, 'Wallapop y IronHack Lanzan Un Programa de Captación de Talento de Mujeres'.

Expansión, Financial Newspaper., 'Wallapop Se Alía Con Ironhack Para Potencias La Presencia de La Mujer En El Sector TIC'.

Genbeta Newspaper, 'Wallapop y IronHack Ofrecerán 200,000 Euros En Becas Para Formar a 100 Mujeres En Tecnología'.

INJUVE - Ministerio de Sanidad, Servicios Sociales e Igualdad, 'Becas Wallapop'.

La Vanguardia Newspaper, 'Wallapop Se Alía Con IronHack Para Formar a Mujeres En Programación'.

3. Female digital entrepreneurship

3.1 Data and trends: little progress and large differences between countries

Female entrepreneurship in the economy as a whole

Female entrepreneurship contributes significantly to economic growth and reduces poverty not only in emerging countries but also in industrialized countries[61]. In addition to increasing employment rates, women's entrepreneurship enhances diversification of businesses through more diverse innovation processes, management and marketing practices. In OECD countries, the number of female-owned businesses stands at around 30% of total businesses.

Nowadays, technological innovation is a catalyst for economic and social development. The G20 Young Entrepreneurs Alliance calculated that the digital economy contributes up to 8% of GDP in G20 countries and shows an upward growing trend[62]. The study highlights that digital transformation is a considerable opportunity to boost female entrepreneurs, particularly the younger generations which have grown up in close interaction with digital technologies.

Focused on the high-technology industry in Europe, almost half of startups belong, nowadays, to the digital economy: 48.9% of startups are related to innovative technologies and/or business models[63] [64]. Nevertheless, from the 2,515 startups and 6,340 founders analysed by the 2nd European Start-up Monitor, only 14.8% of founders were female which represents an increment of 0.1 percentage points in comparison with 2015.

The percentage of female entrepreneurs, by EU member state, for all economics activities[65] is provided in Figure 42.

61 EIGE - European Institute for Gender Equality, 'Gender in Entrepreneurship'.

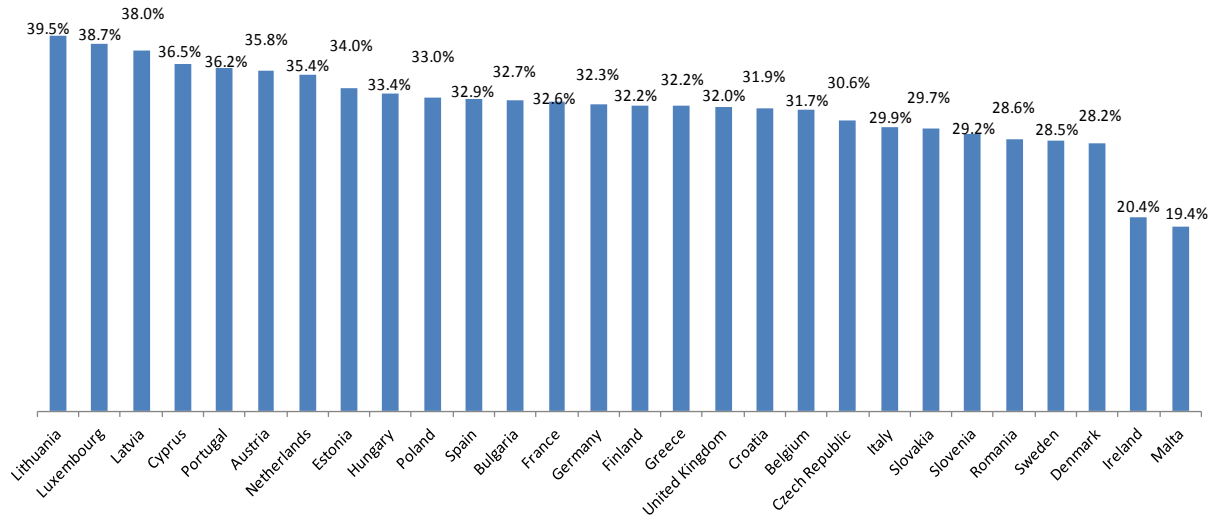
62 Ernst and Young, 'Disrupting the Disruptors. Disrupting Youth Entrepreneurship with Digital and Data: The Digital Opportunity to Empower Young Entrepreneurs for Growth'.

63 Kollmann and Hensellek, 'European Startup Monitor'.

64 The figure includes startups located in Austria, Belgium, Cyprus, Finland, France, Germany, Greece, Hungary, Ireland, Israel, Italy, the Netherlands, Poland, Portugal, Slovenia, Spain, Switzerland and UK.

65 All NACE activities

Figure 42. Percentage of female self-employed in EU-28 (2015)



Source: prepared in-house, based on Eurostat (2015)

The analysis by country shows great differences between percentages ranging from 19.4% in Malta to 39.5% in Lithuania, the member state with the highest rate of female entrepreneurs.

In 2015, the Female Entrepreneurship Index (FEI)[66] analysed the situation of female entrepreneurs in a total of 77 countries and scored them from 0 to 100. They did this in accordance with an evaluation of factors related to Entrepreneurial Environment, Eco-system and Aspirations in order to identify those factors that boost high potential for female entrepreneurs. Six countries in the European Union[67] are among the top ten for female entrepreneurs: the U.K., Denmark, the Netherlands, France, Sweden and Finland.

Table 1. FEI 2015 - Top ten countries for women in entrepreneurship

Rank	Country
1	United States
2	Australia
3	United Kingdom
4	Denmark
5	Netherlands
6	France
7	Iceland
8	Sweden
9	Finland
10	Norway

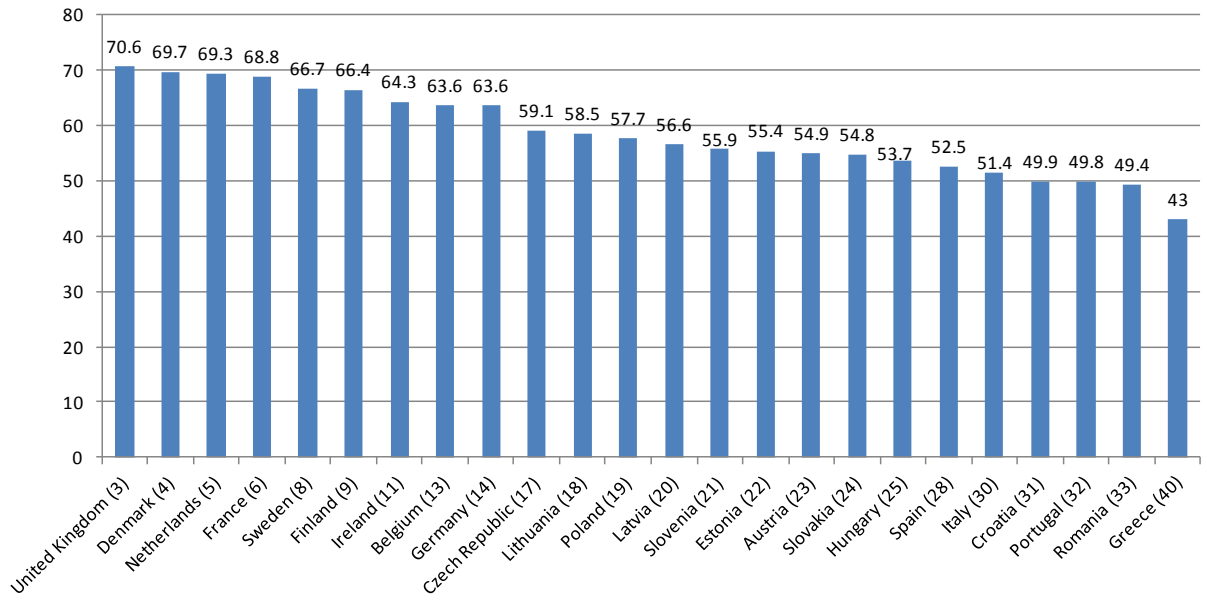
Source: FEI (2015)

66 S. Terjesen, A. Lloyd, 'The 2015 Female Entrepreneurship Index'.

67 EU countries such as Bulgaria, Cyprus, Luxembourg and Malta are not part of the study.

All of the EU countries involved in the study were ranked among the top forty positions (see Figure 43). The evidence suggests that the European countries part of the study show suitable conditions to have higher numbers of women in entrepreneurship. Their findings for the European region in particular have pointed out high levels of education and access to learning programmes for women to improve business skills through SME support and training. Conversely, findings also show that self-perception of females on their start-up knowledge and skills, as well as the identification of good opportunities to start a business in Europe have been identified as points that need to be improved. These weaknesses might explain the scarce number of new businesses. According to the Global Entrepreneurship Monitor[68], in 2016 Europe not only had the lowest female involvement in early-stage activity of all the regions analysed (6%), but also the lowest gender parity. Furthermore, it stated that European women were half as likely to be engaged in Early-stage Entrepreneurial Activity (TEA)[69] as men.

Figure 43. Scores obtained by the EU countries according to FEI 2015



* The numbers in parentheses indicate the FEI 2015 global rank obtained by the EU country

Source: prepared in-house, based on FEI (2015)

68 Babson College et al., 'GEM - Global Entrepreneurship Monitor. Global Report 2016/2017'.

69 Total Early-stage Entrepreneurial Activity (TEA) is defined as the percentage of adult population in the process of starting a business or who own a business which is less than 42 months old.

3.2 Women entrepreneurs in the ICT sector in Europe: characteristics and perceptions of their working conditions alongside a growing payment gap

According to the European Working Conditions Survey (2015)[70], in the labour market as a whole, female entrepreneurs represent 37% of the total number of entrepreneurs in Europe. 23.4% of entrepreneurs in the ICT sector in Europe are women. Five years before, the figure was slightly below at 20%. This indicates that progress is being made, but at a very slow pace.

Although women are underrepresented as entrepreneurs in all sectors, their low presence in the ICT entrepreneur ecosystem is particularly relevant since they represent less than a quarter of total entrepreneurs.

Despite the scarce percentage of women in entrepreneurship, female-owned digital startups are more likely to be successful than those of their male counterparts[71] and investments in female-founded startups perform 63% better than exclusively male-founded startups[72].

What are the characteristics of women that decide to run their own business, or become self-employed, in the ICT sector in Europe?

The average age of women entrepreneurs in the ICT sector in Europe has not varied significantly in recent years. Female entrepreneurs are, on average, slightly older than dependant workers in the sector (43 years old vs. 40) and 3 years younger than male entrepreneurs in the ICT sector. Female entrepreneurs in the ICT sector are also younger than self-employed women in other non-ICT service sectors, where the average age is 46.5 years.

What has increased notably in recent years is the educational level of entrepreneurs in the ICT sector. The level of education for female entrepreneurs is higher than that of their male counterparts, higher than the average level of education compared to the other female workers in that sector and significantly higher than the average educational level of female entrepreneurs in other service sectors.

This has a reflection on the type of jobs carried out by women entrepreneurs in ICT. Almost all women who are self-employed in this sector today are managers or professionals (over 83%), 10 points more than men, while just five years earlier the percentage of men in these kinds of positions was higher than that of women. At the same time, women occupy technical positions less than before, while around 25% of male entrepreneurs still have technical jobs.

---

70 The survey includes 32 European Countries. The last available wave of the survey is from 2015 and the `previous data is from 2010.

71 Roland Berger, 'Digital Equality? Women in the Digital Revolution'.

72 Harvard Business Review, '4 Factors That Predict Startup Success, and One That Doesn't'.

Gender differences related to working conditions among entrepreneurs have been analyzed and comparisons made between female entrepreneurs in the ICT and non-ICT sectors[73]. This analysis includes the following aspects:

- Overall Satisfaction
- Feeling of Job Well Done
- Stress
- Wages

Regarding overall satisfaction, female entrepreneurs responded positively to the question on how satisfied they are with their working conditions (87% positive responses) at the same level as other female workers in the same sector. This number is slightly lower than that obtained for male entrepreneurs in the ICT sector (94% positive responses) and also slightly lower than that obtained from entrepreneurs in non-ICT service sectors (90% positive responses). However, when female entrepreneurs answered whether or not their job gave them the feeling of a job well done, positive responses were higher than that of their male counterparts in the ICT sector (95% positive responses for females vs. 90% for males), than that of other female workers of the ICT sector (82% positive responses) as well as that of entrepreneurs in other sectors (92%). Additionally, women entrepreneurs in the ICT sector experience less stress at work (23% positive responses) than males (28%) and other female workers in the sector (30%); they had very similar results to that of female entrepreneurs in other sectors (23%).

One significant trend regarding female entrepreneurs in the ICT sector in Europe is that women tend to work in larger companies than in the years before. In 2010, almost all female entrepreneurs worked in micro-enterprises (less than 10 employees), with most as solo entrepreneurs with no people working under their supervision, and as freelancers, at a higher rate than men. Although this is still the general situation for most European entrepreneurs in the ICT sector in Europe with around 88% for both males and females; nowadays, there are almost no differences in the size of the firms which both men and women work in. Men, though, are twice more likely than women to have people working under their supervision and the average size of the teams under their supervision doubles that of female entrepreneurs.

Existing research shows that, in the economy as a whole, more women entrepreneurs tend to go solo as freelancers working on their own or operate in smaller companies than male entrepreneurs[74]. In the ICT sector in particular this seems to be also the case;

---

73 Since the total number of observations of female entrepreneurs as a whole is very low (69 observations in the ICT sector) we group all 33 countries and describe average conditions for entrepreneurs for all 33 European countries. For all of the questions, the value 1 signifies when the individual responds positively to the question (i.e. agrees or says "yes") and zero otherwise. Therefore, even if the answer to the question is a negative one, the mean values are always between 0 and 1. These (weighted) mean values show the different experiences men and women as entrepreneurs in both ICT and non-ICT sectors have.

74 European Parliament. Directorate-General for Internal Policies, 'Women's Entrepreneurship: Closing the Gender Gap in Access to Financial and Other Services and in Social Entrepreneurship'.

however, there is a trend towards greater gender balance when it comes to the size of companies where entrepreneurs work.

Summing up, **female entrepreneurs in the ICT sector are overall satisfied** with their work, have a greater sense of achievement following well-executed work and they **experience relatively low levels of stress.** However, **they are worse paid** than their male counterparts.

In 2010, on average, females earned about 20% less than their male counterparts, a gap that was similar with two comparison groups: (1) entrepreneurs in the ICT and non-ICT sectors, and (2) entrepreneurs and non-entrepreneurs within the ICT sector. In 2015, the ratio of hourly wages of female and male entrepreneurs shows that the differences in GPGs have significantly increased. While **the GPG among male and female entrepreneurs in the ICT sector has increased, reaching 30%,** the gap between female and male entrepreneurs in non-ICT service sectors has fallen to 15% and the GPG among employees in the ICT sector (non-entrepreneurs) is less than 12%. **The average hourly wages of female entrepreneurs in the ICT sector is slightly higher than the average hourly wages of female entrepreneurs in other sectors**.

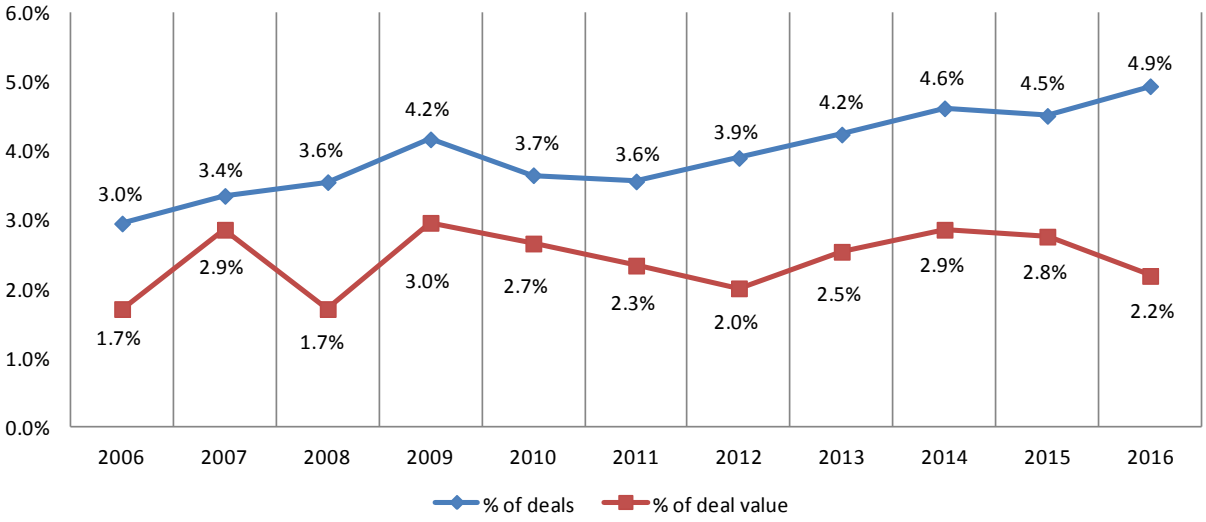
3.3 Trends in female start-up investments: difficulties in accessing funding

Start-ups with female founders obtained 4.9% of all global venture capital deals[75][76] in 2016; approximately two percentage points higher than in 2006, the highest percentage of deals in the past decade. Data reveals that average investments in female led entrepreneurships have a negative trend during the last three years, falling 0.7 percentage points since 2014.

75 V. Zarya, 'Venture Capital's Funding Gender Gap Is Actually Getting Worse'.

76 Data obtained from PitchBook database

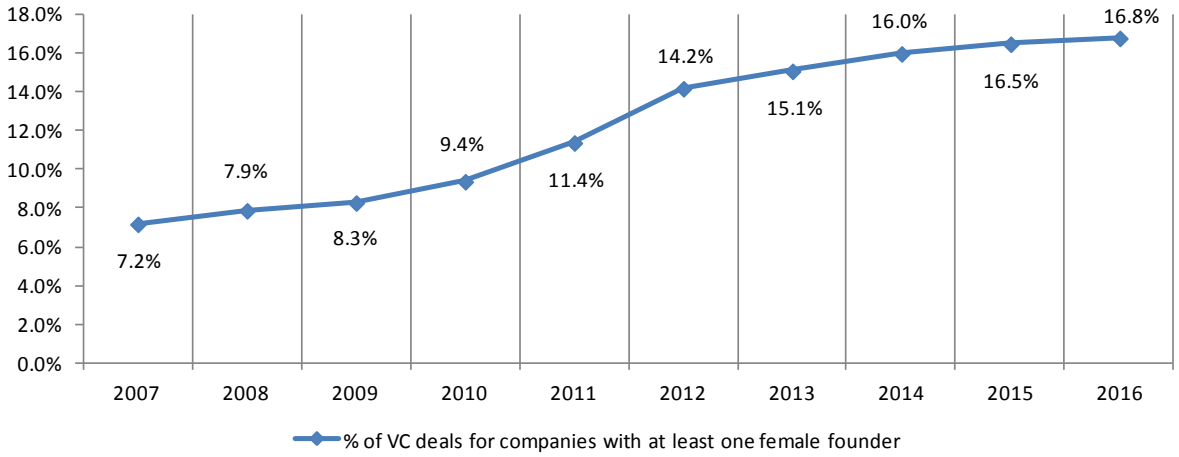
Figure 44. % of VC deals and value for 100% female founders (globally)



Source: Fortune (2016)

On a global basis, the percentage of companies with at least one female founder that have reached Venture Capital (VC) deals continues to show a positive trend in 2016[77]; 77% based on the figures. In Europe, this percentage stood at 16.1%; however, when figures of VC deals in mixed gender founding teams are examined, only 23% of companies with all female founders had completed a deal in 2016.

Figure 45. % VC deals for companies with at least one female founder (globally)

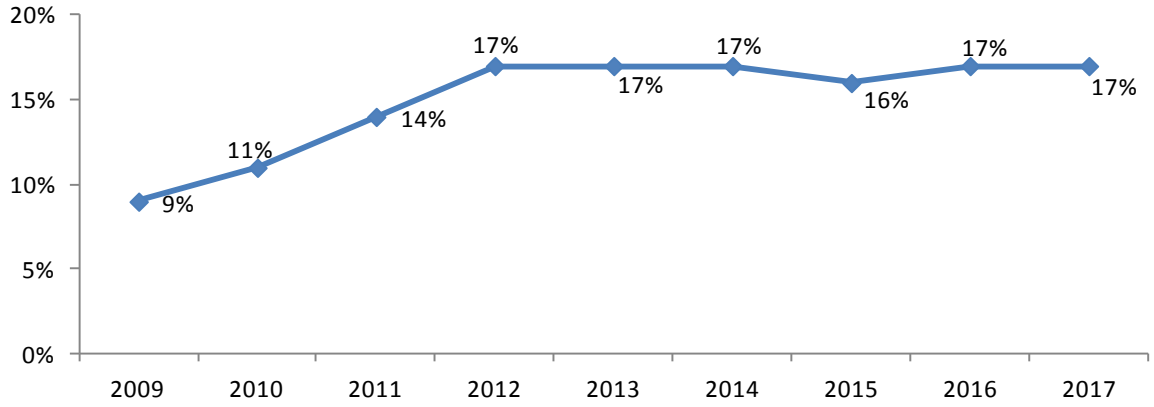


Source: PitchBook (2016)

77 PitchBook, 'Female-Founded, VC-Funded'.

Data from Tech Crunch show similar figures, but reveal stagnation in recent years at the global level. During the period from 2010 - 2015, 12% of venture rounds and 10% of venture capital went to start-ups with at least one female founder. Regarding seed rounds, these figures reached 17% and 15%, respectively[78].

Figure 46. Funded startups with a female founder (globally)



Source: prepared in-house, based on data from Crunchbase (April 2017)

In Europe, the figures are not more promising. In the U.K., one of the largest start-up hubs, male entrepreneurs are 86% more likely to obtain venture capital funds than women. Regarding secure angel investing, the likelihood is 59% higher[79].

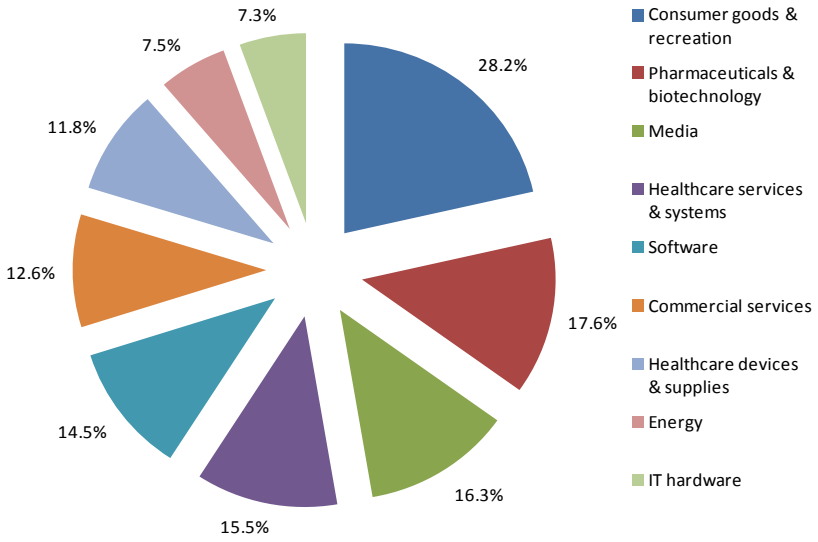
By sector, Consumer Goods and Recreation was the industry with the highest number of deals (28.2%) in 2016 for a company with at least one female founder. When looking at the technology sector, 14.5% were reached by the Software Industry and 7.3% by IT Hardware Companies[80].

78 G. Teare, N. Desmond. TechCrunch, 'The First Comprehensive Study on Women in Venture Capital and Their Impact on Female Founders'.

79 Fanshawe, 'Startup DNA'.

80 PitchBook, 'Female-Founded, VC-Funded'.

Figure 47. % VC deals involving at least one female founder



Source: PitchBook (2016)

Female investors and female entrepreneurs

In 2016, 7% of investing partners at the top 100 global ventures and micro-venture firms[81] were women and 38% of them had at least one female investment partner[82]. Slightly less than 12% of the partner roles at accelerators and corporate venture firms are held by women. Over the period spanning 2014-2016, 16% of newly set up venture and micro-venture firms had at least one female founder; 4 percentage points higher when looking at a period covering five years. In light of this positive trend, greater growth of venture firms with female founders might be a key element to boosting the number of female partners on a long-term basis. Existing literature shows that venture capital firms founded by women are more likely to hire female partners for their firms.

In accordance with the European Early Stage Market Statistics[83], angel investment has experienced a positive growth of 8.3% for the period spanning 2013-2015, which represents 71% of European early stage investment (6.1 billion €). By sector, ICT stands to gain the higher percentages for investments and the number of deals, 22% and 37% respectively; however, according to the 2015 Female Entrepreneurship Index[84], the global percentage of female businesses running within the technology sector has decreased by 19%. One of the problems that women are facing to start a company, a

81 To carry out the classification, it was taken into account indicators such as longevity, recent activity, rounds led and fund size

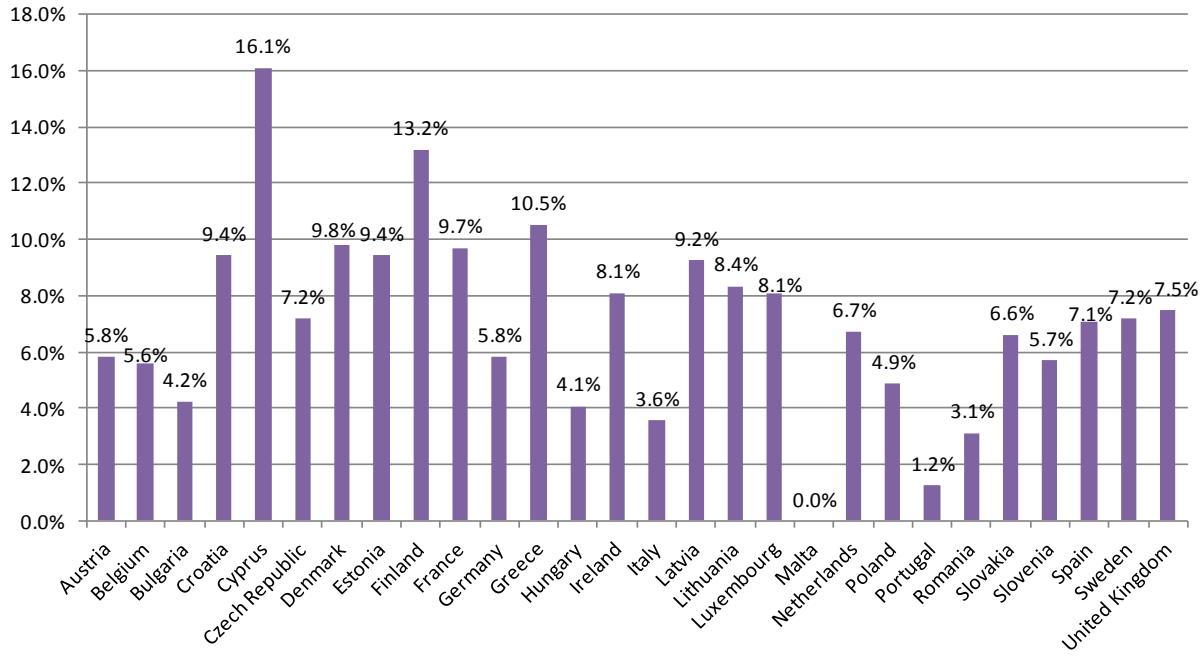
82 G. Teare, N. Desmond. TechCrunch, 'The First Comprehensive Study on Women in Venture Capital and Their Impact on Female Founders'.

83 EBAN - The European Trade Association for Business Angels, Seed Funds, and other Early Stage Market Players, 'European Early Stage Market Statistics 2015'.

84 S. Terjesen, A. Lloyd, 'The 2015 Female Entrepreneurship Index'.

tech company in particular, is the lack of access to capital in a scenario traditionally dominated by men[85]. Only 7.4% of investors who have invested in one or more start-ups are women. When it concerns women angels, this percentage stands at 7.2% (see Figure 49).

Figure 48. % of women investors (EU-28)



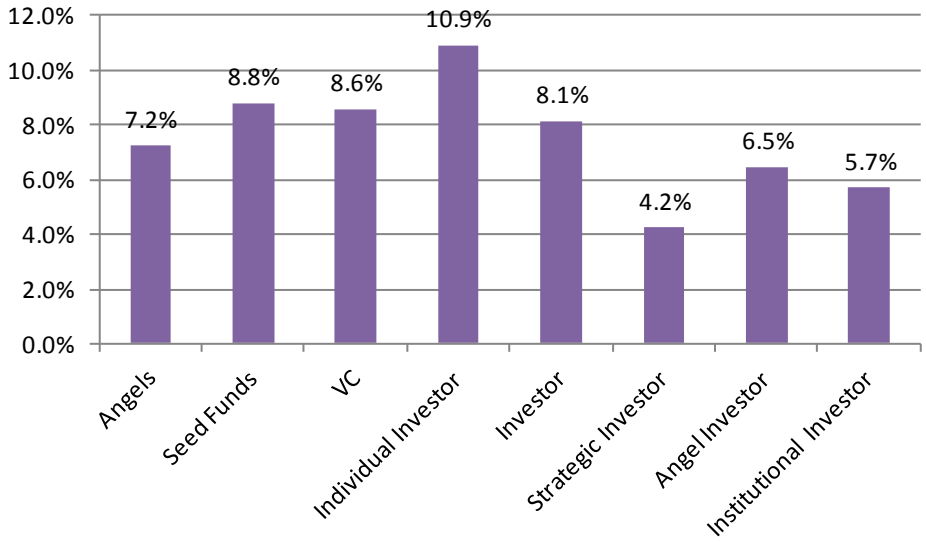
Source: prepared in-house, based on data from AngelList database[86][87] (September 2014)

85 AngelList, 'Gender Gap in Start-Ups and Access to Financing'.

86 AngelList, 'AngelList Database'.

87 According to other databases consulted (OECD-Investor by gender 2014), differences go up to 16.4 percentage points. OECD, 'Entrepreneurship at a Glance'..

Figure 49. Women's role specified in AngelList (globally)



Source: prepared in-house, based on data from AngelList database (September 2014)

Despite the increasing number of business angels worldwide, the representation of women is still scarce. As reported by the European Early Stage Market Statistics 2015[88], the percentage of female business angels has risen from 4% to 10% - more than doubled since 2013 - even reaching 30% in some BAN (Business Angel Networks). Regardless, some of these networks still record an absence of female members from their member base. This fact evinces the inequitable distribution of female business angels among the European BANs.

Although updated figures for the percentages of female business angels are not available for every EU member country, one can see from examples, such as 14% in the UK and 8% in Spain in the year 2015, the geographical heterogeneity concerning the number of female business investors. Even when the figures have increased, as they have for some countries[89], they still highlight the scarce female representation in business investment compared to their male counterparts.

88 EBAN - The European Trade Association for Business Angels, Seed Funds, and other Early Stage Market Players, 'European Early Stage Market Statistics 2015'.

89 Roure and de San José, 'AEBAN 2016. Business Angels Report'.

4. Female leadership in the digital era

4.1 The situation in the corporate world: far from achieving remarkable goals

The proportion of women in leadership roles and executive positions, both in the private and public spheres, is nowadays still far from achieving full gender equality. In fact, gender inequality in leadership positions is almost twice that of the labour force[90].

Globally, the current percentage of companies with female board members reaches 40% and more than 50% of these firms don't have any female C-suite executives[91].

The number of director seats occupied by women in large- and mid-cap global companies[92] maintains an upward trend despite a slow growth. In 2016, women held 19.1% of all director chairs[93] among MSCI World Index companies, which represents an increase of 1 and 3.2 percentage points from 2015 and 2014, respectively. In 2015, 201 new director seats were filled by women, whereas for men this figure amounted to 494. Even more startling are the numbers beyond the boardroom. Only 3.8% of CEO positions were held by women in 2016; compared to 3.5% obtained during the previous year. The representation of female CFO positions is slightly more promising, rising to 8.9% in 2016 from 8.2% in 2015.

According to the study Women in Business[94], the percentage of women in senior roles in listed mid-market businesses around the world, defined as those holding C-suite jobs, has increased from 24% in 2016 to 25% in 2017; one percentage point higher. The percentage of businesses with no women in senior leadership roles has also increased from 33% to 34%, +1 percentage point, over the same period. The study indicates that most of the positions held by women were related to human resources, with statistically significant differences above 10 percentage points compared to posts such as Chief Operating Officer (COO), Chief Marketing Officer (CMO) or Sales Director (see

Figure 50).

90 J. Woetzel, The Power of Parity: How Advancing Women's Equality Can Add $12 Trillion to Global Growth, 2015 <https://ideas.repec.org/p/ess/wpaper/id7570.html> [accessed 22 March 2017].

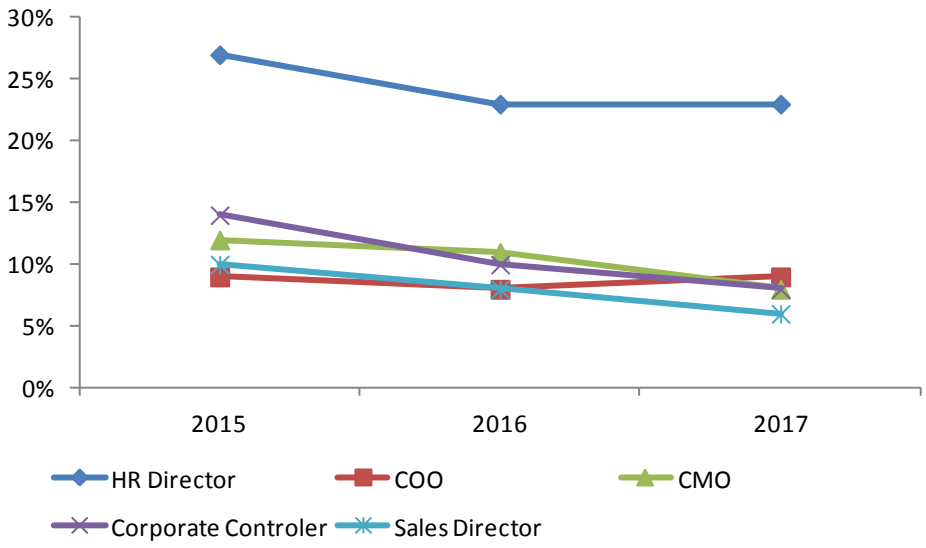
91 Pax Ellevate Global Women's Index Fund, 'Invest in Her'.

92 Large- and mid-cap global companies refer to MSCI World Index companies.

93 Eastman, M., Rallis, D., 'The Tipping Point: Women on Boards and Financial Performance'.

94 Grant Thornton, 'Women in Business'.

Figure 50. Evolution of senior leadership roles filled by women in mid-market businesses globally (2015-2017)



Source: prepared in-house, based on data from Grant Thornton (2017)

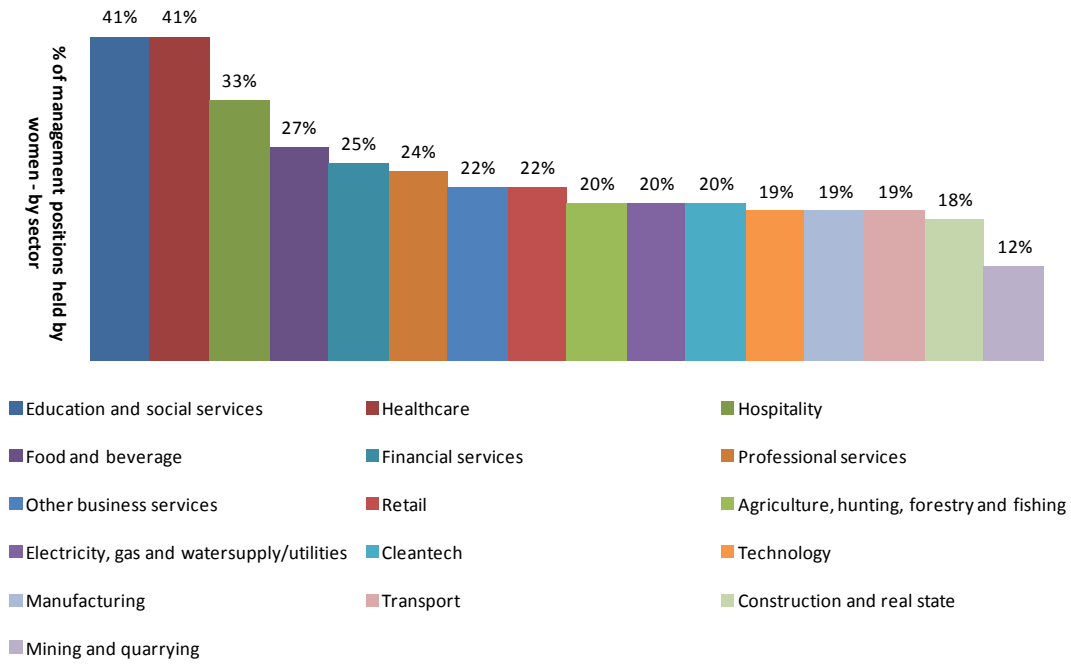
The ratio of positions of responsibility filled by women in medium-sized businesses[95] differs remarkably by industry[96]. There are certain sectors with typically more leadership positions occupied by women, like health or education, while in other industries, such as construction or manufacturing, women absent in top positions. According to the figures presented in the study, women are still underrepresented in the technological sector; only 19% of management positions[97] in this sector are occupied by female bosses. Only mining and quarrying and construction have lower rates of women in senior management positions.

95 The report is based on a survey to 10,000 business leaders in several sectors in mid-market businesses in 35 economies.

96 Deborah L. Rhode and Amanda K. Packel, 'Diversity on Corporate Boards: How Much Difference Does Difference Make', Del. J. Corp. L., 39 (2014), 377.

97 Defined as those holding C-Suite jobs

Figure 51. Senior management positions filled by women globally - by sector



Source: Grant Thornton (2015)

The study on Gender Diversity on European Boards[98] describes the situation of women in leadership positions at STOXX 600 companies from 2011 to 2015. Its findings show an increasing number of women on European boards, rising from 13.9% in 2011 to 25% in 2015. This fact implies that, during that specified period, the average number of women in director seats has doubled from 1.5 to 2.8, while the size of boards remains on an average of 11 members per board. This data could be interpreted as a proportional reduction in the number of male board members in favour of a timid growing participation of women in decision-making positions.

When referring to new director seats, there is a positive trend. Women represent 35% of all newly elected directors at STOXX 600 companies, which implies an increase of 6.9 percentage points since 2011. This upswing, however, is mainly driven by new female employees elected to non-executive positions, particularly independent non-executive seats. In fact, the number of women acting as executive board members has grown up to 6.7%, which roughly represents a 2.7 percentage point growth from 2011-2015. Additionally, the average tenure of service for women in STOXX 600 companies is 3.7 years, in comparison with 6.4 for men. Women's participation at board meetings is also lower; 1.1 women attended less than 75% of the board's meetings compared to 1.6 of men.

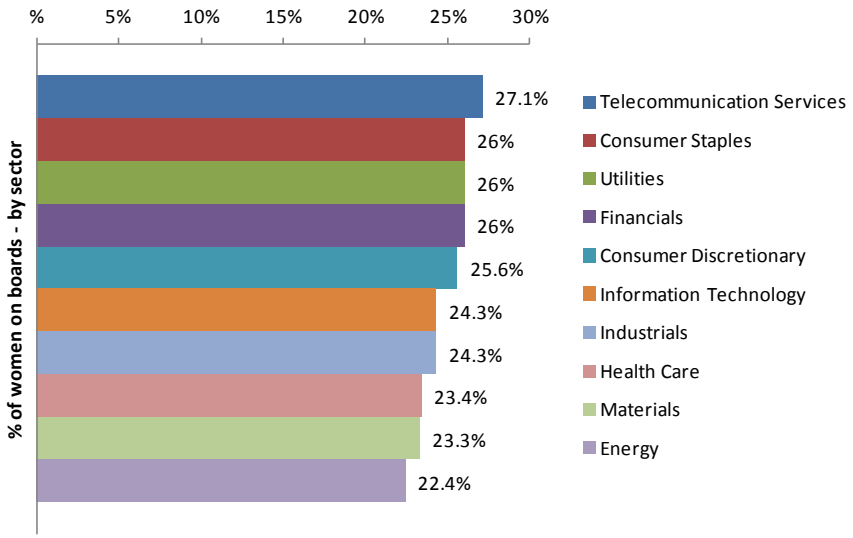
98 Roberts, Matthew, 'Gender Diversity on European Boards. Realizing Europe's Potential: Progress and Challenges'.

The analysis at the European level suggests that the sector of activity is less relevant for women on boards than it seems to be, at the global level, for senior management positions.

Regarding the presence of female board members by sector in Europe, all sectors have experienced a sustainable growth, especially the Information Technology (IT) sector where the number of women on boards is only 0.7 percentage points below the STOXX 600 average (25%). The proportion of women on boards has risen 102% since 2011, meaning that the number of women on boards has grown 12.3 percentage points throughout the five-years period covered. The Telecommunication Services sector shows the highest percentage of women on boards, 1.1 percentage points above the average (27.1%), which represents a 46% increase of women on boards over the period from 2011 to 2015.

Even though the IT sector shows the third highest increase in female board members since 2011, it is also the sector with the highest percentage of all-male boards (17.2%). By contrast, the Telecommunication Services sector is the only sector where all companies have at least one woman on their boards.

Figure 52. % of women on boards - by sector (STOXX 600)

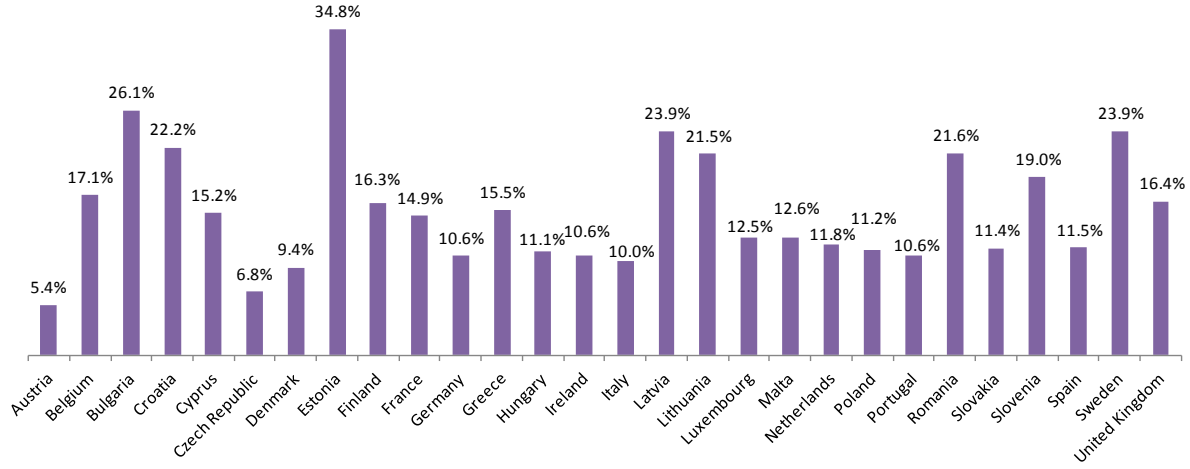


Source: EWoB and ISS (2016)

The greatest difference among sectors within STOXX 600 companies regarding women on boards is 4.7 percentage points. Nevertheless, great differences between Member States arise, which suggests that national policies might be influencing the presence of females on boards, regardless the sector of activity. Thus, by way of example, the number of women on boards at STOXX 600 companies in Sweden (34.6%) is 12 percentage points higher than in Germany (22.6%).

More recent data from 2016 regarding the percentage of female executives[99] at the largest publicly listed companies in Europe[100] evinces this high variation among EU28 countries.

Figure 53. % of female executives at European publicly listed companies in 2016 by country



Source: prepared in-house, based on EIGE database[101] (2016)

The percentage of female executives in publicly listed companies ranges from 5.4% in Austria to 34.8% in Estonia.

These facts might suggest that improvements are concentrated in few European countries with specific policies or actions focused on increasing the number of women in leadership positions, particularly the presence of women on boards.

This data from 2016 also shows the percentage of female CEOs at the largest publicly listed companies as being very variable depending on the European member analysed (see Figure 52).

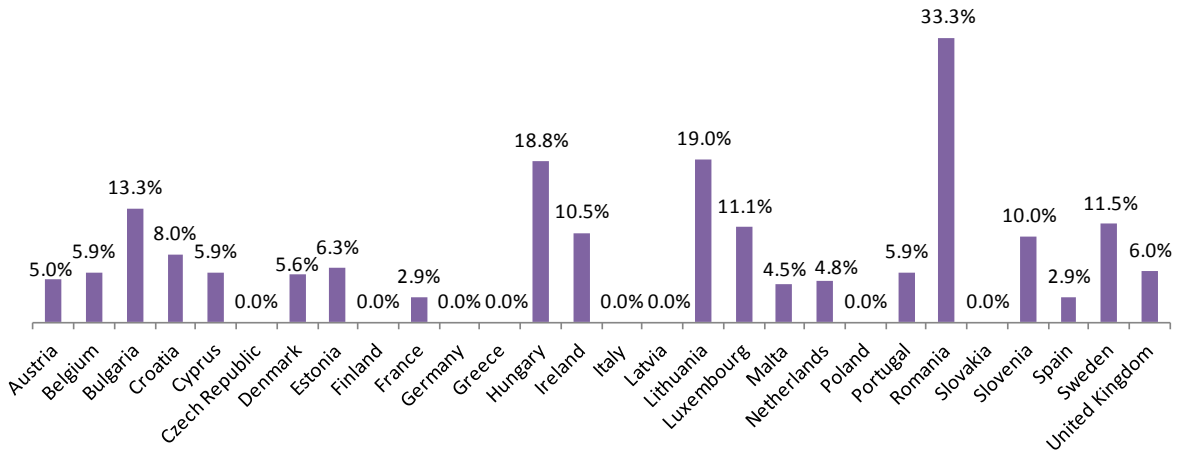
---

99 Executes is defined by EIGE as " Executives: senior executives in the two highest decision-making bodies in each company. The two highest decision-making bodies are usually referred to as the supervisory board and the management board (in case of a two-tier governance system) and the board of directors and executive/management committee (in a unitary system). Note: any individual who sits in both decision-making bodies of a particular company is counted only once"

100 All sectors

101 Publicly listed means that the shares of the company are traded on the stock exchange. The "largest" companies are taken to be the members (max.50) of the primary blue-chip index, which is an index maintained by the stock exchange and covers the largest companies by market capitalisation and/or market trades. Only companies which are registered in the country concerned (according to the ISIN code) are counted

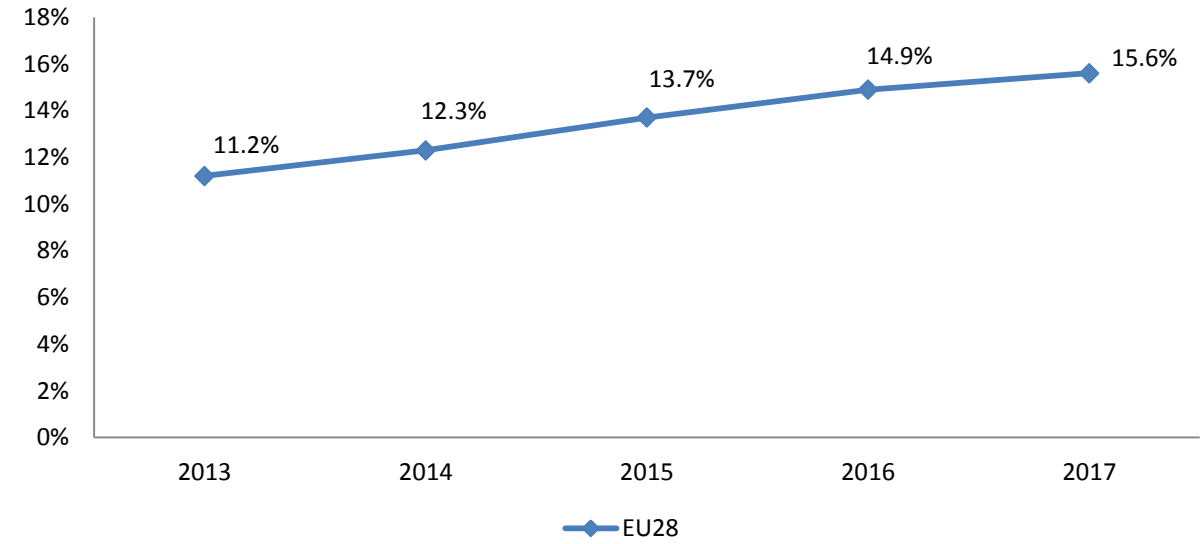
Figure 54. % of female CEOs at European publicly listed companies in 2016



Source: prepared in-house, based on EIGE database (2016)

The progress in the representation of women in senior management positions reveals a positive trend, despite the fact that the rates obtained are still far from achieving remarkable goals towards gender parity.

Figure 55. Evolution of the % of women in executive positions in the largest publicly listed companies in EU28



Source: prepared in-house, based on EIGE database (2017)

Globally in the EU, a slowdown in the growth of women's participation has occurred. From 2012 to 2016 where the annual variation was around 10%; however, the growth between 2016 and 2017 dropped to a mere 4%.

According to the study already mentioned, in 2014 the number of female CEOs in STOXX 600 companies was 21, which represents 3.5% of all the CEO positions included in the study. Despite this shortage of women in management positions, most of the industries covered by the study have at the very least one company with a female CEO or board chairperson. The one exception is the Information Technology sector; the only sector without women occupying these positions of responsibility in any of the IT corporations in the classification of STOXX 600 companies. In the Telecommunication Services sector, only 9.5% of CEO positions are occupied by women.

According to data from this study[102], the percentage of workers in the ICT sector that have female bosses in Europe was 21.4% in 2015, while the percentage was 48.4% in non-ICT service sectors. These figures represent an increase of approximately 2 percentage points in both cases compared to the previous existing data from 2010.

Other studies also support this statement. A study on intensive tech-industries[103] carried out in 2014 reached similar conclusions: (1) 20% of women occupying business roles in tech-intensive companies have female supervisors in comparison with 31% in other industries and (2) 18% of women declared that the paucity of role models is a chief barrier to women's opportunities for advancement.

Looking at the global economy, the improvement is very scarce and the distance between the ICT sector and other sectors remains.

As a result of the aforementioned findings, it can be confirmed that women are underrepresented in leadership positions in all sectors. The figures support a trend that, although very slow, continues to be positive on a global scale. When considering solely IT and Telecommunications sectors, this situation seems to be even more pronounced. There are less women bosses in all corporate leadership levels; however, data suggests that European national policies, such as quotas, have a positive impact on gender parity in leadership positions regardless of the sector of activity.

4.2 Female leadership in the public sphere: the underrepresentation of women persists

In 2015, there was an average of only 28.6% of seats in lower/single house parliaments that were occupied by women in OECD countries. This number was an increase of 8 percentage points from the percentage in 2002[104]. On a global context, 15% of all presiding officers in houses of parliament are women. At the local level, women in decision-making bodies are also underrepresented; 36% of elected members in municipal councils and 15% of mayoral or leadership positions were women in 2015. Although the representation of women in ministerial positions is highly variable among the OECD countries depending on political cycles and legislative actions initiated to obtain gender parity, the average was 29.3% in 2015 demonstrating an 8% growth from 2005.

---

102 Data elaborated based on the European Survey on Working Conditions 2015.

103 A. Beninger, 'High Potentials in Tech-Intensive Industries'.

104 OECD, 'Background Report. Conference on Improving Women's Access to Leadership'.

Furthermore, a gender divide in the political sphere is still present: women are in charge of those ministerial categories usually associated with feminine concepts (care and health, culture, social issues) and gender stereotypes and are excluded from more traditionally masculine areas such as defence or security. According to the OECD this trend is also present in EU public services, with women occupying 34% of the highest-ranking civil servant positions in 2015.

According to the Gender Statistics Database (GSD) of the EIGE[105], the number of female members of parliament/assembly in EU28 in the first quarter of 2017 was 37.3%, an increase of 2.2 percentage points compared to first quarter of 2010.

According to the existing data at the European level, 18.8% of the leaders of the major political parties in EU countries were females in 2016, which was 1.9 points higher than in 2015.

Currently, 6 European Union countries have a woman as head of state or government[106]. When looking at the ministers responsible for telecommunications and/or the digital agenda, the number of member states with females in charge in the first semester of 2017 was 5 out of 28[107].

With respect to the ratio of males and females among the members of the European Commission (Commissioners), the percentage stands at 29.6% in the first quarter of 2017 and is 7.4 points lower than during the first quarter of 2009. In the European Parliament, women represent 37.4% of MEPs and 5 out of 14 Vice-Presidents are women[108]. A recent article, however, identified the top ten MEPs influencing European digital and telecommunication policy and 6 of them were women[109].

4.3 e-Leadership and gender

It is well-known that improvements in productivity and competitiveness within organizations in the digital era require innovation in business processes through information and communications technologies. It has been estimated that the demand for e-leadership, defined as "the accomplishment of a goal that relies on ICT through the direction of human resources and uses of ICT"[110], will only keep on increasing, implying a growing demand for talent with e-leadership skills. According to some studies[111], it is expected that the demand for new e-leadership professionals might rise up to 4.6%

105 http://eige.europa.eu/gender-statistics/dgs/browse/wmidm

106 United Kingdom, Poland, Croatia, Malta, Lithuania and Germany.

107 This information is based on an internal analysis of the ministers responsible for the digital agenda or information society in each of the Member States.

108 European Parliament. Equality and Diversity Unit, 'Women in the European Parliament'.

109 www.votewatch.eu, 'Powerful but Divided: The EU Parliamentarians Who Influence Digital and Telecommunication Policy'.

110 T. Hüsing, et al., 'E-Leadership: E-Skills for Competitiveness and Innovation Vision, Roadmap and Foresight Scenarios'.

111 T. Hüsing, et al., 'E-Leadership: Digital Skills for SMEs'.

between 2015 and 2020 in Europe, meaning that the number of e-leaders needed would reach 776,000 by 2020.

In a conservative scenario, Europe will require at least 50,000 new high-tech leaders annually in the years leading up to 2025. These new leaders will need entrepreneurial skills and a multidisciplinary orientation because they will essentially serve new markets[112].

The EU has already implemented several initiatives in this regard[113], applying recommendations from both the European and national levels to ensure this demand is met throughout European organizations.

In this sense, beyond the participation of women in leadership positions in order to break through the glass ceiling, it is also important to ensure female involvement in e-leadership initiatives, at the same level as their male counterparts, so as to ensure female participation in the digital transformation of the economy and society.

4.4 Corporate leadership diversity and its benefits

Despite the current situation of women and leadership, there are many studies that emphasize the importance of enhancing corporate performance through diversity on boards.

Some reviewed research[114] revealed that companies with gender diversity leadership teams produce higher economic returns, drive better innovation processes, have a greater work rate and effectively manage recruitment and staff retention.

In developing these assertions, the analysed literature[115] reveals that women and men respond to risk differently. What this means to say is that women are likely to be more financially risk-averse than men; therefore, diverse corporate boards could ensure controlled and consensual business decisions. Thus, companies that apply concepts such as "risk resilience" and "risk agility" in their leadership teams are likely to have sustained success over time[116]. Both decision making procedures and the working environment could be enhanced through this kind of diversity.

There is evidence linking women on boards with more collaborative and less competitive styles of decision-making. A diverse corporate board is one that is better at dealing with controversial situations and actually enhances the group's ability to tackle conflicts.

Other studies also evince that there is a correlation between diversity and good governance. Greater levels of female representation on boards are lined to a higher number of meetings and higher rates of attendance and participation in decision-making processes, among other characteristics related to good management practices.

---

112 empirica, 'High-Tech Leadership Skills for Europe. Towards an Agenda for 2020 and Beyond'.

113 European Schoolnet and DIGITALEUROPE, 'The E-Skills Manifesto 2016'.

114 Pax Ellevate Global Women's Index Fund, 'Invest in Her'.

115 Rhode and Packel, 'Diversity on Corporate Boards', 2014.

116 Grant Thornton, 'Women in Business'.

Apart from the above-mentioned benefits linked to higher levels of female representation on boards, one of the most important reasons for increasing the number of women in upper-level positions is associated with creativity and innovation. Several studies support the relationship of heterogeneous leadership teams with market growth and accelerated innovation processes contributed by the different life experiences that these groups bring into the open or, in other words, a broader capacity to find alternatives and solutions[117].

In accordance with these findings, and coming back to technology sectors, a study published in 2016 in Business Research Quarterly (BRQ) titled "Management Capabilities, Innovation, and Gender Diversity in the Top Management Team: An Empirical Analysis in Technology-Based SMEs"[121] **highlights the relationship between management capabilities and innovation with gender diversity[118].** This study supports the fact that management capabilities and more gender balanced management teams show a moderately positive impact on product and process innovation performance in technology sectors[119].

Diversity on corporate boards improves not just managerial styles, better working environments, higher levels of creativity and wider innovation procedures. According to some reports[120], gender diversity in top management teams might provide financial benefits as well. For example, MSCI World Index companies with three or more women in upper-level positions generated a Return On Equity (ROE) of 10.1% annually in comparison with 7.4% for those without at least three women[121]. In fact, reaching gender-balance within the global technology industry's female leadership could provide measurable benefits between 0.5%-0.6% to the global GDP[122].

Supporting these statements, the survey results which Women-Fast forward[123] [124] gathered, among others, elaborate on the performance achieved when female leaders are enrolled in their companies. According to these results, 65% of respondents considered that women in senior executive leadership positions attain better financial performance. When asked about women on their company boards, this percentage rises to 66%.

---

117 Harvard Business Review, 'How Diversity Can Drive Innovation'.

118 Ruiz-Jiménez and del Mar Fuentes-Fuentes, 'Management Capabilities, Innovation, and Gender Diversity in the Top Management Team'.

This study applied a hierarchical regression analysis using a sample composed by 205 Spanish SMEs from technology sectors to assess this hypothesis.

119 However, due to the possible omission of other factors with influence on the performance, it's difficult to establish a direct effect of gender diversity in leadership or the innovation processes.

120 Lee et al., 'Women on Boards'.

121 It has not been possible to establish causality.

122 Mercer, 'When Women Thrive. Technology Industry Perspective'.

123 Ernst & Young, 'Women. Fast Forward. The Time for Gender Parity Is Now'.

124 Survey carried out globally (40% EMEIA, 30% North America, and 30% Asia-Pacific) through 400 respondents occupying seniority positions (100% management level, 50% C-suite).

To summarize, there are several advantages to implementing a higher gender-balance on boards and within management positions. Based on the foregoing data, companies with significant female critical mass on decision making positions have better governance styles, drive more creative and diverse innovation processes by diverse ad farsighted thinking that are more likely to meet customers' needs and even could also, according to some studies, deliver considerable financial benefits.

According to predictions by Ernst & Young, global gender parity will not be achieved until 2095 in the workplace, and it would not be until 80 years later that equality on company and government leadership positions will be reached[125].

"Women on Boards"[126] has estimated three scenarios of achieving a goal of 30% of global female directors:

- "Business as Usual", based on current trends estimates that it will be achieved in 2027;
- "Accelerated Conversion, assuming a growing number of new seats filled by women (1.54 percentage points), it would be achieved in 2022.
- "Accelerated Turnover" assumes the average rate of women filling director seats (16%) but the number of new seats turned over is increased from 7.9% - average calculated based on the same reference period - to 10%. Under these premises, the desired figure would be reached in 2020.

If companies develop specific gender policies, e.g. hiring, promotion and turnover initiatives, to break the glass ceiling, it has been estimated that the technology industry could reach 36% of female representation at the executive level in 2020[127]. This number can be compared to 33% in the called "baseline scenario" with no changes to current trends. By 2025, these rates could go up to 46%.

125 Ernst & Young, 'Women. Fast Forward. The Time for Gender Parity Is Now'.

126 Lee et al., 'Women on Boards'.

127 Mercer, 'When Women Thrive. Technology Industry Perspective'.

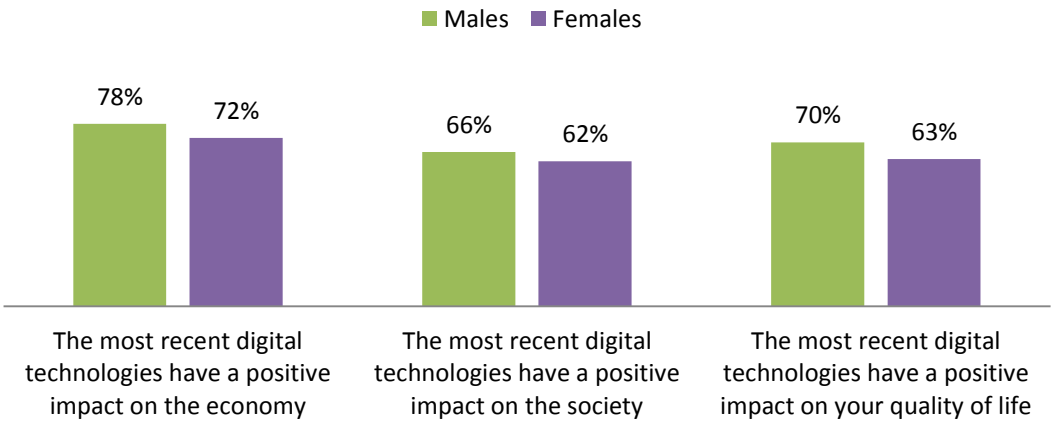
5. Gender differences in attitudes towards technology and digitalization: women are somewhat more concerned and less informed

Differences in the personal preferences that men and women have regarding technology have generally been considered as a factor influencing their educational and professional choices, and partially explains the lack of women in STEM studies and ICT careers.

Gender differences are not only visible in career options but also in citizens' attitudes towards technology and innovation.

A recent Eurobarometer survey asked Europeans about their perceptions on the impact of digital technologies in their lives. The results show the existence of differences based on gender.

Figure 56. Positive view of the impact of digital technologies in various spheres



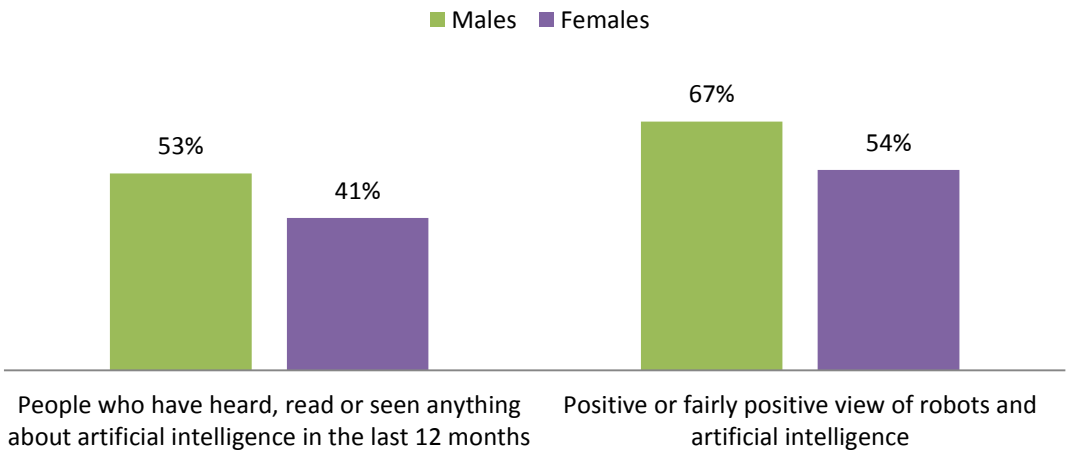
Source: Special Eurobarometer 460

Women have a more negative view on the impact of digital technologies in all spheres, particularly in their quality of life. 70% of men consider that digital technologies have a positive impact on their quality of life while only 63% of women think the same. Regarding its impact on the economy, 78% of men and 72% of women have a positive view. 66% of men and 62% of women think that they have a positive impact on the society.

Other surveys have asked about concrete technologies with similar results.

When asked about the impact of robots and artificial intelligence, lesser women tend to have a positive view than men (54% compared to 67% of men).

Figure 57. % of people informed about robots and AI and with a positive view of it

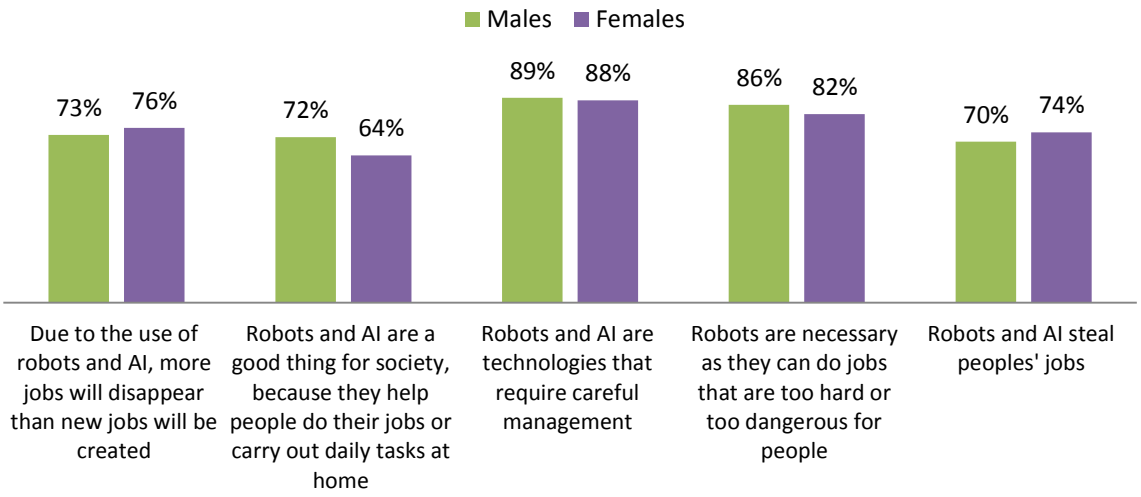


Source: Special Eurobarometer 460

It is also noticeable that women tend to be less informed than men about new technologies. In the case of artificial intelligence, 41% of women have heard, read or seen something about the topic in the last year compared to 53% of men. This gap also exists for other technological topics.

Coming back to the perceptions on AI and robots, most European citizens, from both genders, perceive that robots and AI technologies are useful, particularly for helping people in tough or dangerous jobs. This perception is slightly higher among men (86%) than women (82%). People also think that these technologies entail risks and must be carefully managed (89% of men and 88% of women). Women have more negative perceptions of these technologies, as they think to a greater extent that they might steal people's jobs (74% of women compared to 70% of men) and that their introduction will result in job destruction (76% of women versus 73% of men). The biggest difference among genders is found around the opinion that robots and AI are good for society because they might help do daily tasks at home (72% of men and 64% of women). Although a majority of females have a positive view of this potential use of robots, women still seem to be more sceptical than men about this particular use.

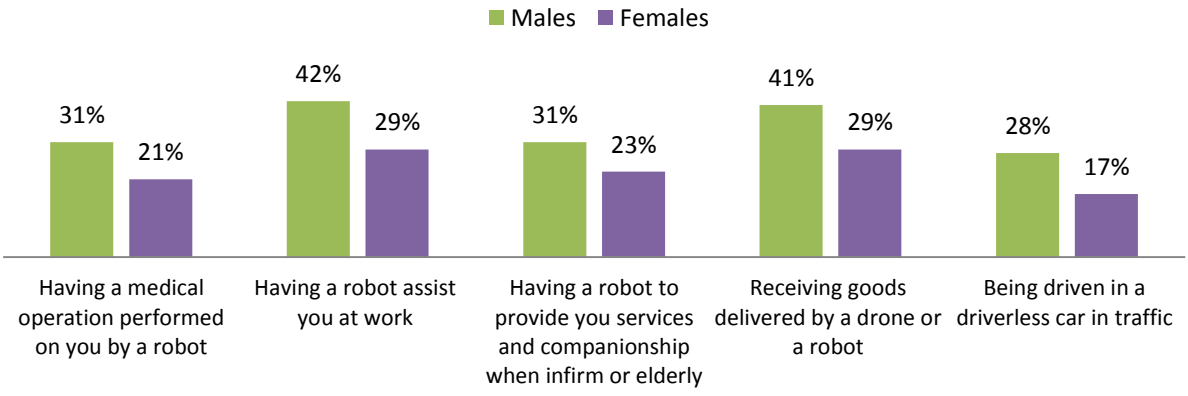
Figure 58. People who agree with the following statements



Source: Special Eurobarometer 460

The greater mistrust of women towards AI compared to men is clearer when asked about concrete uses or situations where robots that can help humans, or even substitute them, already exist. The Eurobarometer asked people about the level of confidence or comfort with five actions that could be performed by robots: a medical operation, work, companionship when infirm or elderly, delivering goods and use a driverless car. In general, most Europeans, especially women, do not feel very comfortable with being assisted by robots in these actions.

Figure 59. People who feel comfortable with robots doing the following actions



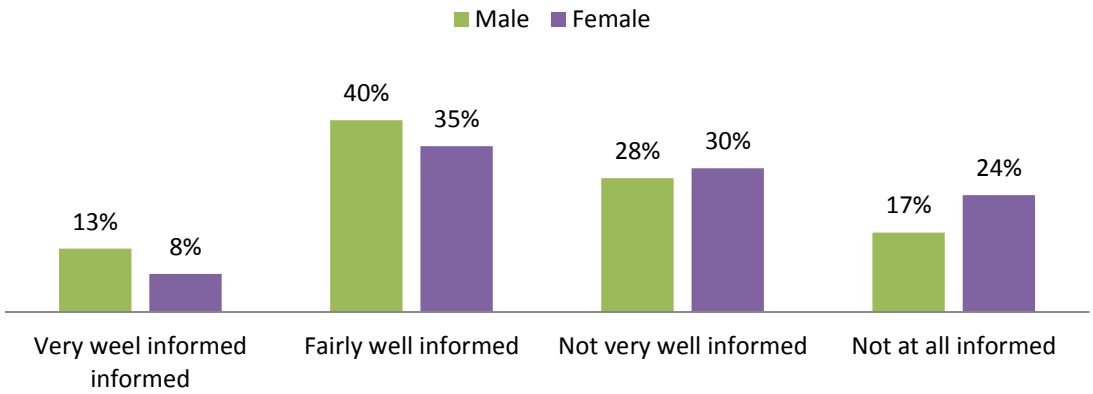
Source: Special Eurobarometer 460

The percentage of women that feel comfortable with these actions is no higher than 29% in the cases provided in the chart above. Women particularly feel uncomfortable with being driven in a driverless car (only 17% of women and 28% of men feel comfortable),

being operated on by a robot (21% of women and 31% of men feel comfortable) and being provided services and companionship when infirm or elderly (23% of women and 31% of men feel comfortable).

Certain gender differences also appear when it comes to cybersecurity issues. Women are less informed than men about the risks of cybercrime. 13% of men and 8% of women said in the 2015 Eurobarometer survey on the topic that they were very well informed, 40% of men and 35% of women that they were fairly informed, 28% of men and 30% of women that they were not very well informed and 17% of men and 24% of women that they were not informed at all.

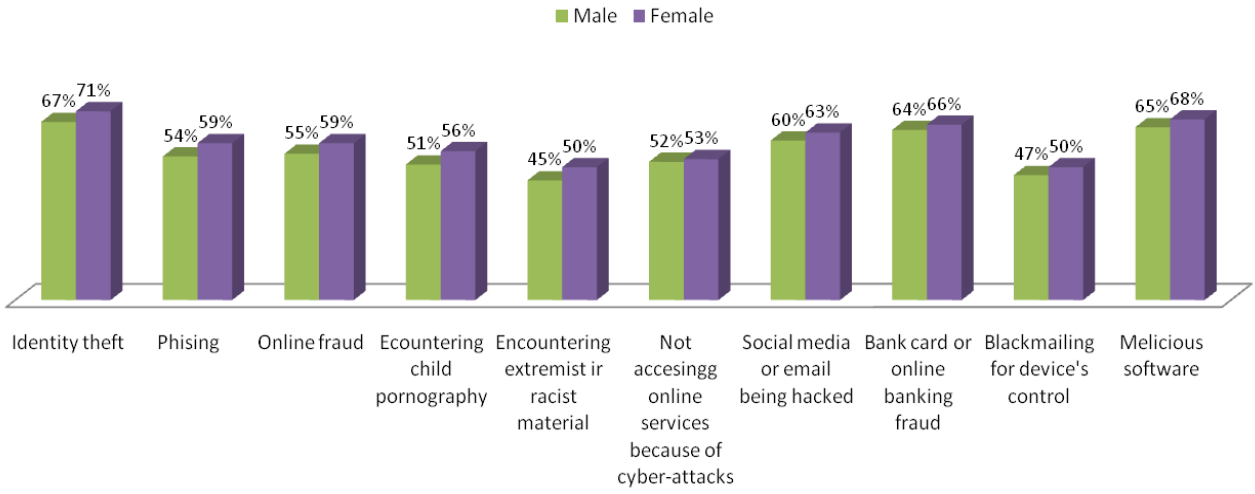
Figure 60. Level of information about the risks of cybercrime by gender



Source: Special Eurobarometer 460

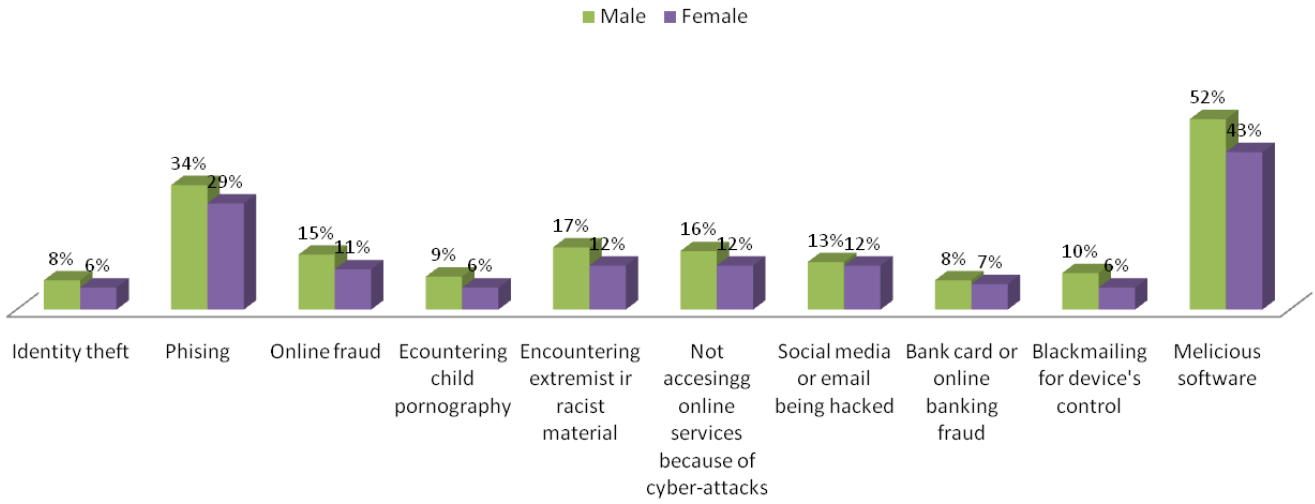
Additionally, women, in general, showed a higher concern than men about being a victim of cybercrimes even though these women had experienced less cybercrimes than men.

Figure 61.Citizens concerned about experiencing cybercrimes by gender



Special Eurobarometer 423

Figure 62. Citizens that have experienced cybercrimes by gender



Special Eurobarometer 423

6. Women's challenges in the Digital Age: unconscious biases are key

Fewer girls choose ICT studies and, when they do, what is generally accepted as being a competitive advantage in the labour market due to a growing demand of technical profiles doesn't seem to benefit these women as much as it does for men. The few women that end up with a digital job are much more likely to abandon it than their male counterparts, particularly after they turn 30 years old.

Within the ICT and digital sector, the glass ceiling is not really disappearing and females are not fully participating in the digital entrepreneurship ecosystems that are being created throughout Europe.

Despite increased awareness and numerous initiatives, women still face significant challenges in the sector. These challenges affect all stages of women's career paths and life courses in the digital sphere, and can be summarized as follows:

Unconscious biases

This issue has been widely discussed and most current studies point to what is known as the **second-generation gender bias**[128]. Unlike the first-generation gender bias, which is defined as a more explicit discrimination that is illegal in most developed countries, this biased behaviour is tied together with the perpetuation of gender stereotypes and traditional assumptions about men and women.

Some stereotypes and biases, for example, continue to challenge women's capabilities and aptitudes in technical and scientific fields. This bias has an important impact on girls' and young women's choices about their studies and careers. Moreover, this type of bias has a huge impact on employers too, who do not value the technical and scientific studies of men and women to the same degree.

Its impact is also very relevant in the existence of the glass ceiling. There are several quantitative studies[129] identifying overt and subtle unconscious biases regarding leadership. As a result, skills generally related to successful leadership and management are frequently associated with men and include assertiveness, decisiveness or dominance. A woman, on the other hand, who demonstrates these attributes is usually classified as bossy or unpleasant. When a less assertive role is adopted and more traditional feminine characteristics emerge, such as empathy or emotional intelligence, this type of leadership role is associated with weakness and hesitance.

The unconscious biases regarding women's capacities to lead and undertake are also reflected very clearly in women's access to funding to undertake their projects. Thus, entrepreneurial features remain closely associated with characteristics most commonly

128 Korn Ferry Institute, 'Second-Generation Gender Bias'.

129 Rhode and Packel, 'Diversity on Corporate Boards', 2014.

attributed to men. Due to its relevance, the specific problems faced by women in starting businesses in the digital sector will be discussed in more detail below.

Other findings point at what have been called "**in-group biases**", also called the **"group-think phenomenon**" which is defined as engaging only with those with similar points of view, as another potential limit on females' career paths in the ICT and digital sector in general, and particularly to female leadership.

Women in digital occupations, as previously seen, tend to work in more feminized working environments, meaning that it is more likely that women work in groups where there are already a number of women.

From the point of view of leadership, this phenomenon has enormous relevance. According to some research[130], CEOs with greater decision-making power than their boards will be more predisposed to appoint new members in possession of characteristics similar to theirs. In a board with a higher degree of decision power, new designated members will most likely share characteristics with the members of the board. This type of unconscious bias hinders women from being part of those informal groups from which potential candidates are appointed which, in turn, perpetuates the lack of representation of women on boards and in managerial positions.

Tokenism

The implementation of certain equality policies at the legislative level, but also at the corporate or organisational level, has attempted to combat existing biases. It has, however, often resulted in "tokenism", especially in highly masculinised sectors such as the digital sector, and in the top management and direction areas. Tokenism affects women's access to the sector, their professional growth and their perception of working conditions[131]. Let us remember that women in the ICT sector, despite being more motivated than their male counterparts, feel that they that can apply their own ideas at work less, are more stressed and have experienced discrimination on the basis of their sex to a much greater extent.

In fact, a recent study found that women in tech-intensive industries are more likely to feel like an outsider than men[132]. According to the study, 83% of men stated that they felt similar to most of their colleagues compared to only 27% of women. Comparing other sectors with tech-intensive industries, almost twice the women felt similar to most people at work (49%).

The effect of tokenism has a special reflection on the glass ceiling. The isolation and marginalization suffered by minority board members prevents a strong feeling of belonging and limits exerting influence, particularly on corporate boards where most of the decisions are made within informal meetings and, therefore, reduces the opportunities to influence group decisions.

---

130 Rhode and Packel.

131 King et al., 'Understanding Tokenism'.

132 A. Beninger, 'High Potentials in Tech-Intensive Industries'.

Ensuring a critical mass, constituted by three or more women, minimizes these consequences and, at the same time, enables the appointment of more qualified females.

Conciliation of professional and personal life

According to Women Matter 2016[133] [134], there is a correlation between socioeconomic inequalities, such as hours of unpaid work, and the number of women on executive committees. These reports suggest that women and men are equally motivated to be promoted to upper levels (68% of women vs. 67% of men); however, even when both genders are seeking top executive positions with the same intensity (48% of women vs. 44% of men), only 25% of those women consider it feasible being promoted to a top executive position in comparison with 42% of men. 42% of female respondents believe it is harder for women than men to advance in their careers. The higher the responsibility the position implies, the more time consuming and, due to gender work-life imbalances, the higher the difficulties for women to rise in the corporate pipeline. 48% of women stated that these issues damaged their careers compared to only 34% of men who felt that way.

The unbalanced share of caring responsibilities among genders has been acknowledged by the European Union as an important element exacerbating female employment challenges. In 2017 a Work-life Balance package was proposed which aimed at improving the conditions necessary to reconcile working and private lives, addressing female underrepresentation in employment and achieving convergence between EU Member States. As part of this package the European Commission has made a proposal for a Directive of the European Parliament and of the Council on Work-Life Balance for parents and careers and repealing Council Directive 2010/18/EU135. The proposal includes measures regarding paternity and parental leave, career breaks and improved access to flexible working arrangements. Other measures of the package include aware-actions to raise awareness, improved monitoring and data availability and the benchmarking and sharing of good practices.6.1 Other obstacles to women's professional growth in the sector

All barriers mentioned so far, especially the difficulty of reconciling personal and professional life, affect women's professional development and create what is known as the "glass ceiling". In addition to these, there are other specific aspects that prevent women from attaining higher positions in this sector, among which the following can be highlighted:

- Women were more likely to start in an entry-level position than men. A research on tech-intensive industries showed that 55% of women entered their professional

133 McKinsey&Company, 'Women Matter 2016. Reinventing the Workplace to Unlock the Potential of Gender Diversity'.

134 This survey covers 233 companies in 9 countries – Finland, France, Italy, the Netherlands, Norway, Portugal, Spain, Turkey, and the UK.

135 http://ec.europa.eu/social/main.jsp?catId=1311&langId=en&moreDocuments=yes

careers at the lower entry-level position compared to 39% of men. As a result, women are more likely to start at a lower-paying role[136].

- **Low transparency**. Lack of transparency in evaluation processes is another barrier keeping women from forging ahead to take up top executive positions in the sector. Only 42% of women filling tech-intensive business roles compared to 55% in other industries clearly understand how they would be evaluated in case they opted for upper-level positions[137].
- **Lack of pool talent**. All the issues previously mentioned affect the choices of girls and young women. The result is that the number of those who choose technical studies is diminishing in Europe. This, in turn, has a clear impact on all other areas of women's careers, as it makes it difficult to reach a critical number of women in the sector. Therefore, a vicious circle emerges. The lack of a talent pool of technical profiles is a widely used argument when it comes to justifying, in particular, the shortage of women in leadership positions. Consequently, one of the common reasons used to explain the absence of females in top leadership roles is the lack of women in executive positions. Previous related experience on CEO positions is considered one of the most important conditioning factors when a new director is appointed as chairperson[138].

Is there an ambition gap?

Some studies suggest that women are not promoted because they don't want to be promoted. These studies compare the rates of men and women who are interested in reaching top management positions[139]. The percentage of women is always lower than the percentage of men. The reason for this is not necessarily a lack of ambition, but, as other more recent studies point out, rather an awareness women develop of the extra effort these barriers entail for them. A study called "Leaders & Daughters"[140] shows that ambition among women is high, particularly among younger women, but the desire to advance to higher positions decreases once women face the reality: "*(...) the response to the ambition question when considered by seniority exposed the glass ceiling effect: Desire to advance to a top position declines at the senior manager level and above and drops from 72 percent to 57 percent as reality sets in about the challenges for advancement to senior leadership.*"

The study also showed that aspirations among women are higher in developing countries than in developed ones.

---

136 A. Beninger, 'High Potentials in Tech-Intensive Industries'.

137 A. Beninger.

138 Rhode and Packel, 'Diversity on Corporate Boards', 2014.

139 For example, Workplace 2016, an annual study of the state of women in corporate America. from LeanIn.Org and McKinsey & Company, found that y 40% of women are interested in becoming top executives, compared to 56% of men. https://womenintheworkplace.com/#about

140 'Leaders & Daughters 2017'.

There are many potential causes for the absence of female representation on leadership positions. From unconscious bias, such as the second-generation gender and in-group bias, to the lack of women executive tank pool talent due to the subsequent scarcity of female leaders, to the phenomenon referred as tokenism. These three factors emerge, in addition to the work-life balance constraints, as the most powerful limitations to progress in women's ability to advance to top positions. As it has been stated, it seems that this situation is even more noticeable with regard to tech-intensive industries in which women are more likely to leave these companies for personal reasons, feel like outsiders from the start or suffer the lack of role models and transparency during the evaluation process for climbing the corporate pipeline.

6.2 Female entrepreneurs' challenges

All the barriers discussed above affect women in general and are closely related to each other, but there are specific difficulties, including accessing finances, women face when it comes to establishing and running a business. Other barriers include (1) the lack of role models, (2) entrenched stereotypes, (3) weaker business networks, (4) stronger perceived difficulties for reconciling business and personal life and (5) gender differences on the sector of activity.

Fear to fail seems to be an important socio-cultural factor influencing both genders, but women to a greater extent. This fear might be correlated with the lack of role models and the low participation of early stage female entrepreneurs in more gender-balanced networks, which is one of the key barriers preventing the number of women in entrepreneurship from increasing[141]. Risk aversion and self-confidence might be diminished with the involvement of women in those networks[142]. In fact, networking is a way to enhance business expertise, get support on access to funds, set suitable partnerships or find qualified employees, among other things. 93% of female entrepreneurs think that business networks are essential for their professional development. Women are more likely to become entrepreneurs when they are in contact with others, highlighting the importance of role models and business networks as a means to increase the number of female entrepreneurs[143].

In fact, those female entrepreneurs who are actively involved in professional networks are more likely to have easier access to capital than those who are not; 27% in comparison with 19% of female entrepreneurs overall[144] [145]. Therefore, the positive impact of business networks in women is proven.

Men and women also show different preferences when it comes to the possible actions for supporting entrepreneurship. The number of women who use entrepreneurial

141 Dood and Keles, 'Expanding the Networks of Disadvantages Entrepreneurs'.

142 OECD, 'Entrepreneurial Activities in Europe. Expanding Networks. OECD Employment Policy Paper'.

143 Roland Berger, 'Digital Equality? Women in the Digital Revolution'.

144 Ernst and Young, 'It's Who You Know: Women Entrepreneurs and the Impact of Networks'.

145 Online global survey conducted from October to December 2016

workshops/support meetings is higher compared to their male counterparts: 55% vs. 44%. Men prefer incubators or mentoring programmes or initiatives[146] to workshops and meetings.

Family obligations and responsibilities related to children and caring for the elderly are important factors associated with the number of female entrepreneurs. Starting a business is seen by women as a good opportunity to get a better balance between work and personal life due to the possibility of having more flexible schedules and autonomy[147] [148]. Female entrepreneurs work, on average, less hours per week than their male counterparts in EU member countries (36.4 vs. 44.3 hours per week[149]), even compared to full-time and part-time male entrepreneurs. And, as already said, particularly in the ICT sector in Europe, female entrepreneurs are less stressed than both their male counterparts and other professionals of the sector.

According to the 2015 Female Entrepreneurship Index[150], greater services related to childcare and family leave are linked to higher numbers of women in entrepreneurship. Evidence shows that female entrepreneurs are more likely to exit their business for personal reasons, such as being married or having children, than male entrepreneurs. According to some report findings[151], female entrepreneurs were 15% more likely to exit than men for personal reasons. In fact, while being married increases the likelihood that men exit their businesses for both professional and financial opportunities, women are more likely to exit for personal motivations.

It is also known that female businesses show differences when compared to male start-ups. Female businesses tend to be smaller and with lower loans and initial capital levels, which usually implies lower returns for equity and debt financiers.

In general, most women undertake new businesses in sectors that are traditionally female-dominated, which seem to be less attractive and profitable for private investors[152]. Women prefer to set up business in certain areas and particularly in health, social work activities or education[153]. Actually, data elaborated for this report show that when considering only non-ICT service sectors the share of female entrepreneurs and self-employees in Europe reaches 51%.

---

146 Ernst and Young, 'It's Who You Know: Women Entrepreneurs and the Impact of Networks'.

147 EIGE - European Institute for Gender Equality, 'Gender in Entrepreneurship'.

148 L. Hayrapetyan, A. Nunes & K. Khachatryan, 'Factors That Influence Female Entrepreneurs in the European Union. XVII Encuentro AECA'.

149 European Commission. Directorate General for Entrerpise and Industry, 'Statistical Data on Women Entrepreneurs in Europe'.

150 S. Terjesen, A. Lloyd, 'The 2015 Female Entrepreneurship Index'.

151 R. Justo, D.R. DeTienne & P. Sieger, 'Failure or Voluntary Exit? Reassessing the Female Underperformance Hypothesis. Journal of Business Venturing'.

152 European Parliament. Directorate-General for Internal Policies, 'Women's Entrepreneurship: Closing the Gender Gap in Access to Financial and Other Services and in Social Entrepreneurship'.

153 European Commission. Directorate General for Entrerpise and Industry, 'Statistical Data on Women Entrepreneurs in Europe'.

In the EU, 2.6 million newly born enterprises created about 4 million jobs in 2014. That year, according to the latest data available, "Information and Communication" was the sector where high-growth enterprises were more predominant (15%), followed by "Administrative and support service activities" (12.7 %), "Transportation and storage" and "Professional, scientific and technical activities" (both 11 %)[154].

As aforementioned, the sectors where women prefer to set businesses tend to be considered by investors as less profitable, which in turn influences the capacity of women to raise funds. The ICT and digital sectors, however, are highly profitable and women still face problems obtaining access to funding. There are considerable differences between women entrepreneurs and their male counterparts regarding their financial patterns and their preferred ways of proceeding:

- Gender differences on risk aversion: only 16.2% of all entrepreneurs seeking funding are women[155].
- Women entrepreneurs start up with lower capital levels and choose smaller loans; female companies start with 50% less capital than male ones[156].
- Women entrepreneurs are more likely to count on family members for finance which is, according to literature, associated with businesses with lower growth capacity. Moreover, women tend to rely on their family members for advice whilst men are more likely to seek for recommendations from their business associates, implying the males receive more relevant business information. Only 5.4% of women seek advice from business associates in comparison with 13.5% of male entrepreneurs.
- Female entrepreneurs tend to obtain lower rates of funding from angel investors, private equity or venture capital funds. Female companies are less likely to be equity financing than male counterparts from angels and venture capital (3.6% vs. 14.4%)[157].
- Female businesses are more likely to be less well-financed than male ones.

Access to funding

Beyond the possible gender differences coming from strictly personal preferences of entrepreneurs, as the sector of activity might be influenced by, it is clear that structural and cultural reasons must be influencing the lower rates of female entrepreneurs obtaining funding or obtaining lower financing than their male counterparts.

154 Eurostat: Business demography statistics, 2016.

155 M. Ewens & R. R. Townsend, 'Can Access to Capital Explain the Entrepreneurship Gender Gap?.'

156 G. Stengel. Forbes, 'Is Change in the Wind for Women Entrepreneurs Raising Capital?'

157 G. Stengel. Forbes.

Some academic research[158] supports the hypothesis of the existence of stereotypes affecting not only female entrepreneurs themselves but also investors, regardless of gender. These stereotypes seem to lead to biased decision-making processes due to the existing gender homogeneity of investment stakeholders. The existence of stereotypes is also affecting both the self-perception of female entrepreneurs about their entrepreneurial capabilities and the relevant stakeholders associated with business creation and growth, such as business angels, venture capital firms, bankers and others[159]. The persistence of gender imbalance in entrepreneurship might be related to long-standing professional attributes ascribed to entrepreneurs which are not traditionally associated to women. As it was stated in a study conducted by Harvard University[160], investors preferred male entrepreneurs over females, and male entrepreneurs were 60% more likely to attain pitch competition than women. It is also concluded that male physical attractiveness led to a 36% increase in pitch success, while attractiveness was not significant among female entrepreneurs. During an experiment in which two entrepreneurial pitch videos with randomly assigned voice were watched, the study found that 68.3% of participants preferred to invest in ventures pitched by a male voice even though these voices presented identical pitches.

Focusing primarily on high-tech entrepreneurs, evidence is consistent and shows that female entrepreneurs tend to receive lower venture capital investments than their male counterparts. To understand the possible causes behind these figures, a study about the impact of gender on venture capital decision-making was conducted[161]. During the experiment, identical high-tech start-ups were evaluated in which only the gender and the educational background were altered during the process. Their findings discovered that females and males with technical backgrounds obtained similar ratios; however, female entrepreneurs with non-technical competencies achieved considerably lower rates than men without technical backgrounds and, therefore, received lower capital investments. It is a fact that in the European technology ecosystem[162], all male founding teams are more likely to raise funding (82%) than all female (7%) and mixed gender ones (11%).

Other experimental approaches[163] [164] have been carried out in order to evaluate the hypothesis about the biasing effects of gender in entrepreneurship and how it is affecting

---

158 A.W. Brooks, L. Huang, S.W. Kearney and F.E. Murray., 'Investors Prefer Entrepreneurial Ventures Pitched by Attractive Men. Proceedings of the National Academy of Sciences'.

159 EIGE - European Institute for Gender Equality, 'Gender in Entrepreneurship'.

160 A.W. Brooks, L. Huang, S.W. Kearney and F.E. Murray., 'Investors Prefer Entrepreneurial Ventures Pitched by Attractive Men. Proceedings of the National Academy of Sciences'.

161 J. E. Tinkler, M. C. Ku, K. B. Whittington, A. R. Davies, 'Gender and Venture Capital Decision-Making: The Effects of Technical Background and Social Capital on Entrepreneurial Evaluations'.

162 Atomico, Slush, 'The State of European Tech. 2016 Edition'.

163 S. Thébaud, 'Gender Status Beliefs in Entrepreneurship and Innovation: Are Women Entrepreneurs Penalized?'

164 The experimental studies were conducted at universities from USA and U.K., where participants had to evaluate the profiles of two entrepreneurs so as to make investment decisions

access to funding. During the process, two business plans were evaluated: one of them was deemed innovative, and the other was not. After both business plans were evaluated, in which gender was randomly assigned, the study concluded that, when the non-innovative plan was evaluated, women were rated with lower ratios in terms of competency and investment worth than men, in spite of the fact that the same plan had been evaluated. These findings demonstrate that gender stereotypes about expectations on women's abilities in entrepreneurship might affect their ability to obtain funding. The innovative plan, when evaluated, had a positive effect on the competencies and a lower negative effect on the quality perceived, which might imply that women have to work tougher than men to demonstrate their entrepreneurial abilities.

Barriers preventing women from becoming investors

But what are those obstacles which prevents higher numbers of women from turning into business angels? There are several potential barriers[165]:

- Women and men have different degrees of risk aversion; women are more cautious as investors and display more collaborative styles
- Women and men are involved in different social networks, which makes gaining access to key relationships limiting. Women not only tend to expect to be invited by other angel investors, but also take extra effort to learn every aspect about business angel activity before becoming involved. In general, they have lower levels of self-confidence and a bigger fear of failure
- Family responsibilities, which are usually shouldered by women, have a considerable effect on the time devoted to their businesses
- Business angel networks are male-dominated; it is still considered a "man's game". Male networks are also mainly focused on investing in the technology sector whilst women are more likely to be involved in other activities such as health, the services sector or social businesses
- Lack of visible role models prevents women from seeing themselves in these investment positions and also limits their opportunities through a lack of mentoring by other role models.

The common traits that define an international business angel have been determined as:

- Middle aged males
- Decisions are based on both financial and non-financial reasons
- Look for recommendations from personal and professional networks
- Invest preferably on areas that can benefit from their experience
- Some have not made their first investment yet

It seems that the business angel profile is stereotyped, commonly associated with a man with a moderate to high-risk tolerance, entrepreneurial experience and a broad

165 F. M. Amatucci, *Women Business Angels: Theory and Practice. Handbook of Research on Business Angels, p. 92*.

professional network. These gender differences not only affect the number of female business angels but also a greater number of women entrepreneurs; female entrepreneurs are more likely to seek or feel more comfortable with women business angels[166].

This leads us to wonder if there is a relationship between the number of female partners in venture firms and the percentage of funded start-ups with at least one female founder.

According to Tech Crunch, there is not clear evidence that venture firms with a female founder are more likely to invest in female founder start-ups; the same pattern applies to seed investors as reported by the study. In fact, the number of start-ups with at least one female founder has scarcely risen up to 17% worldwide in 2017, after an upward trend of 8 percentage points from 2009 to 2012[167]. This figure has shown a stalled growth, with insignificant variations of plus or minus one percentage point since 2012.

Nonetheless, recent studies keep pointing out that the lack of women investors might be one of the causes of the scarce number of female entrepreneurs[168]. Male investors seem to be more likely to show interest in male-led start-ups. Likewise, women-led founders are more likely to be funded by female investors. Therefore, the study concludes that a higher number of female investors might lead to an increase in female entrepreneurship.

Other report findings highlight that more female investors might not only increase the number of female entrepreneurs, but also increase the level of expertise in the investment community of those women involved in venture capital communities and angel investment[169].

Wayra UK:

Women's Age is a project launched in October 2015 by Telefónica Open Future (TOF), the global open innovation platform from the telecommunications company Telefónica[170], for the development of the digital-technology talent and entrepreneurship paradigm. Women's Age was created to encourage female entrepreneurship in the digital start-up environments in countries where the company is represented.

Since Telefónica launched all those initiatives comprising the Open Future platform in 2006, low female participation has been a constant. In 2016 nearly 21% of the start-

166 F. M. Amatucci.

167 G. Teare. TechCrunch, 'In 2017, Only 17% of Startups Have a Female Founder'.

168 M. Ewens & R. R. Townsend, 'Can Access to Capital Explain the Entrepreneurship Gender Gap?.'

169 W. Adema et al., 'Enhancing Women's Economic Empowerment through Entrepreneurship and Business Leadership in OECD Countries'.

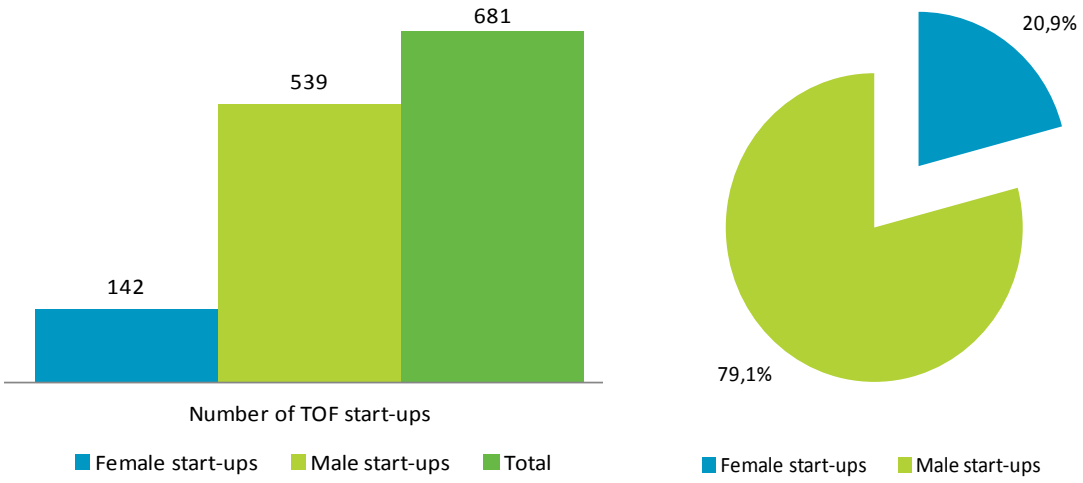
170 Telefónica is a Spanish multinational telecommunications company, considered as the largest telecommunication company in Europe and the fifth largest one in the world.

ups financed under the program were founded or lead by women, and the total amount invested was 40.5 million Euros in 142 female start-ups.

There is a broadly based perception that higher female participation in the start-up ecosystem provides multiple benefits, and this a shared idea within the platform. According to the internal analysis performed by TOF using their own data:

- Female start-ups have shown better performance than those founded by all male teams. In September 2016, 73% of WOMENSAGE start-ups were still running in comparison with 65% of the total TOF start-up portfolio.
- The fail rate of female start-ups stands at 15%, lower than the average portfolio rate of 24%.

Figure 63. TOF start-ups by gender (September 2016)



Source: Prepared in house based on data provided by TOF

Within the European Union, most of the TOF start-ups are concentrated in Spain and the UK, but the UK entrepreneurial ecosystem represents, from the gender balance point of view, a particularly successful case.

Wayra UK shows significantly higher rates of female participation than the average. Currently, the number of Wayra UK start-ups led by **at least one female founder is up to 45%.** Wayra UK, Telefónica's digital start-up accelerator, has tripled its number of female entrepreneurs when compared to the other Wayra initiatives around the world. It is, therefore, a case special case.

In 2015, Wayra UK commissioned a study, called the startupDNA Report, aimed at characterizing its start-up ecosystem[171]. The study, which focused on identifying how

171 The study was based on the replies given to a questionnaire, which was completed by 241 individuals from 222 companies across UK. 79% of respondents were working in a digital start-up while 214 of the total respondents held executive-level positions.

diverse Wayra's entrepreneurial ecosystem in the UK was, showed a strong interest in equality from the organisation's management.

Wayra UK maintains the idea that innovation, creativity and talent can come from anywhere, from any kind of person, and that excluding part of the population means leaving out enormous potential and missing opportunities. Therefore, and based on the results of their study, they decided to launch specific initiatives aimed at improving the diversity of the projects they work with. A number of initiatives, particularly ones regarding gender diversity, were launched:

- Next Tech Girls. Created by Empiric, Wayra UK is a supporter of this initiative which aims to increase the number of women in technology through real work experiences in tech company departments.
- Acorn Aspirations. Hosted by Wayra UK, it works with both young boys and girls from 12 to 18 years, with a special focus on girls and underrepresented communities. The aim is to get these youths involved in entrepreneurship, with the ultimate goal being that they set up technology start-ups.
- Mums in Tech. It is an initiative, hosted by Wayra UK, in which women with children have a flexible way of learning through both social support and coding courses tailored to their individual needs.
- Diversity Tech Summit. In collaboration with KPMG and Diversity UK[172], this event was aimed at studying possible intersections between entrepreneurship in tech and diversity aspects such as gender, location, sexuality, etc.
- International Women's Day, organized with the Institute of Directors[173].
- GSMA's International Girls in ICT Day.
- Events in collaboration with Premier Parents[174] concerning men who promote diversity or with Sisterhood Movement[175] to encourage black women in venture capital.

After analysing Wayra UK's experience, the following lessons can be extracted that might help other organizations reach higher rates of female participation.

Wayra UK's first distinguishing factor that stands out is its **vision and organizational culture. Diversity is an organization's cornerstone** and it is definitely a part of Wayra UK's culture. This commitment has been integrated into the program's vision

172 Diversity UK (https://diversityuk.org/) is an NGO that promotes diversity and inclusion through British organizations by means of influencing policies and civil society in general.

173 The Institute of Directors (https://www.iod.com/), supported by UN Women, it is a business organization for professional leaders.

174 Premier Parents (https://www.premierparents.co.uk/) is an organization specialized in part-time and flexible recruitment in several sectors for, mainly, skilled parents.

175 Sisterhood Movement (https://www.sisterhoodmovement.co.uk/) is a network mainly centered in young black women.

and is clearly reflected in several relevant aspects of its organization:

- **Involvement at the highest level of the organization**. The commitment is clear at the top of the hierarchy, which materializes in the personal involvement of Gary Stewart, Wayra UK and Ireland Director. His personal pledge is stated and shown in all his public appearances[176][177]. As an example of the organization's diversity vision, after being questioned about the low ratio of female entrepreneurs, he answered in one of his interviews:

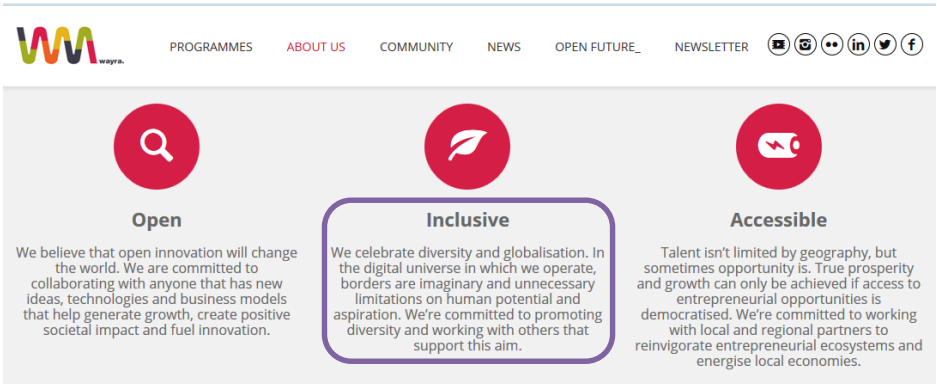
> "We are seeing more female applications, but that might be because **we are more actively scouting female entrepreneurs and scrutinising our own unconscious biases**. It helps that our female founders are among some of our most successful companies, which helps them to inspire future cohorts and to recommend other talented female founders that know that **Wayra actively encourages a diverse and supportive environment**.... it's acknowledging that the tech industry has this problem, and taking active, conscious steps to solve it..."
>
> Gary Stewart, Wayra UK and Ireland Director

- **Diversity at all levels of the organization.** Wayra UK acknowledges the importance of creating a welcoming environment in order to, in this particular case, attract potential female entrepreneurs. Thus, the mission of attracting diverse talent has permeated the entire organization. Half of the workforce is composed of women and they are actively looking for female mentors that are still in the minority.
- **Their mission becomes visible**. Inclusiveness is a differential value that companies focus and try to bring to the exterior of what they do.. Among its mission and values, Wayra UK's main pillars include, specifically, the inclusive measures stated on its website. Special events on diversity (Diversity Tech Summit) are also held.

176 Startup accelerators need more women. Huffington Post. February 2017, http://www.huffingtonpost.co.uk/vana-c-koutsomitis/the-case-for-startup-acce_b_14496992.html

177 Wayra UK Demo Day 2015. Gary S. is interviewed about Wayra UK. For further information: https://youtu.be/3Z2lVrs06Fg

Figure 64. Wayra UK's mission and values



Source: https://wayra.co.uk/

This commitment is also clear in the details. Wayra UK is female-friendly from the first time some potential entrepreneur browses its website. On the home page of its site, a description of its on-going projects is presented. A flash animation, in which a woman is the main and only character, is the first content a website visitor sees. Gender diversity is also expressed subliminally by means of symbolic language.

It seems clear that diversity is permeated throughout the whole organization at all levels. As a result, one can see that the organization's culture is responsible for achieving great results regarding gender diversity and for paving the way to success by promoting diversity. From **the organization's strategy**, the following fundamental ideas have been extracted: **cooperation, collaboration and global problem-solving.**

- **Diverse partnerships and initiatives**. Collaboration with different types of organizations is crucial to attract not only the actual female potential pool talent to the ecosystem but to also stimulate an interest in more girls and young females for jobs in the tech industry. These companies collaborate with educational organizations, industry associations, NGOs and governmental institutions.
- **Tackling the problem from different angles.** Measures are taken **throughout the potential female entrepreneur life cycle**. Actions range from the youth stage, with actions focused on improving their digital skills and their interest in entrepreneurship, to support female adults with, as an example, providing ways to enhance their skills through social benefits and training with flexible schedules. These types of actions oriented towards the youngest are the predominant ones. In this sense, according to existing research, actions aimed at the youngest seem to be the ones that have the greatest impact in reducing the confidence gap[178] and promoting a cultural change.

178 Sarsons, H., & Xu, G. Harvard University, Department of Economics, 'Confidence Men? Gender and Confidence: Evidence among Top Economists'.

- **Focus on local**. The initiative has been broadened to other regions in the UK in order to look for the best innovation and project ideas, independently from where it comes from. Thus, in cooperation with the Innovation Birmingham Campus[179] and Oldham Council[180], two new pre-acceleration programmes have been launched outside of London in 2016[181]. An additional program in Haringey is under negotiation. Those measures might have a real and positive impact on women who are unable to travel to the big cities, where all the activity is usually concentrated, because of family commitments, for example.

When analysing the concrete actions carried out, it is striking to note that, in spite of the great results proven by their high female participation, these actions are not so different from the initiatives carried out by many other entities throughout Europe. Inspirational and training activities, dissemination or internships, it is evident that the United Kingdom has degrees of gender equality and an entrepreneurial spirit generally superior to other countries and regions. Nonetheless, some factors seem to make the difference:

- Sustained commitment at all organizational levels. Wayra UK has been working on tackling diversity in a very intense way, not only on gender matter but also on racial or sexual diversity. The management commitment is crucial.
- Long-term basis. To obtain tangible results on gender diversity, those measures have to be addressed on a long-term basis. Diversity poses challenges that have to be tackled like a long-distance race. It is closely related to a process of cultural change, non-substantial differences could appear in a short period of time.
- Open cooperation approach: cooperation and collaboration with very varied types of organizations seems to be a key element of its strategy and probably at the heart of its success.
- Constancy. Wayra's UK program is not limited by reputation or positioning strategy on diversity; it is an organisational behaviour. Thus, all those actions are carried out constantly over time to enhance cultural diversity, inclusion and gender equity.

179 Innovation Birmingham Campus (https://www.innovationbham.com/) is a tech community where co-working and other facilities are provided to entrepreneurs.

180 Oldham Council website for further information: https://www.oldham.gov.uk/

181 Press releases about these partnerships:

https://wayra.co.uk/innovation-birmingham-partners-with-wayra-uk-to-deliver-new-serendip-smart-city-incubator-quarter/

https://wayra.co.uk/wayra-open-future_-oldham-council-plan-on-creating-shoreditch-of-the-north-by-opening-digital-enterprise-hub/

7. Public consultation

Introduction

The goal of the online consultation, "Women in Digital Age," was to reach out to stakeholders in an open, non-discriminatory manner on how they assess the situation of women in the digital age in general and particularly in the ICT sector, what possible solutions exist and what their perception of the role of the European Commission is regarding the problem.

It was a survey open to any interested participant, even though a campaign of dissemination was carried out among stakeholders through mailings and social networks.

The stakeholder consultation, carried out through the online EU survey tool and available in three different languages (English, French and Spanish) and open from 3 April to 2 June of 2017, was based on one single questionnaire. The questionnaire was composed of open-ended questions, multiple choice questions and simple choice questions. It focused on obtaining a sizable amount of information about the following main research topics:

1. Profile of the respondents
2. The importance of digital competences
3. Map of stakeholders
4. Perceptions of the current situation
5. Identification of successful and less successful stories
6. Women and entrepreneurship
7. Social media and women
8. The role of the European Commission

These topics were answered depending on the type of stakeholder responding to the survey. Those key stakeholders were classified according to the following categories:

- Education
- Policy/Decision making
- Entrepreneurship
- Communication/Media
- Private company
- Individuals

The final number of contributions to the survey was 203.

Analysis of results

Analysis of the results from the consultation was performed using the open source statistic program R. To analyse the survey properly different methods were utilized

depending on the type of question being looked at: simple choice question, multiple choice question or open-ended question. All the analysis performed in this study is descriptive. Since the sample collected in the consultation is unlikely to represent any population, the analysis was geared towards obtaining useful insights about the perceptions of relevant stakeholders without making any further conclusions about the population as a whole.

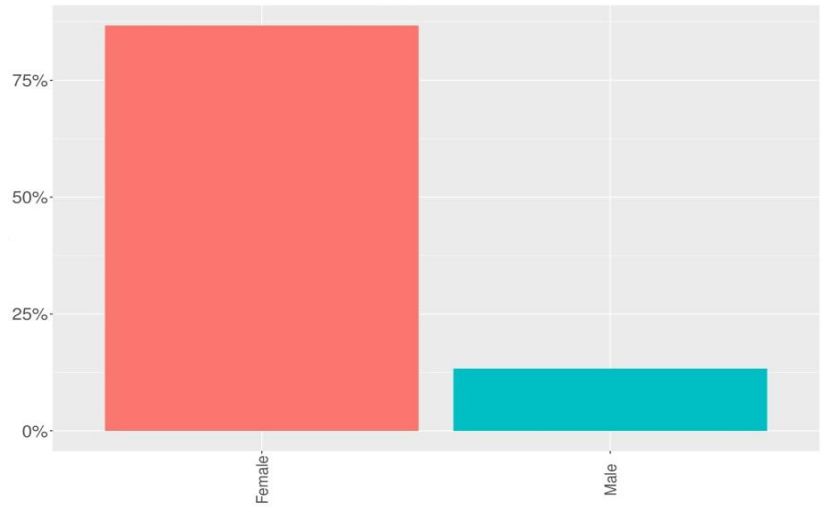
The simple choice questions were analysed by looking at the percentage of respondents for each of the different choices to the question. In some cases the answers are classified by other variables such as gender or age. The results are shown in bar charts. The multiple choice questions are displayed in tile charts to make it easier to compare each question to other factors, such as gender or age. The answers to these questions range from 0 to 5. The colour of the tile is related to the average value provided by the respondents of the different groups analysed.

There are several open-ended questions in the survey. These questions have been analysed with Natural Language Processing and clustering methods.

Socio-demographic profile of the respondents

Overall 86.7% of the respondents were women.

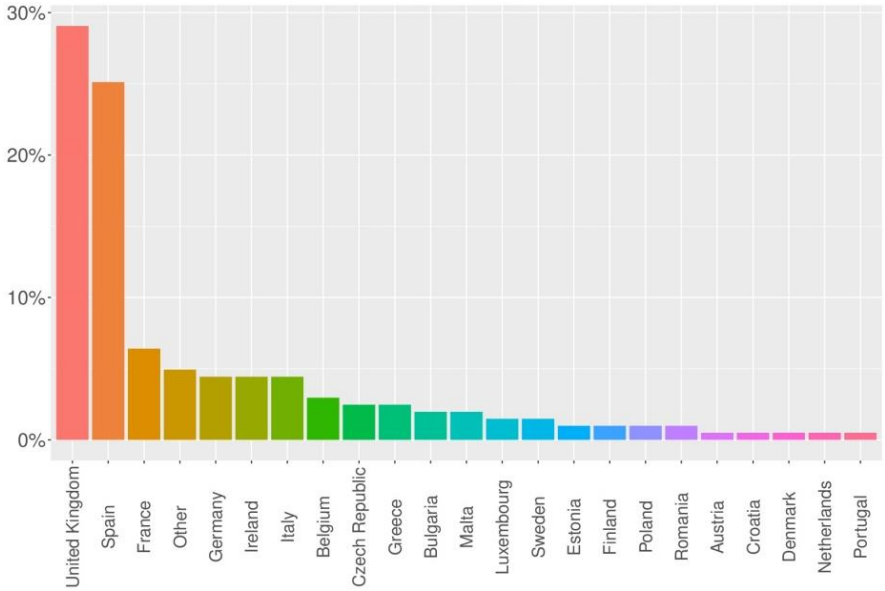
Figure 65. Percentage of respondents by gender



Regarding the geographical representation of the consultation, although more than 60% of the replies came from the United Kingdom, Spain and France, a wide EU membership representation was reached[182]. Other respondents came from the USA, Norway, Montenegro, Iceland, Serbia, Switzerland and Argentina and represent 4.9% of the total number of replies.

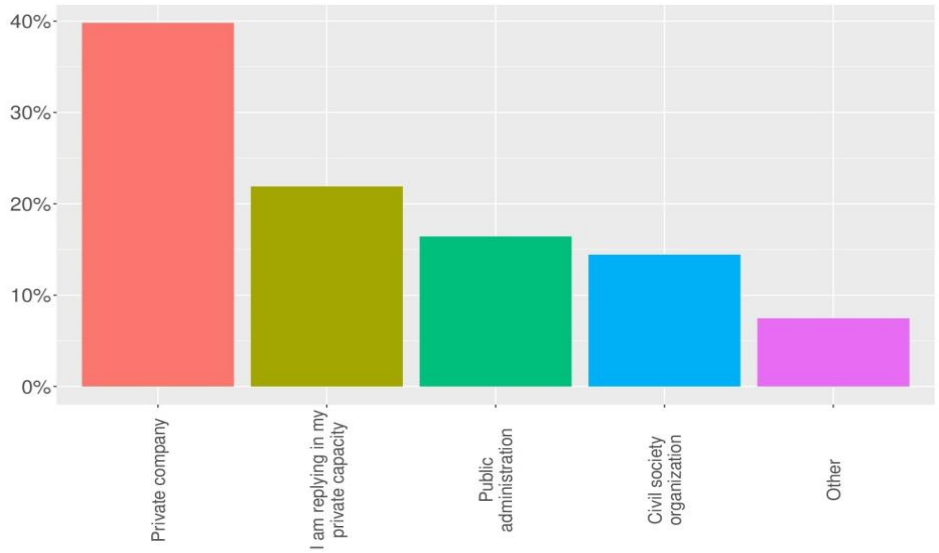
182 All Member States except for Cyprus, Latvia, Lithuania, Slovak Republic and Slovenia

Figure 66. Geographic coverage of the consultation



As shown in the following figure, the results obtained contain a wide and varied representation of sectors within the sector of activity:

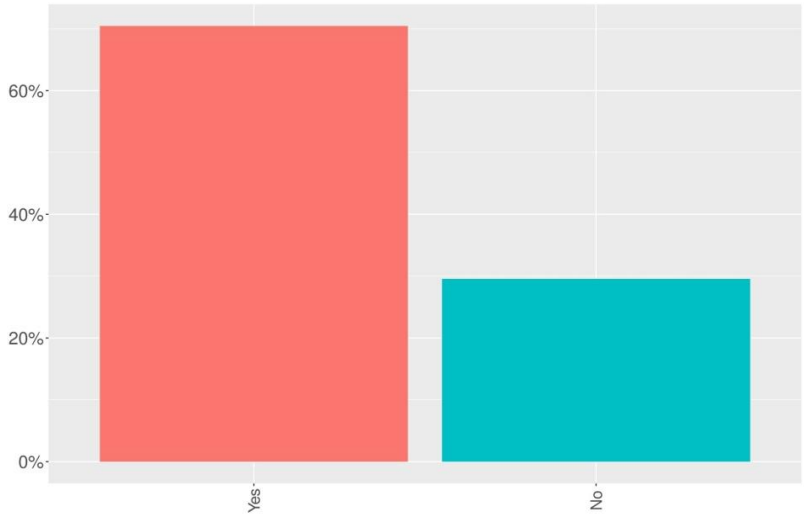
Figure 67. Percentage of respondents by sector of activity



The greatest share of respondents came from private companies, which totalled 39.4%, followed by individuals at 21.7%. Public administrations and civil society organizations made up 16.3% and 14.3% of the total of replies, respectively. When the 'other' option was specified, most of the answers were associated with education and academic and research institutions.

Most of the respondents, 70.5%, had an educational background in ICT.

Figure 68. Percentage of respondents with educational background in ICT



Results

<u>The importance of the digital competences</u>

Digital competences[183] seem to be a very important issue for the respondents. Digital skills are important in both professional and personal life, though their application in the professional life is considered slightly more relevant.

Figure 69. Relevance of digital competences in professional life (%)

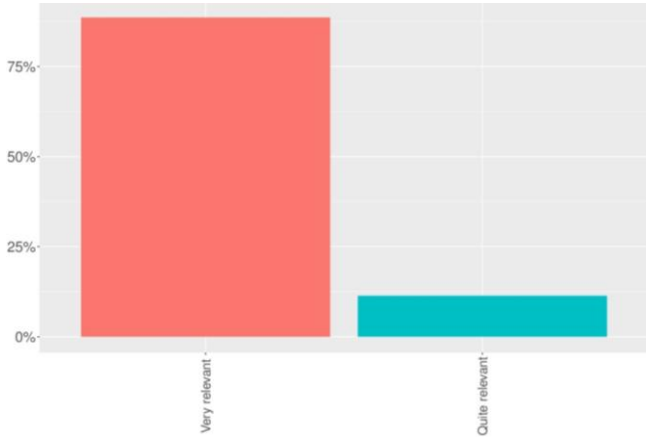
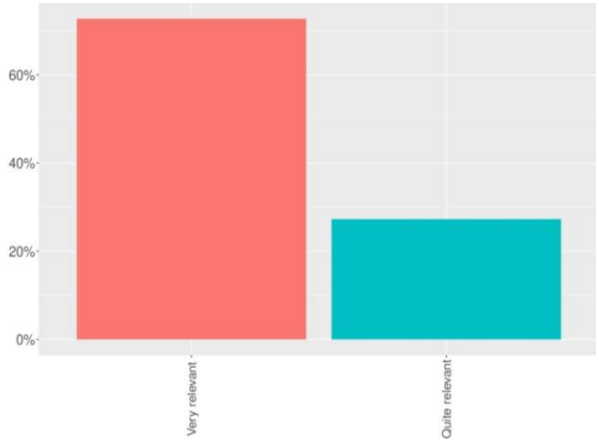


Figure 70. Relevance of digital competences in personal life (%)



183 Digital competence defined as basic skills for the use of digital technologies (such as computers and the Internet) to retrieve, assess, store, produce, present and exchange information, and to communicate and participate in collaborative networks.

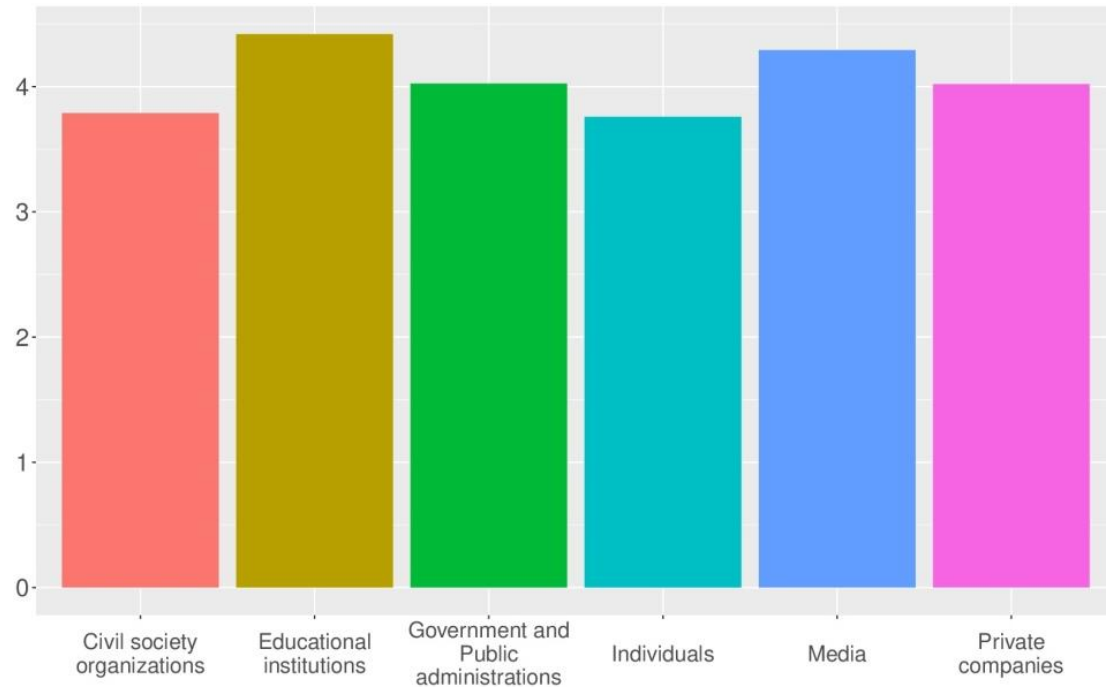
The consultation responses highlight the important role of basic digital skills in daily professional duties. Digital competences have become necessary not only for ICT professions but also for most jobs. These competences are important for technical professional reasons, the employee's own visibility and the access and exchange of data and information.

Nowadays, basic digital skills are also required for leisure and communication activities. According to those surveyed, digital skills are particularly important for engaging in social interactions, being in touch with friends and family and keeping informed and connected.

Map of stakeholders

The objective of this subsection is to examine and classify the most relevant stakeholders regarding decision-making when it comes to empowering and promoting the participation of women in the digital world and understand how they are interrelated to each other. According to respondents, educational institutions are the most relevant organizations in the struggle for a higher ratio of women in the ICT sector. Media are highlighted as another relevant stakeholder; media seem to be seen as powerful channels to reach and spread out female enhancement policies, initiatives and best practices in the digital world.

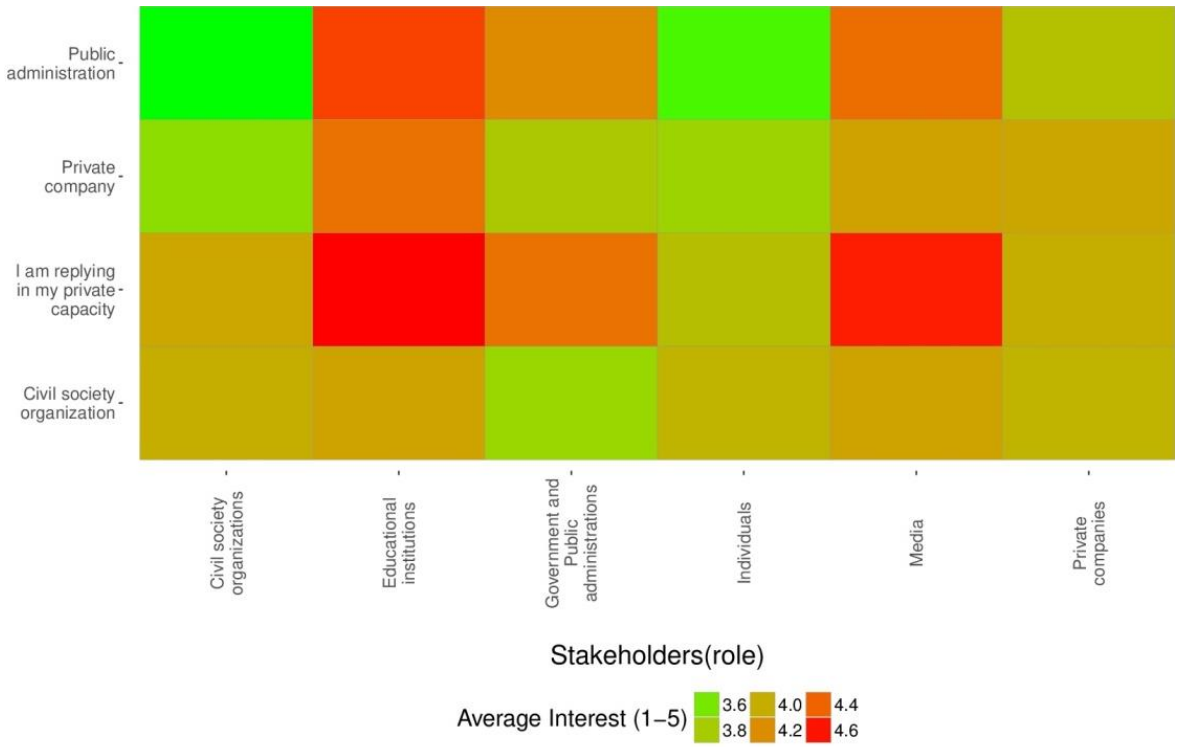
Figure 71. Stakeholders' relevance, on average response, in empowerment and promotion of female participation in the digital world



The tile chart below allows us to analyse the relationship between stakeholders and their relevance[184]. The ordinate axis shows the types of respondents and the abscissa axis shows what sphere the stakeholders, whom the respondents interact with the most, work in. The colour of the tile shows the average score of how relevant the different stakeholders are for each type of respondent.

Generally speaking, educational institutions are seen as the most important stakeholders to improve the situation of women in the ICT sector. Public administrations and those identified as individuals are the ones concerned the most about the role of the educational sector. For public administration, the media is the second most relevant stakeholder, as well as for individuals. For private companies, educational institutions are also the most relevant agent. For organizations from civil society most stakeholders are equally relevant, with the government and public administration as the two less relevant ones.

Figure 72. Stakeholders' relevance on average response, by type of stakeholder surveyed, in the empowerment and promotion of women in the digital world



184 The average score of the relevance of the stakeholders depending on the type of respondent has been obtained by crossing the variable "type of stakeholder" specified by the respondent with the variables defined as "type of stakeholder which has the most relevant role in empowering and promoting the participation of women in the digital world" —the individual score can range from '1' (no relevant) to '5' (very relevant).

When respondents were asked about how those stakeholders might boost and enhance the participation of women in the sector, they indicated that actions should be taken to promote initiatives based on (1) role models, (2) best practices and (3) mentoring aimed at promoting a gender-neutral vision of the ICT sector. In accordance with the analysis of results, these actions can become possible with the aid from public administrations, educational institutions, and the media. Public administrations can initiate these actions and help fund them, educational institutions can promote and support the initiatives that arise from the actions taken and the media can increase visibility of these actions and resulting initiatives.

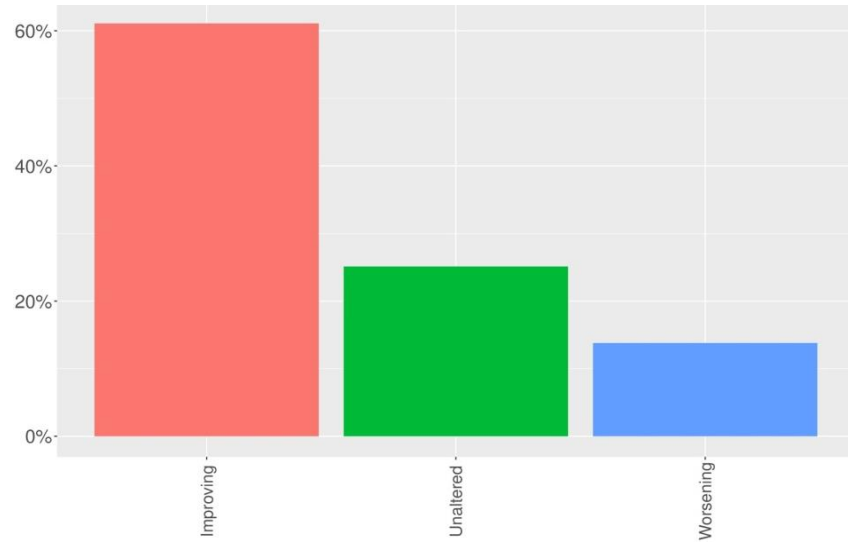
Figure 73. Tag cloud on responses about stakeholders' actions to empower and promote the participation of women in the digital world

Perceptions on the current situation

In this subsection, respondents were asked about their perception of the current situation of women in the digital world and their opinion on how female participation has evolved in recent years.

> *"Too much bias still exists. Gender pay gap and lack of appreciation for the skills and abilities women bring to the digital world mean digital is not being seen as a positive role for women."*
>
> Public administration employee

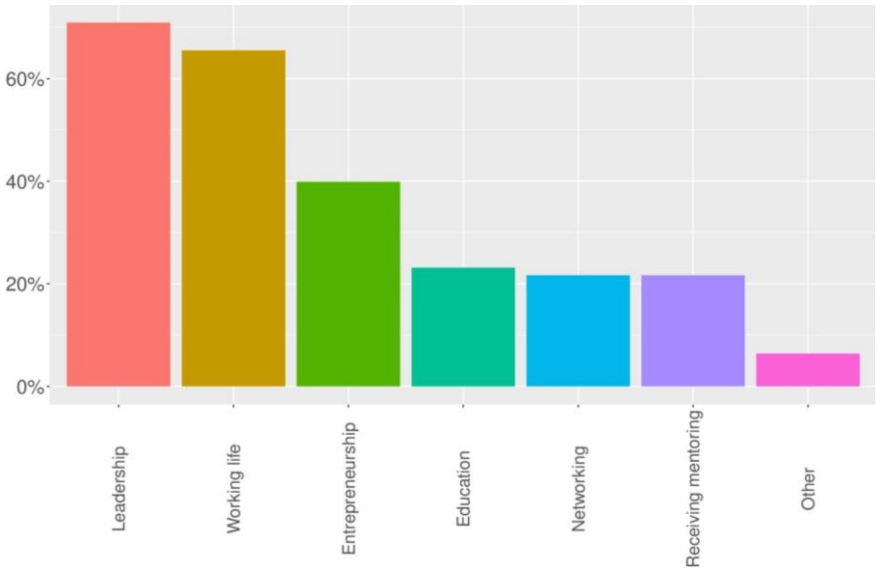
Figure 74. Perception on the participation of women in the digital world (%)



61.1% of respondents believe that the participation of women has improved while 13.8% think that the situation has worsened. One out of four of the respondents, 25.1%, reported that they believe the situation has not changed.

For a more comprehensive overview, the respondents were asked about the particular fields in which women are facing the biggest challenges, with leadership and work-life balance as the most cited responses.

Figure 75. Fields in which women are facing biggest challenges

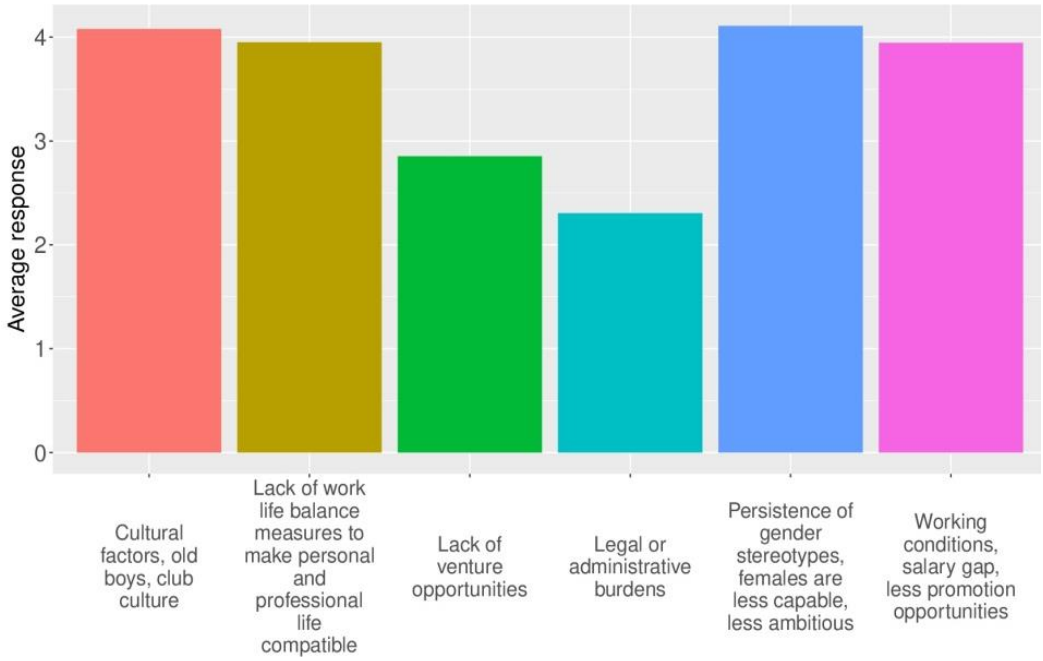


Respondents seemed to perceive subjective barriers, such as the existing culture, as the most influencing factor in current female status in the digital context. Other barriers, such as access to funding and lack of role models, were also mentioned.

Figure 76. Tag cloud on responses about fields in which women are facing biggest challenges

The persistence of gender stereotypes (females are less capable, less ambitious, etc.), certain phenomena (tokenism) and cultural factors (the "old boys' club" and informal male-only business networks) are among the most mentioned factors hindering the process of female empowerment in a traditionally male-dominated world.

Figure 77. Barriers preventing women from participating in the digital world (scaled from 1 to 5, with '1' indicating not relevant and '5' very relevant)



Respondents also referred to those conventional social expectations and responsibilities culturally carried out by women (care of children and older persons, etc.) as negatively affecting female working conditions and their potential career development.

Other structural barriers, like legal or administrative burdens and the lack of venture opportunities, were not perceived by respondents as the most influencing factors in the participation of women in the digital world.

Qualitative analysis of the best practices suggested

In this subsection, suggested best practices and less successful stories were analysed.

Almost four out of ten responses were examples of best practices in the education and training fields. Most of those actions were focused on training for girls at an early stage. Through competitions and courses aimed at increasing the number of female students interested in ICT professional careers, girls are mentored by female engineers and researchers acting as role models who introduce them to the tech sector. Some of the cited best practices aimed at increasing female visibility through awareness raising activities and women engineers serving as role models to encourage female students to choose a career in ICT. Respondents have also described initiatives aimed at encouraging higher ratios of women in computer science degrees. To create higher ratios, initiatives are aimed at reducing entry barriers for women through introductory courses, restructured syllabi, or bachelor's degrees exclusively oriented towards female students.

Among the best practices identified regarding leadership, three main measures were identified: mentoring, networking, and awareness campaigns. Most of the initiatives are focused on establishing networks and providing women access to mentors in order to acquire the skills and abilities necessary to progress on their career paths. Awareness campaigns, though, are mostly aimed at empowering and promoting success stories. Some respondents also suggested measures targeting top and mid-level management positions to promote more females in those types of positions and reduce the gender bias.

Most work-life balance measures identified by the respondents were focused on initiatives to help facilitate it (flexible jobs, maternity leave, daycares, etc.) and involved key stakeholders. The list of such stakeholders included universities, policy-makers and any other organization in which women might take advantage of career advancement opportunities.

Figure 78. Tag cloud on responses about best practices specified by the respondents

Entrepreneurship initiatives, similar to those specified in leadership, are aimed at boosting and supporting the female enterprising spirit in the tech sector through mentoring programs, mentoring activities, role models and other events and workshops to connect female professionals.

Respondents were also asked about any experience where the lack of gender diversity in a team/organization had a clear impact on the results of its work; 24% of them answered positively. Two main ideas were exposed from the respondents' answers. The first idea was that gender-unbalanced teams and leadership have a negative influence on the innovation process.

The development of new products and services requires gathering more diverse data from potential users so as to create a product or service that matches the diverse customer profiles a company may have.

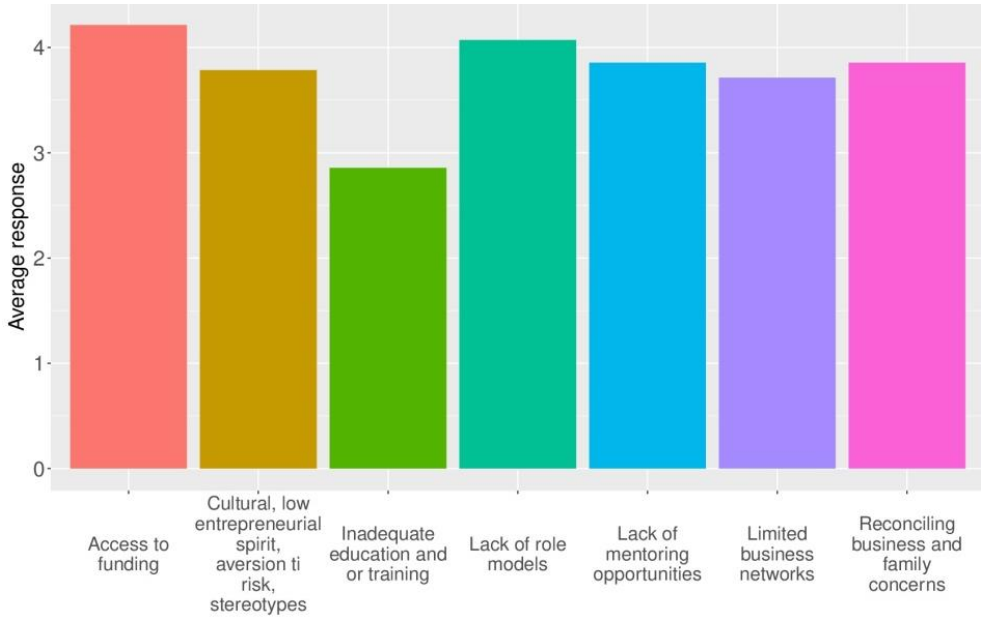
The second idea identifies the effects of gender-unbalanced work teams on women where women are leaving the workforce earlier than planned due to working environments where they have to struggle for recognition at the same level of their male counterparts.

Figure 79. Tag cloud on responses about experiences where the lack of gender diversity had any impact on project team results

Women and entrepreneurship

This subsection focuses on evaluating the perception entrepreneurs have regarding the most pertinent challenges faced by women when it comes to establishing and running their own businesses. According to the results obtained, the most relevant factor was access to funding.

Figure 80. Challenges faced by women when it comes to establishing and running a business (scaled from 1 to 5, with '1' indicating no relevant and '5' very relevant)



Although access to funding was identified as the most common factor preventing a higher number of female entrepreneurs, there are other challenges that precede female entrepreneurs seeking funds. One challenge is getting more females into the enterprising business. To achieve a higher ratio of these enterprising women, respondents recognized increasing role models, mentoring opportunities and business networks as ways to address the problem of lower ratios of females engaging in entrepreneurship. Besides these factors, creating a better work-life balance was another factor highlighted by the respondents. Challenges related to inadequate education or training were the lowest scored factors affecting the number of female entrepreneurs.

Social media and women

There is no doubt about the power of social media and its influence on how people socialize, communicate and network, among other uses. There are, however, some risks associated with the use of these social media sites, including the increase of cyberbullying. The analysed research on this topic focuses on the role of social media and its positive and negative effects, particularly on women, if any.

More than 80% of respondents make use of professional social networks like LinkedIn, followed by platforms such as Facebook or Twitter which are designed, *a priori*, for a more private rather than professional use.

Almost 80% of the respondents specified that they use these platforms on a daily basis. Only 2% of those surveyed have never used social media.

Figure 81. Percentage of social media sites

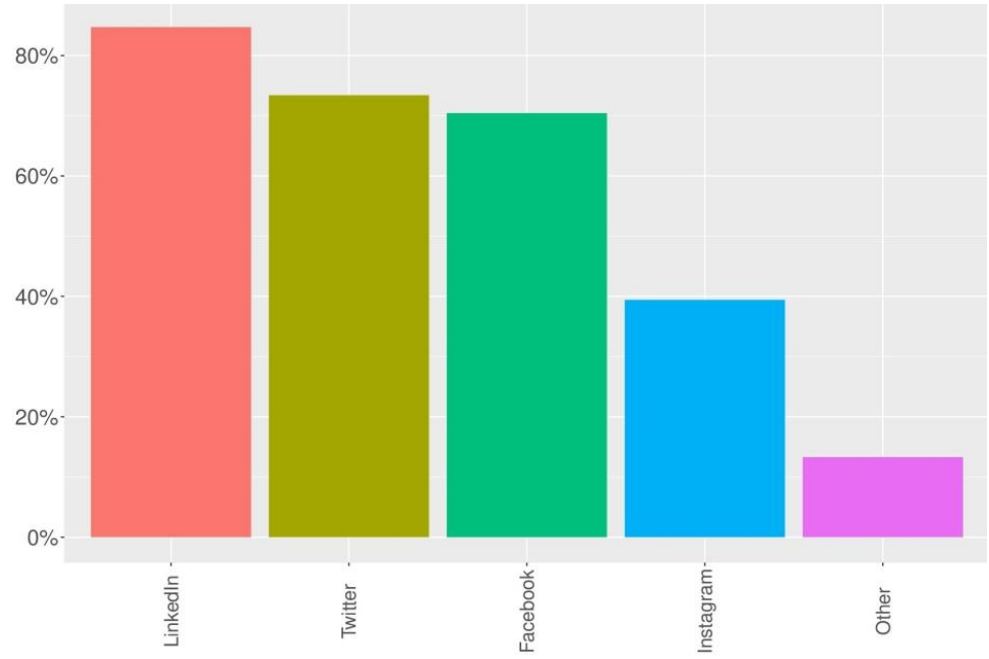
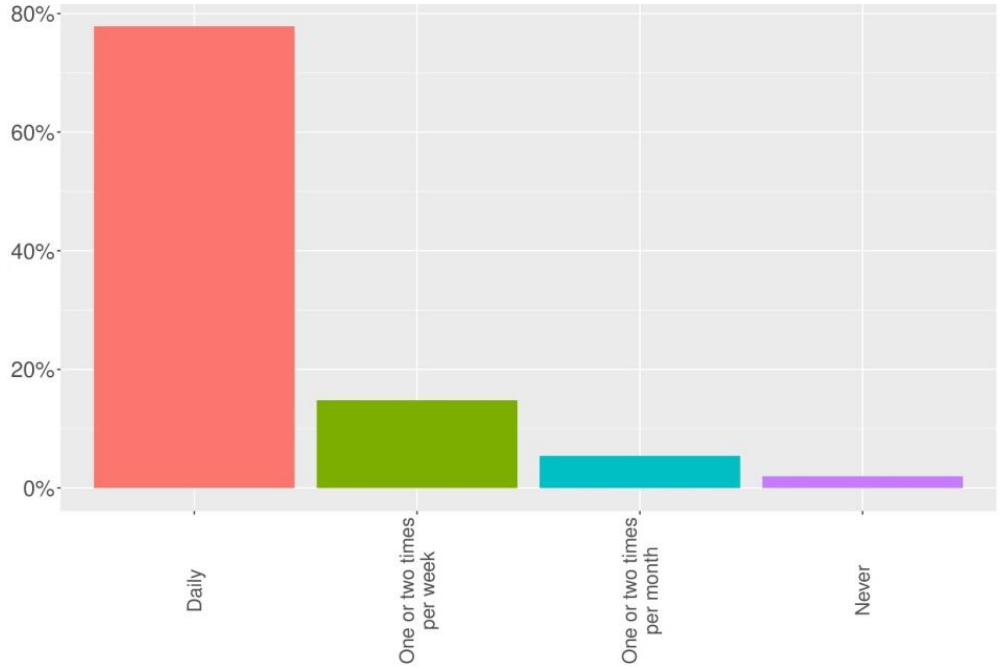


Figure 82. Social media frequency of use (%)



When the respondents were asked about the role that social media currently plays to improve women's presence and participation in the digital age, there was widespread agreement that social networks are effective and influential tools to spread the importance of women in the digital context. Social media is also considered very useful for reaching a greater audience than would be reached through more traditional media.

> *"Social media are currently playing a positive role in improving women's presence mostly due to openness, accessibility and spread of use. They provide a channel for promoting women in equal terms."*

Respondents pointed out a variety of actions and measures regarding the use of social media to enhance female participation.

Figure 83. Tag cloud on responses about the role of social media in order to improve women's situation/presence/participation in the digital age

Those actions can be divided into 5 main groups:

- Increasing female visibility in culturally masculinised activity sectors.
- Reducing stereotypes.
- Awareness raising campaigns via social media to improve female participation in the digital age.
- Increasing participation through promotion/networking and female empowerment.
- Amplifying/sharing best practices.

Respondents' opinions about challenges that social media poses, particularly on women, varied. Several respondents mentioned that there are no differences between the influences on women compared to other potential users of social networks. Other responses were related to cybercrimes and the perpetuation of acquired cultural stereotypes.

Figure 84.Tag cloud on responses about the challenges that social media poses on women

Opinions are classified into six groups of risks or challenges particularly affecting women:

- Stereotype perpetuation.
- Trolling.
- Fake news.
- Cyberbullying.
- Online harassment.
- Intrusion of privacy.

After evaluating the advantages and disadvantages, and considering the cases and practices suggested by participants in the consultation, the role social media currently plays in existing initiatives across Europe seems to be one that mostly encourages and empowers women in the digital age and increases visibility of women's achievements in tech.

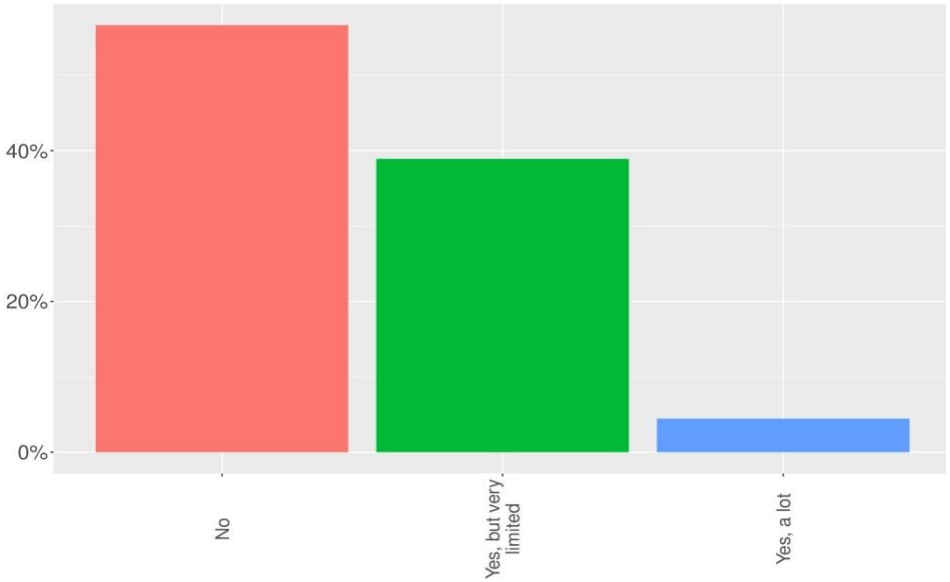
Figure 85. Tag cloud on responses about the role played by social media in EU initiatives and best practices

The role of the European Commission

Current situation of women in the digital context

Stakeholders surveyed believe that initiatives developed by the EC to help with the situation of women in the digital context haven't had a positive impact on this matter.

Figure 86. Impact of the work of the EC on the situation of women in the digital context



Respondents were encouraged to cite concrete programs regarding this issue but only 2 out of every 10 respondents could cite concrete actions that they considered successful. When they did, some of the responses indicated that, although the EC aims at fostering greater female participation in the digital context, most of those initiatives haven't had a profound impact on, in particular, the female situation nor on society in general.

There is a broadly based perception that greater integration and coordination of actions and policies across Member States would be a key success factor. Respondents are aware of the impact of European fragmentation and the limited effectiveness of current actions at the local, regional and national levels.

When asked about what the EC could do, most suggestions aimed at promoting a higher participation of girls and women through awareness campaigns based on real and recognizable role models, fostering a more active participation in the industry. Other proposals encouraged the Commission to further strengthen initiatives in schools and educational institutions in general. Concrete proposals and initiatives suggested can be divided into three categories:

- Leadership/role models.
- Education.
- Awareness-raising campaigns.

Women and ICT-related studies

Stakeholders involved in business or educational activities and policy makers were asked about what role, including specific actions, the European Commission should take in encouraging women's enrollment in ICT-related studies.

Most of the responses focused on the educational environment, highlighting the importance of participation by all involved parties such as female role models, parents, teachers, educational policy makers, etc. The actions suggested by the respondents aimed to encourage stakeholders to attract particular groups by providing a more diverse education via reformed syllabi that make the content more attractive to women, scholarships for women who choose an ICT-related degree, faculty training on gender diversity, and more.

In the private sector, initiatives to promote women within their companies and other measures, such as fixed quotas, were proposed.

Once again, particular concern regarding EU fragmentation is cited though the respondents' proposals. The belief that EC initiatives might reach a wider range of potential beneficiaries, on a geographical level, exists.

> *"More promotion of current programs within countries and at a regional/local level."*
>
> ICT business employee

Women and digital skills

Key stakeholders, like those involved in business or educational activities, and policy makers were asked about their ideas regarding innovative EC approaches that could be implemented to encourage women to acquire or improve their digital skills. The main proposals were focused on providing equal opportunities for both genders, not only by reforming educational practices but also by breaking down negative social and cultural stereotypes.

Respondents indicated that those measures have an impact on women's perspectives about digital competences and their own capabilities, increasing female confidence. These benefits will lead to more female competiveness and empowerment in ICT, providing to more equal opportunities and a more balanced and attractive sector. A more harmonized and connected policy agenda with other related international policies will also improve those results.

Figure 87. Tag cloud on responses about impact of EC actions to encourage women acquiring or improving their digital skills

EC role in social media and women

The present subsection focuses on education entities', the media's and policy makers' perspectives, the three most involved sectors on the matter to be analysed. Those stakeholders were asked about the role of the European Commission on maximizing the benefits and minimizing the negative effects of social media on women and girls.

The actions suggested by the stakeholders were mainly focused on the following issues:

- Prosecuting crimes on social media (cyberbullying, trolling, harassment, etc.) with a common jurisprudence for all EU member countries.
- Government commitment to taking more control over social media companies and their security policies for law enforcement.
- Social awareness campaigns to educate on more efficient and non-discriminative uses of social media.

Female working conditions and the EC's role

Stakeholders belonging to educational institutions, private companies and policy making were asked to give ideas about the role the EC can play in order to improve the working conditions of women in the ICT sector.

Figure 88. Tag cloud on responses about the role of the EC in improving female working conditions in the ICT sector

Most responses were related to the differences that still exist between genders, particularly the working conditions which hinder equal opportunities for both men and women. Some suggested establishing policies and regulatory incentives so as to encourage gender equality policies within private companies. Other responses were focused on the promotion of best practices to foster and grow the number of female ICT workers and leaders. The proposed ideas can be organized into four groups:

- Working conditions (gender pay gap, etc.).
- Better work-life balance.
- Promoting best practices.
- Policies and regulatory incentives.

Respondents indicated that a better work-life balance and working conditions would increase the number of women in ICT-related studies, female workers in the sector and females in positions of responsibility. These actions would also allow for easier and more frequent reintegration of women into the labour market. Suggested measures included equal and non-transferable parental leave, childhood care facilities, equal pay, promotion and sponsorship opportunities, blind hiring processes, etc.

Female entrepreneurs and the EC's role

Access to funding is the key problem when it comes to facilitating women becoming entrepreneurs in the digital context. Most of the respondents' opinions focused on facilitating access to funding along with the creation of funds specially designed for female entrepreneurs. Other suggested measures were aimed at encouraging entrepreneurship through actions such as mentorship or networking. With respect to the role of the European Commission, some respondents believed that all initiatives and policies created by the EC should always take into consideration the gender issue and be designed from a gender perspective.

Examples of the main ideas outlined in this subsection include:

- Gender perspective in every EC initiative and programme.
- Mentorship.
- Networking.
- Funding opportunities.

Those measures would be aimed at breaking entry barriers and stereotypes about women and female risk aversion among the whole entrepreneurship ecosystem, including in women themselves.

Conclusions

From the results previously presented the following general conclusions can be extracted:

- Generally, it seems that subjective barriers are considered more relevant than structural ones regarding the situation of women in the digital context.

- Despite what is sometimes generally assumed, positive and negative impacts of social media on users are not seen as an exclusively female matter.
- Role model and mentoring actions have been highlighted by most of the respondents as one of the most effective measures to tackle the situation of women in the ICT sector.
- The role the European Commission plays regarding gender equality aspects in the digital sphere is perceived as weak, and its actions are considered to have little to no impact on the problem.
- There is also the perception that the European Commission is not targeting the existing fragmentation in Europe enough. Policies are perceived as not being successful at overcoming the existing fragmentation of regional and national initiatives in place.
- In particular, regarding every research topic covered by the consultation:
    - Digital competences are perceived, by most of the respondents, as very important skills for both personal and professional life.
    - Stakeholders emphasize educational institutions and, to a lesser extent, other informal training institutions as the most relevant stakeholders playing a proactive role in improving female representation in the digital sphere and, particularly, in early educational stages. Responses also stressed media as the most powerful channel to obtain a wider audience for those initiatives and raising awareness on the issue.
    - The general recognition of the current problems facing women in the digital world is improving, especially the fact that many of the problems are mainly subjective. Even with this increased awareness, leadership and working life conditions are still the fields in which women are facing the biggest challenges.
    - Most of the best practices suggested by participants in the consultation focus on young girls. Lack of gender diversity in organizations is also stressed as directly affecting the innovation processes.
    - Female entrepreneurs encounter the most prominent challenge in accessing funding.
    - Social media increases female participation and visibility in the digital age. It also facilitates networking and raising awareness on issues. Respondents, however, are concerned about some cybercrimes and stereotype perpetuation.
    - The European Commission should play a stronger integrating role in supporting those initiatives and actions already implemented by the stakeholders mentioned in the consultation.

8. Digital innovation versus an assumed gender bias

The 2016 Innovation Report for the President of the European Commission on "how best to position Europe as a global pro-innovation actor" titles its second chapter "Everyone must own the Revolution", and it is summarized as follows:

The world is on the crest of a wave of revolutionary disruption. Europe can choose to own, not merely experience, this Revolution. Europe could also easily miss the wave, if we quite humanly ignore it, or exaggerate its challenge and freeze in impotence. Europe can catch the wave by drawing on our strengths as a mature community of values and an open society. But success requires the collective courage to open and sustain a different public conversation[185]*.*

Owning the digital revolution is a collective challenge that requires a collective response. Women can't be left behind in this effort.

In order to engage everyone women need the right skills, they need to be part of the workforce and reach leadership positions. If equality in the digital sphere is not achieved, talent, vision, resources and wealth will be missed.

7.1 The consequences: is technology gender biased?

The lack of diversity, particularly of women, in teams developing technology has an impact on innovation.

A direct evidence of this fact can be found in examples of failed, inadequate or unfortunate products and services such as Apple's HealthKit, a comprehensive health tracker app that neglected to include a menstruation tracker until the iOS 9 version, or an artificial heart that suited 86% of men but only 20% of women because of its size[186].

Indirect benefits of having diverse teams are more complex to prove, but there is evidence that diversity, particularly in intensively knowledge-based industries such as ICT, increases performance and innovation. Concretely, recent studies show that research teams with higher levels of diversity, from both a gender and nationality standpoint, have higher levels of R&D intensity and efficiency[187].

Considering the growing importance of big data and algorithms in our lives, if no action is taken, the impact of the lack of diversity in technology can be extreme.

---

185 Robert Madelin, 'Opportunity Now: Europe's Mission to Innovate'.

186 More information on this device can be found here: https://motherboard.vice.com/en_us/article/technology-isnt-designed-to-fit-women ; and here: http://www.smithsonianmag.com/innovation/the-worlds-first-true-artificial-heart-now-beats-inside-a-75-year-old-patient-180948280/?no-ist

187 Schneider and Eckl, 'The Difference Makes a Difference: Team Diversity and Innovative Capacity'.

Artificial Intelligence is considered one of the technologies that is most likely to change and reshape the way we live and work in the near future. The huge amount of data available in the Internet ecosystem, the increased computer and storage power and the emergence of new open source tools and methods are fostering an environment where AI can thrive. Machine learning, including deep learning, allows for self-driving cars, human quality automated language translation and medical diagnosis systems. Artificial intelligence is expected to be one of the most disrupting technologies in the short future, and it will have an impact on virtually every industry and aspect of our daily life[188].

The increasing relevance of AI in our daily live has implications from a gender point of view. First, there is a concern that machine learning might perpetuate, if not magnify, existing gender stereotypes. Machine learning algorithms are mainly trained by using information provided by people. If there is a gender, or race or age bias in the training process, the resulting AI will be biased as well, reinforcing a vicious circle with unpredictable results.

Exiting research has identified signs of data-driven discrimination —including gender— in digital services or products, such as Google or Facebook.

Historic gender biases are present in existing data: books, articles, news, films, blogs, comments in social networks, etc. Machine learning and deep learning techniques, when applied blindly, incorporate the gender stereotypes imprinted in these data through language patterns[189].

According to a recent study from Bolukbasi et al.[190], the widespread use of word embedding techniques has a strong potential to replicate and even amplify existing gender discrimination, prejudices and stereotypes. They found, for example, "female/male gender stereotypes to a disturbing extent" in Google News.

Gender bias might also have an important impact when it comes to personalized content, particularly when it comes to advertisements. Datta et al.[191] found that females had less of a chance to come across ads for high paying jobs than males in Google. Lambrecht & Tucker[192] empirically found that a gender-neutral ad with information about STEM studies was showed to 20% more men than women on a major social media platform.

The potential outputs of such biases are countless. For instance, the use of "biased" AI human resources applications for curricula vitae analysis might result in the preference of men over woman for certain jobs, since the system might link certain careers with men and not with women. Regarding the personalization of content in social media, the impact

---

188 Kuziemski, 'It's Make or Break Time for Artificial Intelligence. Here's How We Can Make It Work'.

189 Caliskan, Bryson, and Narayanan, 'Semantics Derived Automatically from Language Corpora Contain Human-like Biases'.

190 Bolukbasi et al., 'Man Is to Computer Programmer as Woman Is to Homemaker?'

191 Datta, A., Tschantz, M. C., and Datta, A., 'Automated Experiments on Ad Privacy Settings'.

192 Lambrecht and Tucker, 'Algorithmic Bias?'

of certain types of advertising might have unintended consequences in women's careers' choices by narrowing the information that girls and women can access online.

Identifying the causes of the empirical results highlighting sexism might help prevent its negative impact, particularly for girls. From the existing literature several explanations as to why biases may develop in personalization algorithms can be pointed out:

- Technology replicates the uncovered (or not) existing discrimination and cultural prejudices:
    - data available might be partial
    - results just reflect historical biases
- Discrimination is the result of market dynamics:
    - Algorithms maximize the probability of success of an ad by applying segmentation of targets on the base demography and, therefore, may show certain ads to those with higher chances of clicking on them.
    - The ads market assigns different prices to different socio-demographic target groups. Women between 25 and 45 are considered to be a more expensive target compared to men. With this information, cost-effectiveness strategy algorithms provide more impressions of certain ads on men than women.

Bias in social media: an experiment on Facebook

As the impact of social media becomes more relevant, the concern about possible bias grows. In 2016, 52% of Europeans used social networks, including 82% of youth aged 16 to 24 and 76% of young adults aged 25 to 34[193]. By gender, women are slightly more likely to use social networks than men; girls aged 16 to 24 in the EU use these networks 5 percentages points more compared to boys. There are differences depending on the services, for example, on Facebook there are more female than male users while Linkedin is globally accessed more often by men than women[194]. Adults spend around 5.5 hours a week using social media and around 25% of online time for women consists of accessing social media accounts[195].

Social networks, particularly Facebook, have become an important source of news and information. For youth and women, social media is increasingly becoming the main source of news[196]. Moreover, social networks have an increasing impact on consumers' decisions and, as a result, it is expected that the share of social media advertising

193 Eurostat. Digital economy and society statistics - households and individuals.

194 York, Alex, 'Social Media Demographics for Marketers'.

195 Nielsen, 'The 2016 Nielsen Social Media Report'.

196 Reuters Institute for the Study of Journalis, 'Digital News Report 2016'.

expenditure as a percentage of digital advertising spending will reach 34.5% worldwide in 2017[197].

A survey carried out by the EC among stakeholders[198] working on gender issues in the digital sphere pointed out that social media has both positive and negative impacts on females. On the one hand, it may increase female participation and visibility in the digital age as well as facilitating networking opportunities and increasing awareness. On the other hand, respondents are concerned about how these tools can increase certain cybercrimes against women and how social media can encourage the perpetuation of gender stereotypes.

Given the relevance that social media has in shaping the preferences and choices of the younger generation, a test in Facebook was conducted aimed at identifying possible areas of further research. The test consisted of comparing the recommendations provided to two different profiles with no navigation history and very basic information about the user. The effect of the gender in the functioning of the recommendations algorithm of Facebook was attempted to be isolated by creating two profiles with exactly the same information and activity but different genders.

The results of the test showed that, although the social network showed certain differences in performance, particularly when welcoming users after logging in and in the recommendations offered to the two profiles created, no significant gender biases were identified in the recommendation engine. The suggestions and content offered to both the man and the woman were the same or of similar characteristics, particularly the technology-related content. The minor differences seemed to be due to randomness or a business strategy, such as the use of A/B testing techniques[199] or commercial policies with advertisers, in the selection of content carried out by the platform algorithm and the results of this test can't asseverate the existence of gender biased behaviour. The conclusion was that biases might be more influenced by the activity of the network of contacts of the user than the self-attributed gender and user activity. That is, the algorithm might replicate biases existing in the network, a.k.a. the people or "friends," of the user. Two users with the same interests and exactly the same network seem to receive the same recommendations from the tool. The small differences found in the experiment, such as the difference in welcome messages, might be a sign of a more subtle bias that would require a more detailed examination. Consequently, further research would be needed to identify the underlying causes of biases in social networks using existing academic literature to identify the dynamics of

197 Statista, 'Social Media Advertising Expenditure as Share of Digital Advertising Spending Worldwide from 2013 to 2017'.

198 We launched an online consultation, "Women in Digital Age", from 3 April to 2 June of 2017, to reach out to stakeholders in an open, non-discriminatory manner on how they assess the situation of women in the digital age in general and the ICT sector in particular. It was carried out through the online EU survey tool and available in three different languages (English, French and Spanish) and we obtained 203 responses.

199 This is a technique used to analyse the impact of certain contents in users. We ignore if Facebook applies such techniques with its content, but it could be the case.

gender stereotypes in social networks.

Artificial Intelligence systems are learning from us, and in this process they are replicating existing biases.

Microsoft's failed AI Chabot "Tay", launched in 2016, is a clear example of this process of machine learning. The Chabot was meant to interact in Twitter with US users as a teenage girl would have done. The account was removed within 16 hours.

Tay was conceived as a "conversational" AI experiment that would learn as it engaged in conversations with people in the network. The result was that in less than 12 hours the Chabot was posting racist, misogynist and politically incorrect messages. Yes, it had learned from teenagers, but it didn't have the necessary tools to identify what was inappropriate.

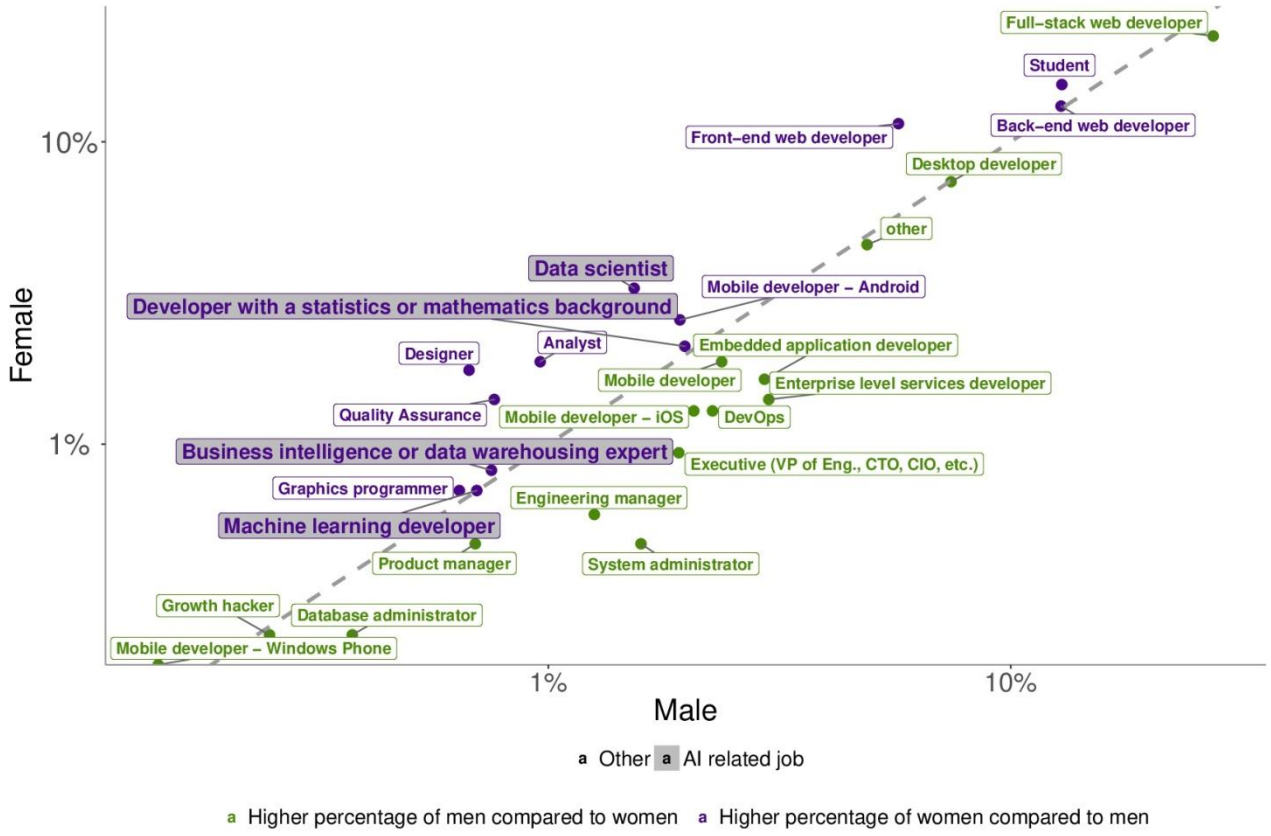
This means that biases have to be corrected. Technology reflects the values of its developers, and of the information they draw from. It is clear that having more diverse teams working in the development of such technologies might help in identifying these biases and preventing them.

Many researchers are already working on solutions to guarantee the fairness of algorithms and AI systems. This issue should be taken into account both by industry and policy makers, to ensure that stereotypes and sexism is not perpetuated by the generalized application of machine learning techniques. Particular care should be taken in relation to social networks, since their impact in younger generations is crucial. It should be ensured that services, products and systems are inclusive and fair, even to a greater extent than us, humans, are.

There is a second potential effect of AI that might have a more negative impact on women than men. As a result of the development of AI and robots, substantial changes in the labour market should be expected. While AI will displace lots of workers, including knowledgeable and high-skilled workers, it will also create new job opportunities in emergent technology fields. Massive employment destruction in some categories of workers should be probably expected, combined with a growing demand on skills in other categories related to technology and AI, as has already been mentioned in previous sections of this report. Depending on the gender composition of the labour force of the affected sectors this phenomenon could have different consequences for women, either good or bad.

In this AI-driven environment, women should be called on to play a pertinent goal; however, already the absolute number of women involved in the deployment of these technologies is vastly outnumbered by the number of men. The only good news is that this trend could be shifting in the medium term because women working in ICT are slightly more oriented towards occupations related to AI compared to other occupations, as can be seen in the following graph.

Figure 89. Fields of application of AI according to the greater weight of one or another gender



Source: prepared in house based on Stack Overflow Developer Survey 2016

To compound the problem, as seen in previous sections, women are more reluctant to trust in technologies and services based on AI.

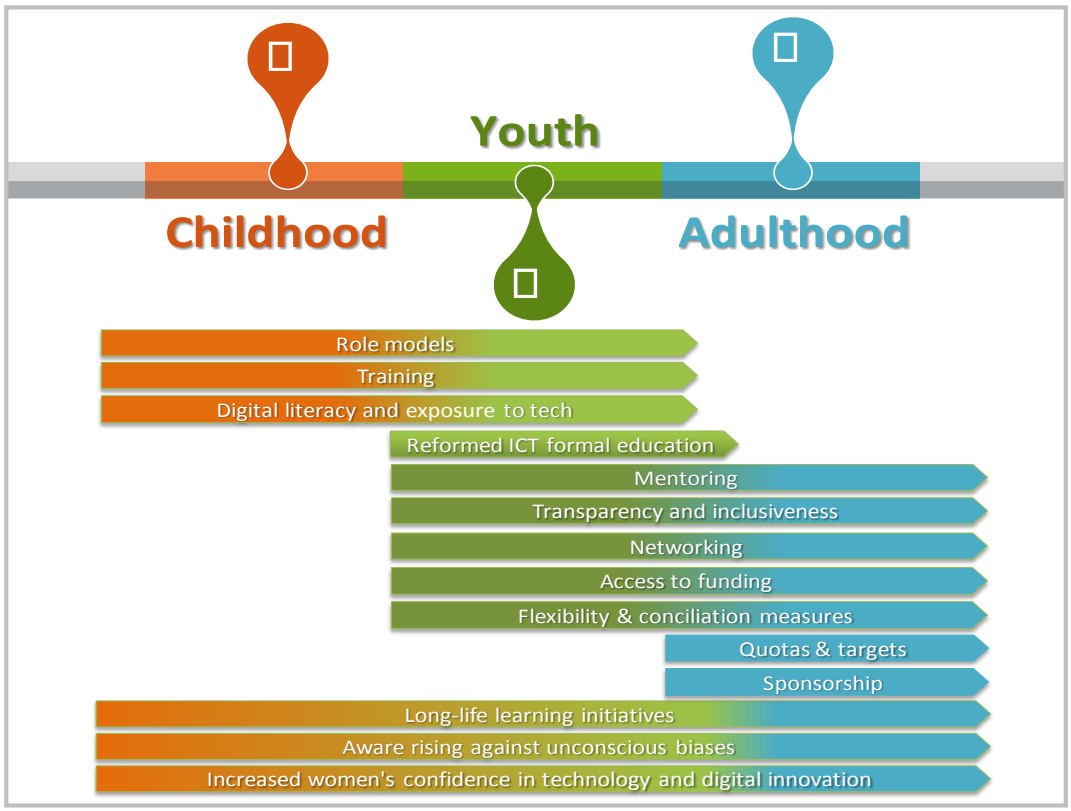
If measures are not taken to help alleviate this distrust, a much lower involvement of women with these crucial technologies compared to men can be expected. Moving forward, one will see both positive and negative consequences following this current trend. On the one hand, the role of women in softening the inherited bias of AI for the good of our society will be challenged. On the other hand, women will be, again, left behind in one of the most promising and relevant technology sectors.

7.2 Approaches to enhancing diversity in the digital sphere

Policies and initiatives aimed at increasing gender equality in the ICT and digital sector should pay particular attention to the turning points that have the greatest influence on a women's life cycle: childhood, adolescence, entering the world of work, motherhood and

returning to the labour market - what Castaño & Webster (2011) call transitions in the life course circle[200].

Figure 90. Tools to promote women's participation in the digital age throughout their life course



Source: own elaboration based on BMZ, 2017[201]

From the research it can be concluded that most of the factors preventing women from fully participating in the digital era are cultural. Overcoming the present situation will require a deep-reaching cultural and social change. A wide-ranging and long-term action plan should be carried out, involving actors at every level: European, national and regional. Those actions should be mainly focused on the early stages of the life cycle where aspects such as risk aversion, confidence and experience gap - all associated factors that limit women's potential - should be prevented.

The following table links the most important factors or challenges faced by women in the digital world with the most common prevention and mitigation measures successfully implemented, briefly described below. This table is the result of the analysis of the

200 Castaño and Webster, 'Understanding Women's Presence in ICT'.

201 Federal Ministry for Economic Cooperation and Development, 'Women's Pathways to the Digital Sector: Stories of Opportunities and Challenges'.

existing bibliography, the cases examined and the contributions made by the different stakeholders in the public consultation carried out for this study.

Table 2. Challenges vs. measures

		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		■	■									

Source: own elaboration

Role models

Increasing the visibility of women in ICT and digital is essential to combat existing stereotypes, particularly among the younger generations. The lack of female role models in STEM studies, in the digital sector, in entrepreneurship and in leadership positions helps perpetuate existing gaps and deprives young people, in particular, of inspiring examples. Role models can be promoted in a

All International Gender Champions have signed the IGC Panel Parity Pledge to seek a more gender-balanced representation on discussion panels.

number of ways:

- Creating awareness campaigns to fight existing stereotypes, both in the digital sector and in gender roles in society; giving visibility to existing female digital champions; providing guidance and inspiring others to pursue an ICT or digital career.
- Ensuring the visibility of relevant women in events, expert groups, educational content and the media is critical to generate these kinds of opinionated leaders and role models.

Training and lifelong learning initiatives

Education and training are essential for cultural change and, therefore, necessary to end unconscious biases affecting the gender balance in the digital sector.

Firstly, actions at very early stages of the educational process to mitigate the impact of unconscious biases in children development are required.

Secondly, formal and informal digital skills training for young girls should be implemented all around Europe to mitigate the experience and confidence gap and to overcome the preconceptions about digital that currently limit females' interest in it. This would also help to improve women's confidence in new technologies.

Lifelong learning enables women to make smoother transitions throughout their life cycles, keep their skills up-to-date and acquire new skills to meet the challenges still posed by the digital world.

Changes in ICT-related formal education

The general widespread fall in the number of STEM-related students in Europe and the fall, in particular, of the number of ICT-related degrees requires immediate action. These studies are not sufficiently attractive, especially for women. The need for action has already been already acknowledged by The Digital Skills and Jobs Coalition; however, a gender perspective must be explicitly applied. Three of the approaches that seem to be most effective in attracting and retaining female talent to ICT degrees are:

- **Changes in grades' curricula** to make them more attractive and closer to young women's interests.
- Creation of **introductory courses** by levels of experience, aimed at reducing the experience gap of girls versus boys and addressing the confidence gap that undermines females success.
- Introducing **innovative teaching methodologies** that are more focused on the practical applications of technologies.

Using the hashtag #ILookLikeAnEngineer, the engineer Isis Anchalee tagged her own picture, aimed at breaking down stereotypes about how an engineer looks and the movement went viral.

Raising awareness against unconscious biases

It is necessary to speak clearly about the gender biases that exist around the digital sector. Since many of these biases are unconscious, making them visible is the first step in combating them. Those biases affect all of us: parents, teachers, recruiters, leaders, investors, etc. and that along with education, the visibility of cultural biases and stereotypes is an effective weapon for promoting the cultural change needed to achieve equality.

Raising awareness of gender biases affecting the digital world can be achieved through communication campaigns, awareness-raising campaigns in schools, the promotion of role models, awards and public recognition, competitions, etc.

An important pillar in the fight against gender stereotypes is to adopt a gender perspective in all campaigns and actions regarding the digital age. In other words, all campaigns or actions to increase the number of STEM students, for example, must take into account the gender perspective. All actions aimed at strengthening or supporting the European digital ecosystem must take into account the gender perspective. Such strategies may be more effective in combating preconceived ideas that are deeply rooted in our culture than awareness-raising campaigns specifically aimed at combating gender inequality.

Mentoring

Mentorship is one of the most widespread initiatives worldwide to support females' development throughout their life course in the digital sector. Mentoring initiatives help mitigate the effects of the women's confidence gap and their tendency to have weaker networks in the professional sphere. Mentors also often act as role models who help to dispel the ambition gap and overcome barriers such as groupthink. Mentoring can also help to terminate existing stereotypes about the tech sector and about what is adequate for boys and girls. It can take place among younger girls in educational environments or in professional environments, and within companies or in a cross-sectional manner.

Technovation is an international initiative focused on girls from ages 10 to 18. After participating in their mentoring initiatives 78% of participants were more interested in computer science, 70% of them in entrepreneurship or 67% in business leadership.

Some examples of these initiatives are:

- Companies' mentorship programs, also in mix-gender pairs to reduce the middle ranks' lack of confidence about the importance of talent diversity[202].

202 According to the findings pointed out on Winning the Fight for Female Talent, the percentage of CEOs at global level who are concerned about the importance of talent diversity and inclusiveness is 87% in 2017, which represents 23 percentage points increase compared to 2015. Although, middle ranks seem to be less convinced than their leadership teams about the need of sponsoring women. In the technology industry, sector under the long male dominance, only 28% of middle managers are engaged with improving gender diversity in comparison with

- Sponsorship initiatives where executives and/or industry influencers act as benefactors with talented employees. Sponsorship is crucial to helping increase the pool talent of candidates who want to be part of corporate executive tanks[203] and mitigating the role of women's' limited networks and tendency towards groupthink in the context of a glass-ceiling. Some more benefits of these initiatives are
    - Increasing the visibility of women in leadership positions as well as their abilities and achievements required to acquire that role within their company.
    - Introducing female participants to other managers through specific professional events and informal business meetings.
    - Stimulating male managers to participate as sponsorship champions in mix-gender peers.
    - Enhancing workforce leadership skills.

Deustsche Telekom has increased in recent years the number of mentoring programs to support its female talent pool. Its Supervisory Readiness Program is also aimed at preparing female candidates for upcoming positions in supervisory boards.

- Creating professional networks and contacts in the early stages of women's' life cycles. Strategic associations and contacts are crucial for further professional development. Having contact with female engineers or professionals, either male or female, outside of their personal contact networks might motivate and inspire females to enrol and succeed in STEM careers.
- Mentoring programs focused on skills and abilities not commonly acquired through formal education. Mentoring programs in entrepreneurial skills and abilities strengthen female confidence and assertiveness in their capabilities. Mentees are introduced into the entrepreneurial ecosystem through initiatives in which necessary skills and abilities to be a future tech entrepreneur are learned through actions such as hands-on activities, business plan creation or simulated pitches presentations.

The initiative Million Women Mentors (MWM) is aimed at increasing the number of girls to pursue STEM careers. The objective is to engage one million mentors, men and women, in STEM to act as mentors by 2018. During the third quarter of 2017, the initiative has obtained more than 1.9 million pledges to mentor girls and young women in STEM fields.

39% of global organizations. The levels of commitment to gender equality should therefore be reinforced at all levels of the company.

203 Rhode and Packel, 'Diversity on Corporate Boards', 2014.

Transparency and inclusiveness initiatives in the sector

Companies in the sector must improve their transparency regarding their internal hiring and promoting policies and processes to encourage women to apply for those positions and overcome existing barriers. Transparency on job vacancies, discussion panels and board member and chairperson appointments and procedures implies that, through disclosure, it is feasible to assess whether a number of women were considered as candidates to fill the open position or not.

Ericsson has reviewed and amended all its human resources processes in order to ensure that diversity aspects are taken into account. By 2017, all leaders in the company will have been involved in a workshop aimed at tackling unconscious bias.

Hiring processes should also be more inclusive, for example, taking into consideration the right wording for attracting female candidates to job offers[204]. These measures help to ensure that the company can have access to a female pool talent.

Initiatives to obtain/retain a more gender-balanced workforce would imply measures such as:

- Actively searching for a greater diversity of groups of candidates. Ensuring a more gender-balanced list of candidates in the recruiting process.
- Improve the company's reputation regarding diversity and gender balance. Greater visibility of companies' diversity strategies and culture[205] is positive for ensuring a more diverse pool talent.
- Awards and incentives for those senior and middle-level management positions who promote talented female workers.
- Greater transparency on recruitment and promotion policies.
- Promoting companies' diversity committees and departments. Some research suggests that more promising female candidates could be identified by incorporating an inclusive nominating committee attuned to this matter. Companies that strengthen their internal policies will increase the presence of women in positions of power and decision-making[206].

Alcatel-Lucent, as part of the commitments assumed through the Women's Empowerment Principles and signed by the CEO, Ben Verwaayen, measures its progress towards enhancing its female management position ratios with a series of indicators which are audited by Ernst&Young and published in its annual CRR (Corporate Responsibility Report).

---

204 Gaucher, Freisen, and Kay, 'Evidence That Gendered Wording in Job Advertisements Exists and Sustains Gender Inequality'.

205 Research shows that employers that openly share information about their efforts towards greater diverse workforces have a positive impact on their pool talent. As a matter of fact, 61% of women, who are actively searching for a position, take into consideration the potential employer's diversity leadership team composition. By sector, this rate raises to 79% of women working in Engineering and Construction. (PwC, Winning the Fight for Female Talent. How to Gain the Diversity Edge through Inclusive Recruitment)

Other measures that the sector should implement to increase inclusiveness work to ensure the visibility of women in that sector's events.

According to the International Geneva Gender Champions[207] Annual Report[208], female panellists are still underrepresented on discussion panels, particularly in certain areas. On average, male panellists had a 50% higher representation than their female counterparts. Furthermore, this gender gap is more striking on concrete panel themes such as Telecom/IT, Science/Technology, International Law or Security in which there were twice as many men and there were women. Female panellists, however, are overrepresented when the panel topic of discussion is Gender Equality.

Actions to correct this should consider the following objectives:

- Fostering transparent and justifiable candidate selection and remuneration policies on corporate and public entities is particularly valuable for overcoming the glass ceiling barrier. As the Gender Diversity on European Boards found, director nomination processes are, in most markets, not explained or explained in a very limited nature. Some countries, such as the U.K. and Sweden, provide full disclosure for the entire director nomination process because of their national Corporate Governance Code recommendations. Additionally, criteria for the selection of board members are not always disclosed and when they are, general soft skills or personality characteristics instead of specific skills or qualifications are typically defined during the selection procedures[209].
- Limiting the period of mandate. Setting age restrictions and limited periods to ensure a growing number of available seats or a controlled power of CEO influence in the membership selection process in pursuit of a higher board power to determine and expand the amount of potential candidates[210].
- Ensuring that disaggregated data by gender is available within the organization, in order to enhance monitoring, evaluation and accountability of policies in place.

Flexibility and conciliation measures

Balancing one's personal and professional life is difficult for many women. Some characteristics of the ICT and digital sector -long working hours, need to keep skills

The Czechitas initiative promotes flexible learning conditions to those mothers on maternity leave or with children up to 15 years of age by ensuring a percentage of seats in its digital academy.

206 Rhode and Packel, 'Diversity on Corporate Boards', 2014.

207 This international network comprises 122 representatives from international organizations, ambassadors, civil society and business from over 60 countries are committed to advance on gender equality.

208 International Gender Champions, 'International Gender Champions. Annual Report'.

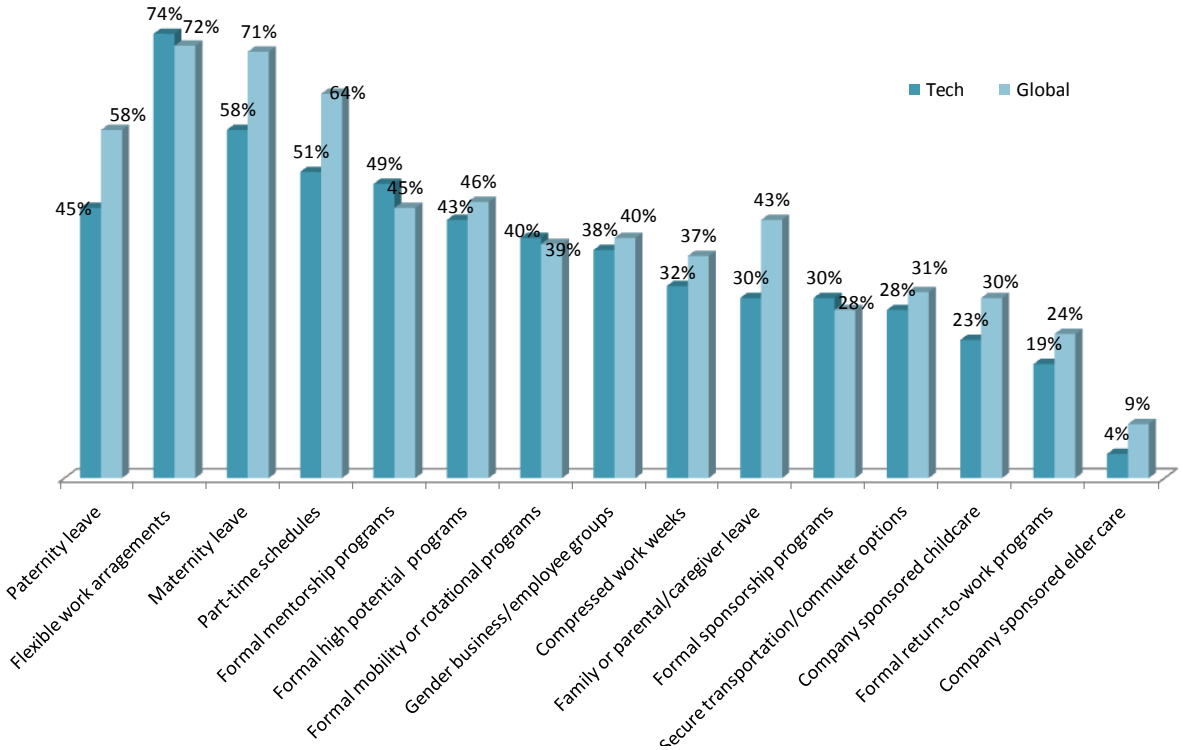
209 Roberts, Matthew.

210 Rhode and Packel, 'Diversity on Corporate Boards', 2014.

constantly updated, etc.[211]- make this a particularly challenging sector, and boosts the glass ceiling barrier and drop-out phenomenon.

According to Figure 91, when programs and benefits from technology industries are compared to other sectors, companies seem to have less policies or measures directly linked to the conciliation of personal and professional life, such as maternity leave (-13 pp.), paternity leave (-13 pp.) or formal return-to-work programs (-5 pp.).

Figure 91. Programs and benefits in the technology industry compared to global organizations



Source: prepared in-house, based on data from Mercer (2017)

Tackling specific policies and measures are the cornerstone to overcoming those barriers. Those policies should essentially be focused on:

- Work-life balance measures
    - Flexible work arrangements (part-time schedule, home office, compressed workweek, etc.) to efficiently manage both work and family responsibilities.
    - Time-balanced parental leave system. Equal responsibilities in children's care leads to balance the appreciation on female's counterpart childcare responsibility.

211 Commission, DG Communications Networks, Content & Technology, and Iclaves S. L, *Women Active in the ICT Sector Final Report ; a Study*.

- Out-of-work monitoring and reporting systems. Interaction between firms and people who have taken maternity/paternity leave so as to facilitate the individual's return to work
- Nursing and childcare facilities
- Particular actions for female entrepreneurs such as equated maternity pay and tax-free childcare.

- Facilitating "return to work". Promoting companies' measures to implement specific programs helping long-term unemployed or inactive women get back into the labour market, including women returning from maternity leaves.
- Awareness campaigns, mainly geared towards males, not only in companies and public entities but also to the general public about culturally imposed responsibilities such as child care, domestic duties, work absence during children's sickness and/or other related medical conditions, etc.

Quotas and mandatory targets

Not only public institutions, but also private companies are concerned about the glass ceiling barrier women face in the workplace. The existence of a gender imbalance in management and executives positions and the increasing awareness of diversity being a key factor driving more innovative environments and board decision-making enhancement has companies looking for appropriate actions to help their female employees. Promoting soft law recommendations or targets for gender diversity on boards has proven to have a real impact on companies' board compositions[212].

The multinational corporation Sonae has committed itself to the Portuguese Government to maintain the percentage of female representation on their board of directors and supervisory board over 30%.

Quotas and targets can also be applied to experts groups, panels in events, advisory boards and, in general, to any decision-making body or representative group in the sector.

Actions should take into account aspects such as:

- Accompanying any quota or goal should be a campaign raising awareness of the gender gap. Campaigns should be addressed towards male directors and others in leadership roles in order to make them aware of the benefits of diversity. Active diversity engagement from male directors tends to permeate throughout the companies they head

For German listed companies to be comprised, as suggested by The German Corporate Governance Code, supervisory boards should specify actions taken in order to guarantee a gender-balanced representation.

- Increasing companies' commitments to growing the percentage of female representation

212 Roberts, Matthew, 'Gender Diversity on European Boards. Realizing Europe's Potential: Progress and Challenges'.

in leadership positions, by signing agreements or codes of conduct for example, instead of using mandatory quotas. Voluntary measures, such as the defining measurable goals for reaching gender diversity on company boards, which are evaluated annually, might be more effective than mandatory measures in some contexts[213].

- Creating positive incentives, such as fiscal or economic incentives, to increase diversity. Financial benefits for female attendance to digital events are an example of this. With these kinds of measures, goals are not fixed, but the presence of female managers and entrepreneurs in digital events is promoted to increase the likelihood of mutual cooperation and create a sense of belonging for female workers.

Networking

Women tend to create weaker professional networks during their lives. Networking increases the sense of belonging and creates a collective identity among members. Networking also facilitates the exchange of knowledge and experiences, improves the visibility its members and helps to spot career opportunities. Actions aimed at increasing networking opportunities for women and facilitating the creation of relationships might mitigate the effect of the confidence and ambition gaps, as well as reduce certain biases and tokenism. Greater professional support enhances the possibilities of women being promoted and/or running a successful business.

I-Wil.net is an online platform, set up by the IESE Business School, which promotes networking and business opportunities. It connects women, allowing them to share experiences and support each other and offers access to learning materials and events with the participation of experts and alumni. It counts on more than 600 members in 14 countries.

Professional networks add focus on the necessity of opportunities for the development of skills and abilities as well as provide context for the levels of diversity in leadership or entrepreneurship.

Actions to promote networking should consider:

- Sharing best practices.
- Connecting and leveraging communication with other networks and organizations with similar goals to,
    - Break into the boys' club. Men's involvement is essential to aide their comprehension about female challenges in the sector.
    - Boost network expansion.
    - Participate actively in the cultural change.

213 Rhode and Packel, 'Diversity on Corporate Boards', 2014.

- Spreading network achievements, events, internal research and other kinds of information out through effective communication tools (website, social media, email, other events, interviews, etc.).

Access to funding

As has been pointed out, women are not only underrepresented as entrepreneurs but also as investors. Measures to encourage greater female investment include:

- Awareness campaigns,
    - About investing and good business opportunities in the sector, mainly focused on making the sector more attractive to potential female investors.
    - Aimed at raising investor firms' awareness of unconscious bias and diversity.
    - About existing resources, facilities and programs for actual and potential female entrepreneurs.
    - Aimed at reaching existing clusters, hubs, accelerators, incubators, etc. and providing information about the benefits of implementing a strategy based on diversity.
- Specific female entrepreneur networks to,
    - Connect potential entrepreneurs with gender conscious investors, experienced mentors, other entrepreneurs, etc.
    - Promote cases of success by acting as role models for young women and girls.
- Business public funds especially targeted at female entrepreneurs.
- Exclusive incentives/tax breaks for
    - Registering and running female businesses.
    - Female tech start-ups (taxes, IPR, etc.) in order to make the sector more attractive.
    - Firms investing in female start-ups.
- Formal and informal education on business culture at the early stages of the life cycle, i.e. secondary schools, with trainers and consultants who have experience in the sector and can mentor young entrepreneurs in order to,
    - Create female, financially savvy and informal business networks.
    - Increase the untapped female entrepreneurial spirit.

UKBAA (UK Business Angels Association) and Angel Academe are committed to raising the number of female investors in the UK up to 30% in two years1. Along with the measures planned to be implemented, both organizations have jointly commissioned a study in six European countries, backed by the European Commission, aimed at identifying the barriers behind the low representation of women in angel investing, only 14% female angels are in the UK, so as to turn the situation around. Other actions include a Women in Angel Investment Summit, an e-learning program about the skills needed to become an angel investor, and an ambassadorship program in which active female angels promote the advantages of angel investment in the UK.

9. The role of the European Union

The results of the open consultation show that there is a fairly widespread perception that the European Commission makes little effort to improve women's participation in the digital world and that the impact of existing measures is very low. There is also the perception that the European Commission is not targeting the existing fragmentation of regional and national initiatives in Europe enough.

For several years, the European Union has been launching initiatives specifically aimed at increasing women's participation in the digital world and the ICT sector, as well as numerous initiatives in the different areas that have been analyzed throughout this study.

For example, the European Union supports **female entrepreneurship** through the Small Business Act[214] and the Entrepreneurship 2020 Action Plan[215].

Suggested actions include support tools and initiatives, such as the European Community of Women Business Angels and women entrepreneurs, funded by the European Parliament. Other tools and initiatives include the European network to promote women's entrepreneurship (WES); the European network of female entrepreneurship ambassadors[216]; the European Network of Mentors for Women Entrepreneurs; the European on-line Platform for women entrepreneurs, WEgate[217], a one-stop-shop for women entrepreneurship and the European Network of Women Web Entrepreneurs Hubs[218], specifically promoting female entrepreneurship in the digital sector. The EU also awards the EU Prize for Women Innovators[219].

In the field of **leadership**, the European Union has, for decades, put into place initiatives to promote gender equality in decision-making, such as the Strategy for Equality between Women and Men 2010-2015[220] or the Directive on improving the gender balance among non-executive directors of companies listed[221]. These initiatives work to eliminate the glass ceiling effect by adopting recommendations and strengthening self-regulation.

---

214 https://ec.europa.eu/growth/smes/business-friendly-environment/small-business-act_en

215 https://ec.europa.eu/growth/smes/promoting-entrepreneurship/action-plan_en

216 http://ec.europa.eu/DocsRoom/documents/17322/attachments/1/translations

217 https://www.wegate.eu/

218 http://wehubs.eu/

219 http://ec.europa.eu/research/prizes/women-innovators/index.cfm?pg=home

220 European Commission, 'Strategy for Equality between Women and Men 2010-2015'.

221 European Commission, 'Directive of the European Parliament and the Council on Improving the Gender Balance among Non-Executive Directors of Companies Listed on Stock Exchanges and Related Measures'.

However, even with these initiatives in place the representation of women on boards is still far from the aimed target of 40% by 2020 set in the Commission proposal[222].

Devoted to its predecessor's key pillars, which included equality between women and men in decision-making, the Strategic Engagement for Gender Equality 2016-2019[223] undertakes its targeted objectives based on various legislative, non-legislative and funding instruments. In accordance with the pillars outlined, the specific strategies used in order to obtain gender balance when it comes to decision-making positions include:

- Continued support to the proposed Directive on improving the gender balance among non-executive directors of companies listed and other initiatives aim to improve the gender balance in decision-making
- Data dissemination of figures about women and men occupying decision-making positions
- Policy proposals aimed at enhancing gender equality in political decision-making while at the same time fostering initiatives among national authorities geared towards equal political and public decision-making positions
- Support for all Member States so as to implement quantitative targets for decision-making positions in higher education institutions
- Reaching a goal of 40% of women in EC senior/middle management positions by 2019

In 2013 the European Commission launched the **e-Leadership Skills Initiative**, which expanded one year later to include SMEs. In 2016, an agenda on "Leadership Skills for the High-Tech Economy" was commissioned and since 2015 the Commission has implemented monitoring measures of the Member States' performance, referencing the "e-Leadership Index"[224] in their measures. None of these initiatives, however, have explicitly taken into consideration the gender perspective.

The **Work-life Balance package**, launched this 2017 and already mentioned, includes several legislative and non-legislative measures aimed at addressing female under-representation in employment and improving better conditions to reconcile working and private lives. In the legislative sphere, it includes a proposal for a Directive on work-life balance for parents and caretakers, modernizing the existing EU legal framework. The non-legislative measures include actions enhancing the enforcement of current legislation, prioritizing EU funds to improve long-term and childcare services, raising awareness via campaigns, benchmarking, sharing of good practices and improving data collection at the EU level.

The European Union considers **digital skills and jobs** as one of the main pillars for achieving the Digital Single Market, something that is one of its 10 strategic priorities. It

---

222 European Commission Directorate-General for Justice and Consumers, 'Gender Balance on Corporate Boards. Europe Is Cracking the Glass Ceiling'.

223 European Commission Directorate-General for Justice and Consumers, 'EC Strategic Engagement for Gender Equality 2016-2019'.

224 European Schoolnet and DIGITALEUROPE, 'The E-Skills Manifesto 2016'.

promotes various initiatives aimed at upgrading e-skills for citizens and workers. In 2016, the European Commission published the Skills Agenda for Europe[225] which acknowledged the underrepresentation of women in the labour force as both a problem and an opportunity for Member States. Actions carried out in this area, such as the Grand Coalition for Digital Jobs[226] and the EU Code Week[227], have specifically included women as a target audience as a means to encourage them to take up ICT-related careers.

Awareness-raising campaigns to improve the digital skills of girls and women and motivate them to pursue ICT studies and careers have been launched. The European Commission also partners with third parties in initiatives. These third party partnerships include the International Day "Girls in ICT"[228] sponsored by the International Telecommunication Union (ITU) and the GSMA's Women4Tech[229] programme within the Mobile World Congress.

Finally, bodies within the EU support evidence gathered from offices like The European Institute for Gender Equality (EIGE) or Eurostat.

225 European Commission, 'Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions: A New Skills Agenda for Europe'.

226 https://ec.europa.eu/digital-single-market/en/digital-skills-jobs-coalition

227 http://codeweek.eu/

228 https://ec.europa.eu/digital-single-market/en/news/european-commission-invites-organisations-attract-more-girls-and-women-digital

229 https://ec.europa.eu/digital-single-market/en/news/women-tech-mobile-world-congress-meet-winner-and-finalists-hack-d-gap-challenge

10. Conclusions

Being digital is no longer an option for European citizens. Innovating is no longer an option for the European Union; however, more than half of the European population faces these challenges in inferior conditions.

Conditions of inferiority stem from widespread stereotypes of women's supposed lack of capacity for certain technical and scientific tasks or lesser interest in the digital world. Preconceived ideas about what a good leader should be or what it takes to succeed as an entrepreneur are examples of ideas that have not been overcome, and in some areas are being reiterated in the society. Females are not taking advantage of the opportunities created by the ICT and digital sectors in the labour market and they seem to be encountering specific barriers and difficulties, especially regarding the fact that the childbearing age is most often at a critical juncture in their professional development.

Despite the growing demand of ICT specialists and digital profiles, the percentage of Europeans with **ICT-related education,** at all levels, is decreasing. This trend is shared by both genders, but the gender gap has slightly widened. There are still four times more men with ICT-related studies than women in Europe.

The gap between men and women who graduate in ICT fields is persistent all around the EU. The biggest differences are found, in absolute terms, in Malta and Finland. In relative terms, the gaps are the biggest in Belgium, Slovakia, Luxembourg and Lithuania, where the number of male ICT graduates is more than 10 times higher than that of females. The gap is relatively the smallest in Bulgaria, Romania and Cyprus, where male ICT graduates triple those of women.

The gender gap is also widening in **employment**. In 2015, 5.8% of European workers were employed in digital jobs, compared to 5.4%, in 2011. The slight growth occurred for both men and women, but was greater among males, thus increasing the existing gap. The share of men working in the digital sector is 3.1 times greater than the share of women. The gender gap is larger if only the working population with tertiary studies is considered. The share of men with university studies working in digital jobs is 3.6 times bigger.

The imbalance is even greater among tertiary graduates in ICT-related fields, those that can be considered as the more technical profiles, since females make up 13% of those working in digital jobs. This share was 15% in 2011.

In fact, results show that **ICT-related studies have a positive effect on the employability of men, but not on that of women**.

Stereotypes not only concern what is seen as appropriate for each gender, influencing young people's choices, but also affect the perceptions of the capacities and abilities of each sex. Thus, what appears to be a competitive advantage for a man, such as having a certain type of education, is not so for women.

The "opt out" phenomenon is common in all sectors of the economy, but it is generally less frequent among those working in digital jobs. This is probably due to the fact that digital jobs generally pay better than other jobs and that workers in these occupations have, overall, better working conditions. However, **women aged 30 to 44 are the exception, and leave their digital jobs more than the average**, and of course to a much greater extent than men. This fact suggests that digital jobs are particularly difficult for women who are trying to reconcile their professional and personal lives. And all this despite the fact that female workers of the ICT sector say they have more flexibility, feel they are well paid and are motivated to a greater extent than female workers from other service sectors. Though, they experience more discrimination.

As a result, the annual **productivity loss** for the European economy due to women leaving their digital jobs to become professionally inactive is **16.1 bln Euro**.

Regarding **digital skills**, data reveals that there is a shortage of advanced digital skills in the EU that affects the whole population. Around 25% of male Europeans and 27% of female Europeans have no or low digital skills. From a gender perspective, the positive news is that the gender gap among the youngest is narrowing. When it comes to basic skills, there is no gender gap among those under 55 years. When considering advanced digital skills, girls below 24 years surpass their male counterparts by 3 percentage points. In the other age groups, a gender gap negatively affecting women still persists.

There are relevant differences among the EU countries regarding the gender gap of digital skills. The biggest gaps in absolute terms occur in Luxemburg, the Netherlands and Austria, countries with some of the highest percentage of people with above basic skills. There are no gender gaps between males and females with basic digital skills in Belgium, Denmark and Germany, and between males and females with above basic digital skills in Slovakia and Malta.

However, it should be noted that the data refer to self-assessed skills by the citizens in surveys and that women generally are more questioning with their own skills and capabilities than men.

In 2015, 23.4% of **entrepreneurs in the ICT sector in Europe** were women (4 p.p. more than in 2010). Female entrepreneurs in the ICT sector are overall satisfied with their work, have a greater sense of achievement following well-executed work and they experience relatively low levels of stress. However, they are worse paid than their male counterparts: the gender payment gap between female and male self-employees in the ICT sector is 30%.

Although research suggests that female-owned digital startups are more likely to be successful than those of their male counterparts and investments in female-founded startups perform 63% better than exclusively male-founded startups; according to the Female Entrepreneurship Index, the global percentage of female businesses running within the technology sector decreased by 19% in 2015.

One of the main barriers faced by female entrepreneurs in the digital world is the difficulty of accessing funding. Globally, start-ups with female founders obtained 4.9% of all venture capital deals in 2016; approximately two p.p. more than in 2006. Average investments in female entrepreneurs have fallen 0.7 p.p. since 2014.

Biases play a very important role in the entrepreneurial world, in fact, male entrepreneurs are 60% more likely to attain pitch competition than women - even if they present exactly the same project -. Again, biases about women's capacities have a tremendous impact.

The lack of women among investors is also very noticeable. Globally, only 7.4% of investors and 7.2% of angels who have invested in one or more start-ups are women. And despite the percentage of female business angels in Europe has risen from 4% to 10%, even reaching 30% in some BAN (Business Angel Networks), others still record an absence of female members.

In recent years there has also been a stagnation in the struggle to overcome the **glass ceiling**. A slowdown in the growth of women's participation in executive positions in listed companies has occurred and improvements regarding female's participation in boards are concentrated in few European countries. Findings suggest that national policies, such as quotas, might be influencing the presence of females on boards, regardless the sector of activity. Nevertheless these policies do not always translate into increased participation of women in other leadership positions in organizations, such as middle management, particularly in the ICT sector, and tokenism is commonplace. In 2015, 21.4% of workers in the ICT sector had female bosses in Europe (2 p.p. more than in 2010).

The main barriers to women's equal access to leadership positions, especially in highly masculinised sectors such as ICT, include: biases towards women's leadership capacities, problems in reconciling, non-transparent business policies and informal structures where women have been systematically excluded.

The limited progress in this area runs counter to evidence suggesting that companies with significant female critical mass on decision making positions have better governance styles, drive more creative and diverse innovation processes by means of putting more ways of thinking forwards that are more likely to meet customers' needs and could also, according to some studies, deliver considerable financial benefits.

Still, there are certain gender differences in **attitudes towards technology** and digitalization. Women have a more negative view on the impact of digital technologies in all spheres, particularly in their quality of life. They also tend to be less informed than men about new technologies and show higher concerns about their negative impacts. This may be related to women's worse perception of their own digital skills, which may make them more insecure, but in any case it suggests that it is still important to mitigate the preconceptions about technology and digital that still exist.

After analysing the trends and dynamics affecting women in the digital world, the main conclusion is that **biases and stereotypes** are still at the heart of the problem. Biases about what's appropriate for each gender, biases about the tech capabilities of women, stereotypes about digital, biases about the entrepreneurship or leadership capabilities of women. Biases and stereotypes are reflected in all the barriers we have mentioned: an unbalanced share of caring responsibilities among genders, inequitable human resource practices in recruitment and promotion, tokenism or scant funding for female's projects. These barriers are responsible for phenomena such as the confidence gap, the experience and the ambition gaps, or a greater risk aversion; thus generating a vicious circle. Some consequences are the lack of role models, the lack of a pool talent or the persistence of in-group thinking or an "old boys' club" culture, which in turn help perpetuate biases.

Globally, the figures of participation of women in the ICT and digital sector are not significantly improving and in some regions, such as Eastern Europe, some indicators are worsening. Only by looking at the micro level initiatives and experiences that show the way towards transformation are found. These initiatives have some features in common: they are based on **collaboration and cooperation** among diverse stakeholders, have a central focus on **raising awareness** of the situation and clearly rely on **education and skills** as a driving force for change. These initiatives must be scaled up. Innovation at this regard is needed. The recommendations made by Robert Madelin, as displayed in Figure 92, on how Europe should face its mission to innovate can be applied to innovation from a gender perspective.

Figure 92. Understanding innovation in Europe

Source: Robert Madelin, 'Opportunity Now: Europe's Mission to Innovate'., 2016

Fighting gender imbalances, like innovating, is a complex task. It is necessary to know and understand what is happening in order to face it. Therefore, **information, knowledge and awareness are crucial**.

Being aware of what's going on, though, is not enough. Despite the growing number of studies and data alerting us to the situation in recent years, there has been little progress made on the issue. Therefore, it is necessary to change the current approach to the problem and innovate to find solutions.

Open governance

Gender diversity is a complex phenomenon, like all cultural phenomena, which requires an open approach that allows for the integration of the very diverse actors involved so that they can collaborate in a more fluid way.

Open innovation:

Innovation can come from anywhere. No one person will bring greater gender equality to the digital sector on his or her own. Greater achievements would be possible if the subject is approached in a more distributed, decentralized and participatory way. In our search for value, processes must become permeable to external innovations and exchange of experiences, overcoming traditional linear approaches. The case of Ironhack, a coding school that found new ways of reaching female audiences by collaborating with an e-commerce platform, is a good example of this.

Shared commitment and cooperation

A common frame of vision is needed at the EU levels that allows overcoming the existing fragmentation of initiatives and scales-up the few successful initiatives across Europe. A shared, high level and long-term vision is also essential to establishing long-term initiatives. Only commitment and persistence in the medium and long-term will bring about change. Coordinated and sustained action is required.

It's about people

Diversity is about people. Education and skills must be at the centre of every strategy and such strategies need to consider all life courses in the digital age, from childhood to adulthood, and include long-life learning. Education must bring about the necessary cultural change, alongside skills development, to provide the indispensable tools for equality.

Unfortunately, there are no magic recipes to ensure women's equal participation in the digital age. Where progress has been made, this has been the result of **strategic changes that have permeated the entire organizational culture**. Gender equality and increased diversity have been adopted as core guiding principles of the organization and the actions undertaken have come as a result of this. Specific actions, often aimed at fulfilling general commitments or improving the corporate image, tend to have a very limited impact.

This commitment obliges us to **innovate**, and to focus efforts where the impact on cultural change is greatest: **education and social awareness.**

It also obliges us to **collaborate** and to overcome the current fragmentation of initiatives, which limits their impact and visibility. This is a global problem which must be tackled globally.

Efforts must be **constant and sustained** over time, as this is a long-distance race.

If forces are not jointed to defy existing stereotypes, **the unstoppable advance of digital in all spheres of our lives will amplify and perpetuate gender stereotypes**. It is not only a question of convincing women to take an interest in certain subjects, but it is a question of making society as a whole see the importance of making the most of all of our potential in the great challenge of innovation. The aim is to provide the necessary tools to overcome the barriers that prevent women from fully participating in the digital revolution, but, above all, to remove these barriers.

11. Recommendations

Trends show that there is no significant positive change and that there is a huge disparity between countries in the EU regarding the participation of women in the digital sector.

First of all, it is important to stress the lengthy nature of the changes that are necessary for the full integration of women into the digital world. Efforts made so far are, however, not sufficiently acknowledged by many stakeholders. It would be expected that many measures, which have been in place for more than 10 years, would have yielded more visible results already, but since that is not the case it appears that there is a need to review the current strategies in place.

Change occurs only when there is commitment at the highest level, and permeates the entire organizational culture. Although there is no doubt that gender equality is an important element of the European Union's agenda, its digital strategy does not always reflect this. For example, there is no mention of gender equality in the Digital Single Market Strategy, while other gaps, such as the digital gap between urban and rural areas, are acknowledged. In addition, some initiatives launched in recent years do not sufficiently take into account the gender perspective. Stakeholders also feel that the European Commission's role has been particularly ineffective in helping to overcome the existing fragmentation of initiatives across Europe.

Based on the findings of this report, a series of policy recommendations have been elaborated.

- Consider gender equality in the digital field as an essential element of the Union strategy.
    - Establish specific goals in the Digital Single Market Strategy for gender equality in digital.
        - Include indicators of Europe's digital performance and follow the evolution of EU member states in digital equality in the Digital Economy and Society Index (DESI).
        - Improve accountability of gender measures within ICT funding programs (Horizon 2020, etc.).
    - Include gender perspective in all actions within the Digital Single Market Strategy.
    - Work with member states to establish national targets.
    - Increase coordination of initiatives at the European level.
- Education and training should be at the centre of the strategies implemented to achieve gender equality in the digital era. For that reason, educational institutions, both formal and informal, should be considered priority stakeholders for change.
    - Support changes in the educational curricula of ICT in Europe.

    - Promote changes in secondary education, encouraging teacher training and the creation of counselling initiatives.
    - Support all those initiatives, at all educational levels, that aim to reduce the impact of confidence and experience gaps, such as introductory courses or coding clubs.
    - Further support mentoring programmes throughout Europe and require member states and regional governments to implement mentoring programmes.
    - Promote the creation by member states and regional authorities of bridge programs linking tertiary education institutions with the industry.
    - Encourage the implementation of guidance for teachers and career orientation professionals.
- Promote more transparent recruiting and human resources policies in the sector
    - Require companies that partner with the EU to have minimum standards of transparency
    - Promote more balance business practices:
        - the use of blind CVs in recruiting,
        - that selection boards or committees have a minimum number of women to avoid the effect of in-group thinking,
        - to establish quotas in the candidates for each position.
    - Create an EU label with a monitoring scheme
- Create a certification scheme for algorithms and AI systems to guarantee neutrality and the absence of biases.
- Further and specifically support female entrepreneurs in digital:
    - Increase funding opportunities for female entrepreneurs.
    - Enhance regulation favouring female entrepreneurs in the sector e.g. tax exemptions and smart regulation (reduction of administrative burdens).
- Continue and increase awareness raising efforts, with actions and campaigns aimed at the population as a whole, not just girls and women.
    - Launch and support national and regional institutional campaigns targeting girls (on the age of deciding branch of studies) and families, fighting stereotypes about female's capabilities and digital itself.
    - Special emphasis on the importance of promoting female role models.
    - Establish gender parity goals for speakers at all events within the digital sector that are organized or supported by the EU.
    - Establish quotas for female candidates for all digital related award or public recognition by the European Commission.

- Act as a catalyst for existing initiatives at regional and national levels.
- Provide visibility of ICT products and services designed or created by women.
    - Give explicit support for this type of products or services as a contracting party or buyer.
- Create and institutional campaign showing economic benefits of diversity and the risks of lacking in the short future qualified workforce.
- Compel all communication campaigns within the framework of the Digital Single Market Strategy to take the gender perspective into account, for example by giving priority to female role models.

- Monitor and evaluate the impact of the Work-life Balance package in the digital sector and, if necessary, review and improve it on an ongoing basis.
- Improve the availability of data for the elaboration of further evidence-based recommendations.
    - Create datasets with longitudinal data[230].
    - Commission a detailed study of the impact on the different genders of how digital technology is perceived, and how young people's choices are impacted by the way in which it is presented, especially in the curricula of ICT-related studies.

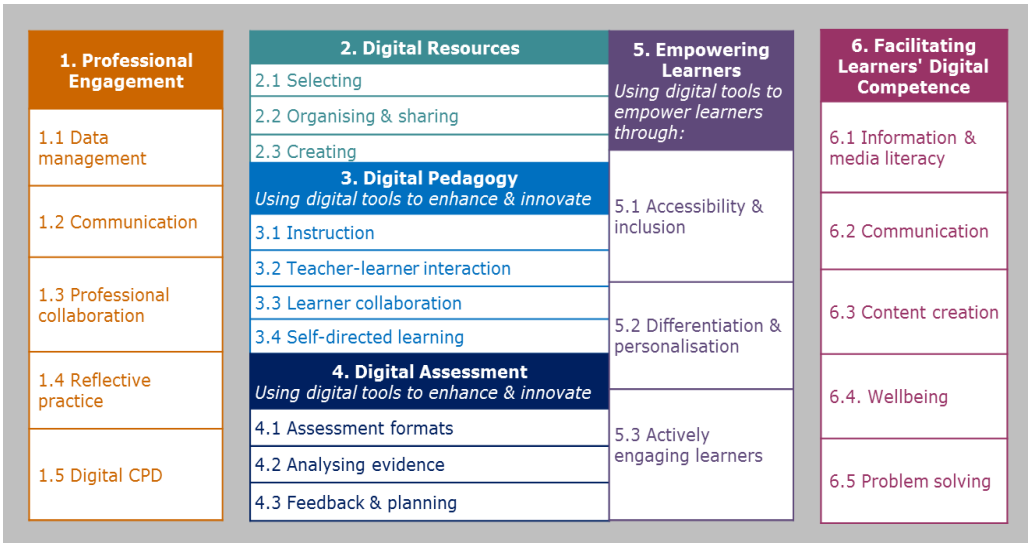
230 Longitudinal data sets involve repeated observations of the same subjects (a cohort of individuals) during a long period of time, allowing researchers to analyse changes at the individual level depending on multiple factors, including the effect of public policies enacted. Having longitudinal data sets in the EU exploring the dynamic relationship between socio-demographic factors, including gender and other social and economic circumstances (labour, education, technology related topics, etc.), could be very useful to analyse the effect of gender on technology related topics and how this relationship is evolving over time. It would allow analysing the skills, perception, and attitudes toward technology depending on gender, its evolution, and the effect of the policies. Moreover, Europe can act as a natural policy lab because many policies are developed at the national and regional level. Various waves, for instance every decade, would be necessary to include new generation of citizens. It will allow exploring the evolution of specific cohorts and of the society as a whole. These types of datasets are used in the USA for education and labour market research.

Annex I. eSkills and teachers

Women represent an important share of workers in certain sectors such as health (48% female physicians in 2014, with 15 EU countries reporting higher share of females than males[231]) and education (women represent around 70% of teachers in Europe[232]), both sectors that increasingly require advanced digital skills.

Particularly, the training of teachers to transform teaching and learning of digital skills in a lifelong learning perspective has been identified as a priority by the Digital Skills and Jobs Coalition of the European Commission[233]. The digital skills of Europeans that are crucial for our social and economic development can't be achieved if educators do not acquire the right digital competences. This is necessary for digital skills to be integrated into the curricula.

Table 3. Overview of the DigCompEdu framework



Source: European Commission, 2017

In March 2017 the European Commission presented a proposal for a European Framework for the Digital Competence of Educators (DigCompEdu) that identified 23 competencies that have been grouped into 6 areas[234]:

1. Professional engagement,

231 http://ec.europa.eu/eurostat/statistics-explained/index.php/Healthcare_personnel_statistics_-_physicians

232 http://ec.europa.eu/eurostat/documents/2995521/7017572/3-02102015-BP-EN.pdf/5a7b5406-4a0d-445b-8fa3-3558a8495020

233 https://ec.europa.eu/digital-single-market/en/digital-skills-jobs-coalition

234 European Commission: Digital Competence Framework for Educators (DigCompEdu). https://ec.europa.eu/jrc/en/digcompedu

2. Digital resources,
3. Digital tools for teaching and learning,
4. Digital tools for assessment,
5. Digital tools to empower learners and
6. Facilitation of learners' digital competence.

But, are there gender differences in the digital training and skills of teachers in Europe?

The TALIS dataset from the 2013 OECD[235] has been analyzed, the latest available[236] to try to identify gender differences in this regard.

The results show that when studying for being a teacher, women are less likely to be involved in subjects related to technology and ICT. This is consistent with the data of women participation in ICT studies in Europe.

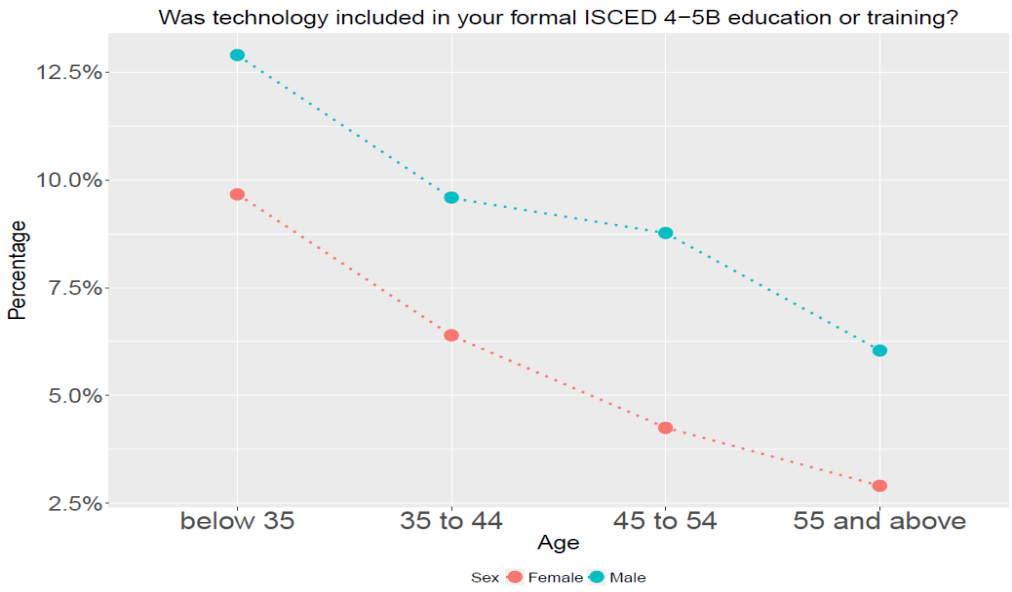
Younger generations of teachers, both men and women, have greater proportions of people with tertiary education with technology formally included in their training, but a small gender gap remains around 3 percentage points gap in post-secondary education or short cycles of tertiary education, and around 6 percentage points in tertiary education and higher.

Figure 93. Teachers with technology included in their formal ISCED 4-5B education by gender and age

235 TALIS is the first international series of surveys to focus on the learning environment and the working conditions of teachers in schools.

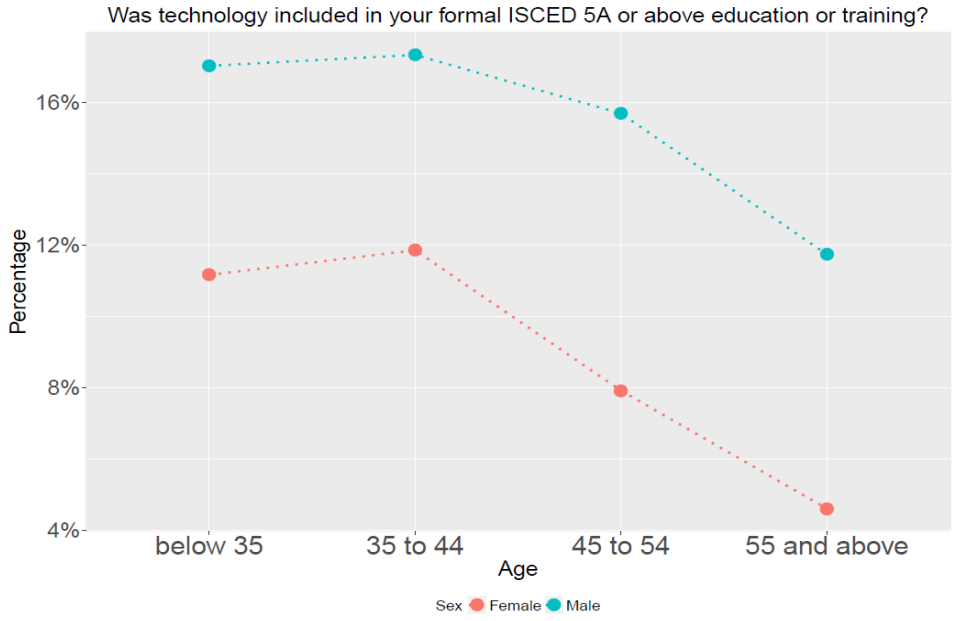
We have analysed the ISCED level 2 teachers of the second cycle of TALIS (2013) international survey of teachers. The first edition of TALIS was carried out in 2008. A new cycle is expected for 2018. http://www.oecd.org/edu/school/TALIS%202013%20Conceptual%20Framework.pdf

236 We have included in the analysis the following countries (all EU countries represented in the study): Netherlands, Bulgaria, Latvia, Italy, Croatia, France, Finland, Estonia, Spain, England (United Kingdom), Romania, Slovak Republic, Czech Republic, Flanders (Belgium), Sweden and Denmark.



Source: OECD, 2013

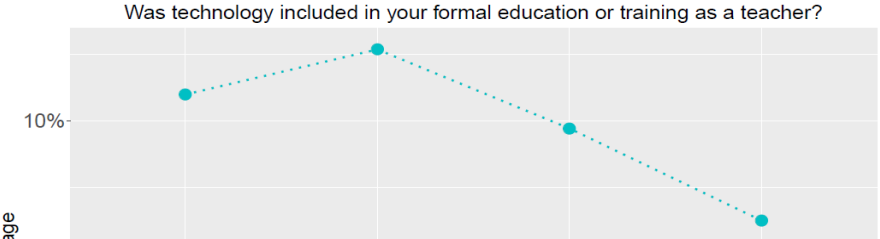
Figure 94. Teachers with technology included in their formal ISCED 5A or above education by gender and age



Source: OECD, 2013

Even lower are the percentages of teachers whose formal training as educators included technology, with the highest percentage being men between the ages of 35 and 44 years old at only 15%. For all ages, the gender gap remains in this context. The percentage of males that had technology as part of their training for being a teacher doubles that of women at all ages. Less than 8% of female teachers had technology as part of their training, which is less than 5% in the case of women above 55 years old.

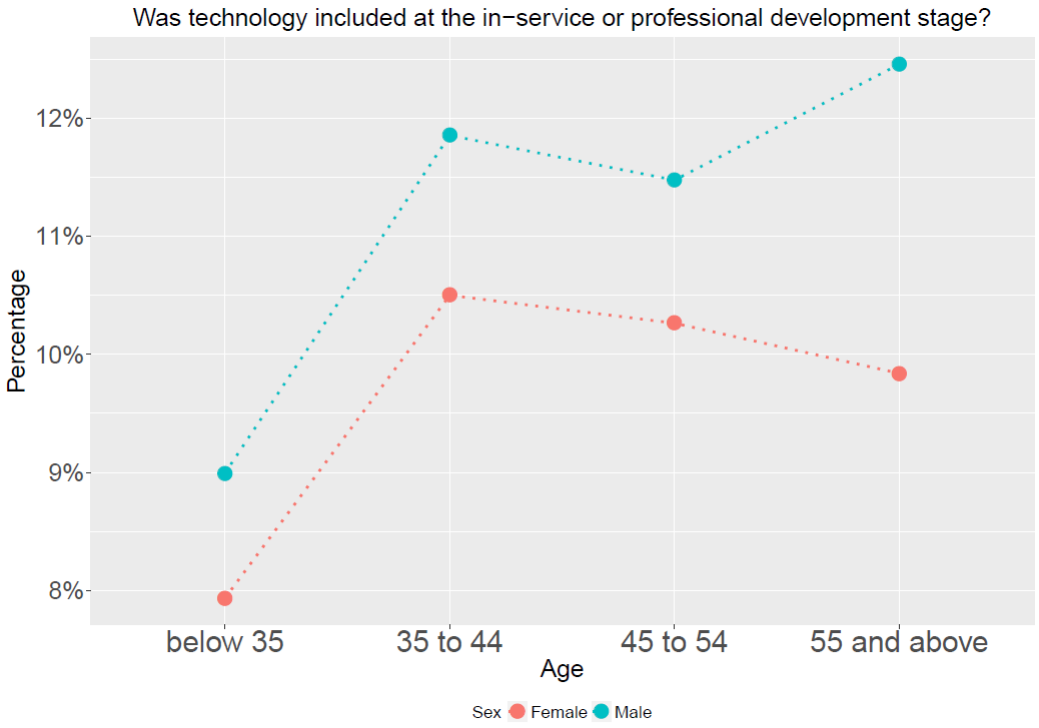
Figure 95. Teachers with technology included in their training as educators by gender and age



Source: OECD, 2013

The percentage of teachers that received technological training within their professional development plans is still very low, and while the gender gap still exists it is narrowing among the younger generations. Technology has been included in the in-service or professional development training for 9% of male and 8% of female teachers below 35 years old, for 12% of male and 10.5% of female teachers between 35 and 44 years, for 11.5% of male and 10.3% of female teachers between 45 and 55 years and for 12.5% of male and 9.8% of female teachers over 55.

Figure 96. Teachers with technology included in their professional development

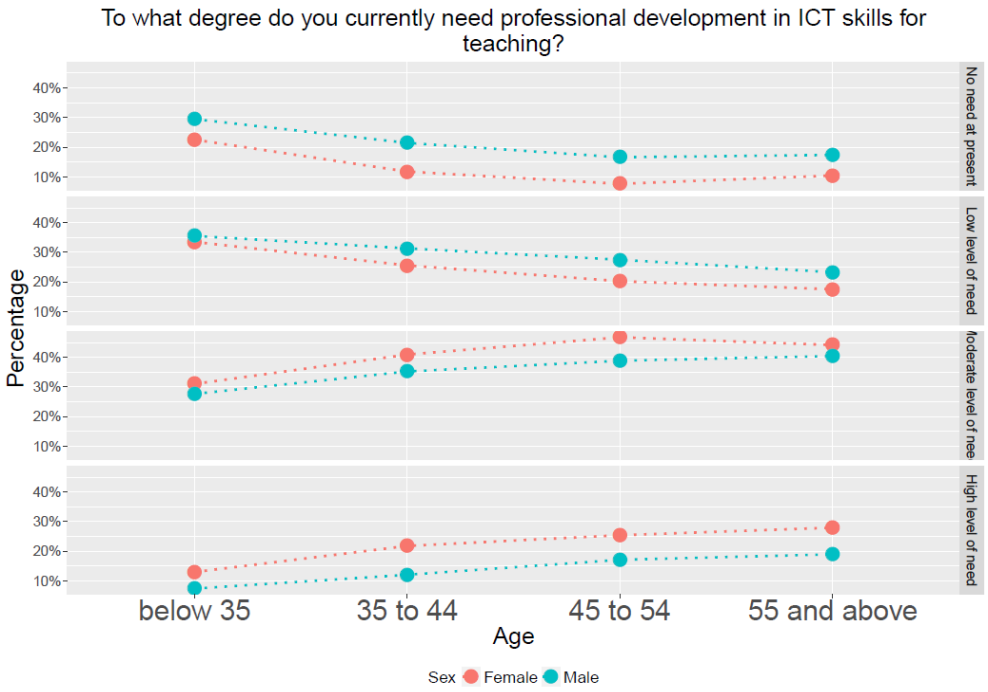


Source: OECD, 2013

The conclusion of the previous figures is that technology training is still low for all teachers; female teachers are less likely to receive training on technology than males during their formal education.

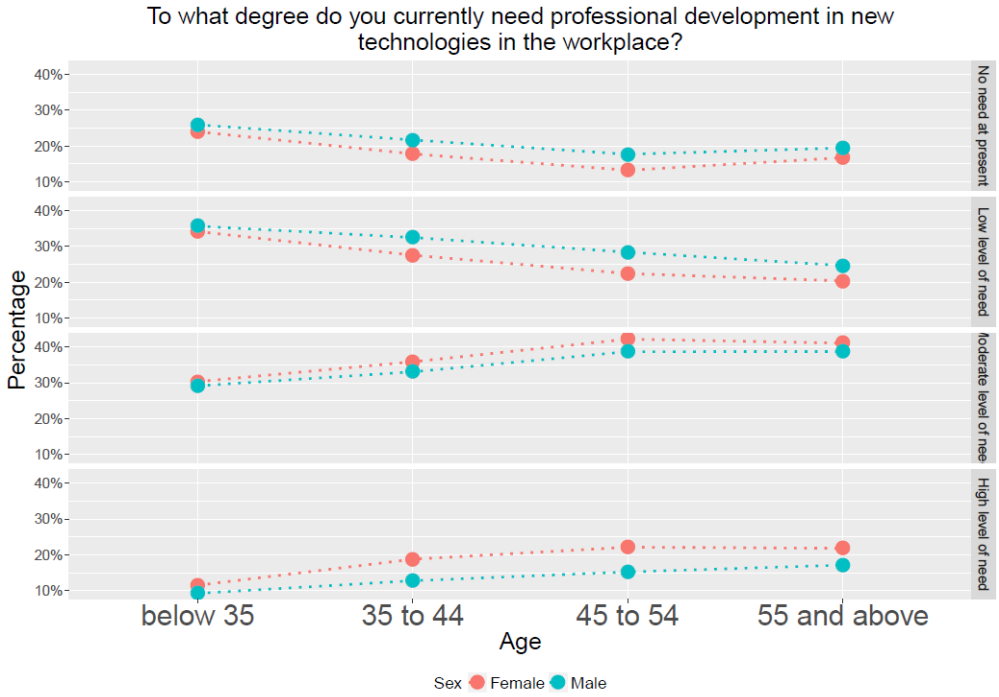
Once in the workplace, where ICT skills for teaching are increasingly important, both males and females acknowledge the need for professional development in ICT skills for teaching, particularly teachers who are over 45 years old. Women are even more aware of this need, and around 75% of female teachers think that the need is moderate or high, compared to 60% of males. Professional development in new technologies in the workplace is also moderately or highly needed for around 65% of female teachers above the age of 45, compared to around 55% for male teachers.

Figure 97. Need for professional development in ICT for teaching by gender and age



Source: OECD, 2013

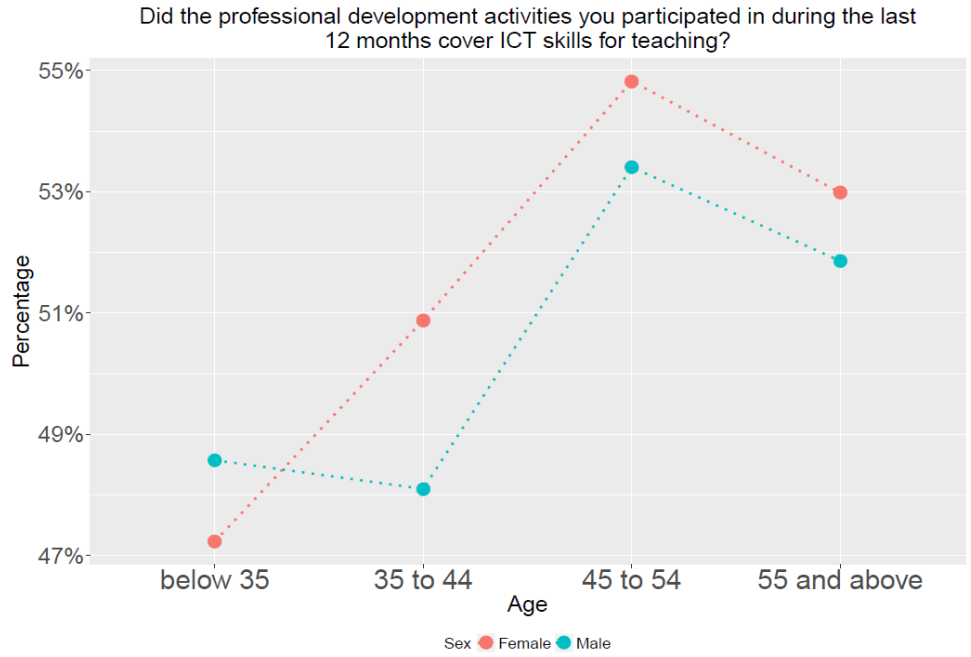
Figure 98. Need for professional development in new technologies in the workplace by gender and age



Source: OECD, 2013

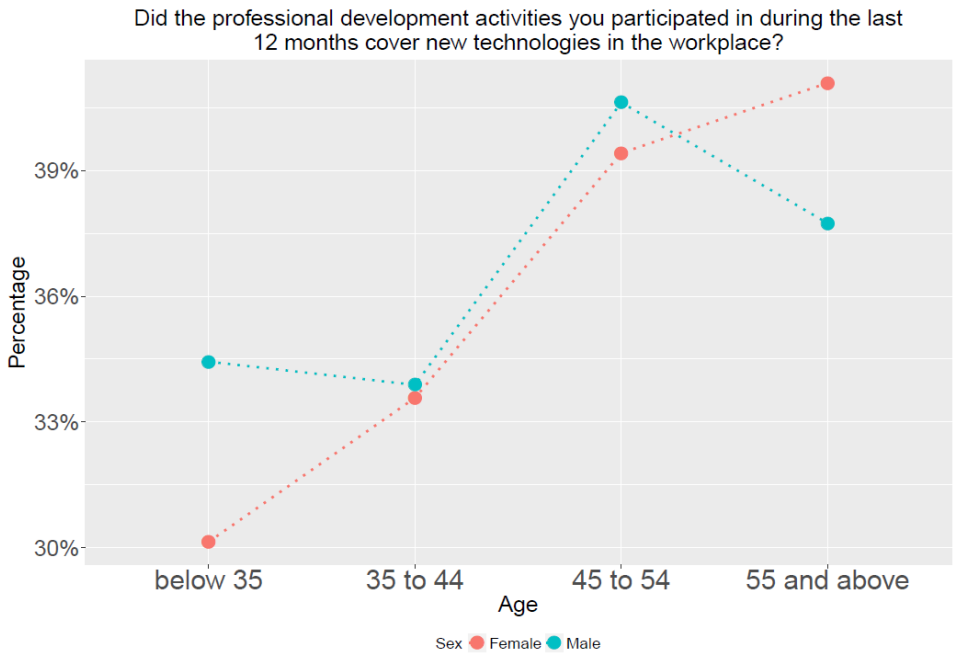
Aware of this need for skills development, female teachers over 45 participate more actively in professional development activities covering ICT skills for teaching. This is also the case among those between 35 to 44 years old.

Figure 99. Participation in professional development activities covering ICT skills for teaching by gender and age



Source: OECD, 2013

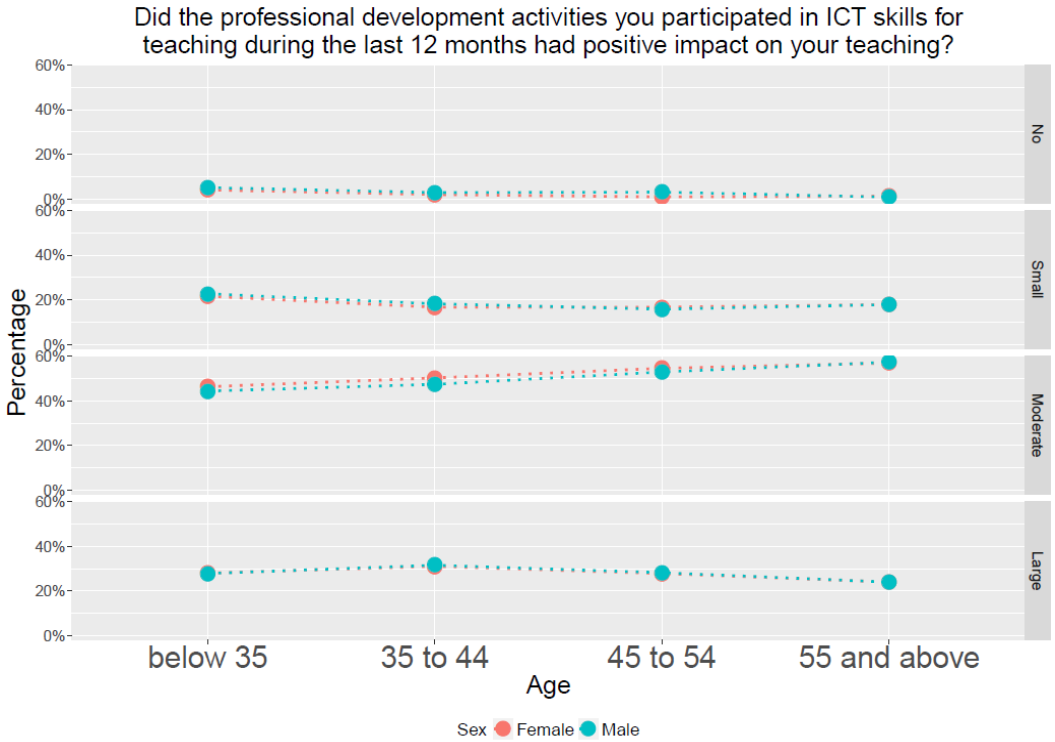
Figure 100. Participation in professional development activities covering new technologies in the workplace by gender and age



Source: OECD, 2013

The assessment of the impact of professional development activities covering ICT skills for teaching is high for both genders and is considered moderately or highly positive by over 80% of participants of all ages without gender differences.

Figure 101. Perception of the impact of professional development activities covering ICT skills for teaching



Source: OECD, 2013

Findings suggest that women are less motivated to study subjects related to technology, but once in the work place where these skills are needed, they try to catch up.

Annex II. Data analysis

1. European Labour Force Survey

The study was made by using the microdata of the Eurostat Labour Force Survey (LFS) from 2011 and 2015 for data and trends regarding the participation of females in ICT and digital education and jobs. The LFS is a large household sample survey providing quarterly and yearly results on labour participation of people aged 15 and over as well as on people outside of the labour force. In this report the yearly results have been used.

Our subset of the dataset includes those individuals aged 17 to 65. As a result, 2.884.611 observations were used as a starting point in the 2011 dataset and 2.902.101 in the 2015 dataset. In all cases, the observations were weighted using the variable COEFF of the LFS dataset.

The first stage was to categorize European Countries into 4 groups according to their geographical location. In the 2011 microdata we excluded Iceland, Norway and Switzerland and used the remaining 25 EU countries included in the 2011 dataset. Regarding the year 2015, the LFS added three additional member states which were not included in the previous wave: Cyprus and Croatia in Southern Europe, and the Czech Republic in Eastern Europe. The distribution of countries among regions is the following:

- Southern Europe: Greece, Spain, Italy, Malta, Portugal, Slovenia (Cyprus and Croatia in 2015).
- Eastern Europe: Bulgaria, Hungary, Poland, Romania, Slovakia (Czech Republic in 2015).
- Western Europe: Belgium, Germany, France, Luxembourg, Netherlands, Austria.
- Northern Europe: Denmark, Estonia, Ireland, Latvia, Lithuania, Finland, Sweden, UK.

Our first area of analysis referred to people employed with ICT-specific skills. Those individuals who chose educational fields more oriented towards future work in the ICT sector were selected. In other words, people who studied Science, Technology, Engineering or Mathematics (STEM). In the previous EC 2013 study[237], this taxonomy was used to determine the gender gap at work in the ICT sector by distinguishing whether the studies were related to ICT according to the ISCED-97 classifications. Due to methodological changes in the LFS for the year 2015, though, information on the type of studies was only available for those 34 years old and younger or who had finished their studies within the previous 15 years. For that reason, the result of such analysis would not allow the comparison between the data from 2011 and that of 2015. With this information in mind, the new analysis retrospectively to the year 2011 to obtain a comparable gap was performed. This will allow one to see the evolution of this indicator.

237 Commission, DG Communications Networks, Content & Technology, and Iclaves S. L, *Women Active in the ICT Sector Final Report ; a Study*.

With this aim, the following educational fields were selected (same as in 2013) using ISCED-1997/2011 classification for populations 34 years or younger who had finished their studies within the previous 15 years:

a. Physical Sciences (441 in Eurostat Codes)
b. Mathematics and Statistics (46, 461 and 462 in Eurostat Codes)
c. Computing (48, 481 and 482 in Eurostat Code)
d. Engineering and Engineering Trades (52, 521, 522, 523 and 524 in Eurostat Codes).

Table 5 presents for every country in the study, divided into the different blocks of European Countries, the distribution of individuals who undertook selected fields organized by the highest educational level attained and gender.

Table 4. Percentage of Individuals who undertook education in Maths, Statistics, Computing and Engineering by level of Education

2011

	EU25	Western Europe	Eastern Europe	Northern Europe	Southern Europe
Upper Secondary	41,96%	13,66%	68,07%	30,04%	25,10%
Post Secondary	7,11%	13,23%	4,43%	3,02%	9,55%
University	49,32%	70,34%	27,13%	64,66%	62,76%
More than university	1,62%	2,78%	0,37%	2,28%	2,59%
WOMEN					
Upper Secondary	40,29%	10,10%	67,99%	35,58%	15,77%
Post Secondary	7,10%	7,55%	4,55%	3,74%	14,32%
University	51,16%	79,65%	27,23%	58,79%	67,51%
More than university	1,46%	2,70%	0,24%	1,89%	2,40%
MEN					
Upper Secondary	42,51%	14,42%	68,10%	27,68%	29,61%
Post Secondary	7,11%	14,45%	4,40%	2,71%	7,25%
University	48,72%	68,34%	27,09%	67,16%	60,46%
More than university	1,67%	2,80%	0,41%	2,45%	2,68%

2015

	EU28	Western Europe	Eastern Europe	Northern Europe	Southern Europe
Upper Secondary	28,56%	13,98%	44,81%	25,05%	30,06%
Post Secondary	7,92%	9,46%	10,23%	3,61%	6,49%
University	61,38%	73,13%	44,25%	69,32%	61,10%
More than university	2,13%	3,43%	0,70%	2,02%	2,35%
WOMEN					
Upper Secondary	23,77%	10,56%	42,49%	24,57%	17,95%
Post Secondary	7,25%	6,45%	8,76%	4,16%	9,45%
University	65,73%	76,08%	47,98%	69,47%	69,04%
More than university	3,25%	6,91%	0,76%	1,80%	3,56%
MEN					
Upper Secondary	29,98%	14,74%	45,36%	25,26%	34,95%
Post Secondary	8,13%	10,14%	10,58%	3,38%	5,30%
University	60,09%	72,47%	43,38%	69,25%	57,89%
More than university	1,80%	2,65%	0,69%	2,11%	1,86%

Description of Gender Gaps - From Education (in ICT-related issues) to Work in the ICT sector

1. Gender Gaps in Educational Choices

The first gender gap refers to educational choice. Table 6 reports the percentage of individuals who undertook studies in Maths, Statistics, Computing and Engineering (STEM), educational fields related with ICT jobs, and organizes the data by gender and the two groups of educational levels separately[238]. As indicated above, in using the ICT-related studies variable, the information is not available for people over 34 years old who completed their education more than 15 years ago.

238 Individuals are grouped by two educational levels: (1) Non-College or less than University Studies which include both upper secondary and post secondary education, and (2) College, which include information about University Studies and more than University Studies

Table 5 Gender Gaps in the Percentage of Individuals who undertook studies in Maths, Statistics, Computing and Engineering

2011

	EU25	Western Europe	Eastern Europe	Northern Europe	Southern Europe
Total Population (17-34 or that finished their studies <15 years ago)					
Total	3,29%	2,13%	8,08%	2,43%	2,30%
Males	4,95%	3,45%	12,35%	3,51%	3,10%
Females	1,63%	0,76%	3,81%	1,41%	1,51%
Gap (Male-Female)	**3,32**	**2,69**	**8,54**	**2,1**	**1,59**
Population (17-34 or that finished their studies <15 years ago) with less than University Studies					
Total	3,86%	1,33%	12,00%	1,92%	2,27%
Males	5,77%	2,31%	17,04%	2,52%	3,26%
Females	1,88%	0,31%	6,12%	1,34%	1,28%
Gap (Male-Female)	**3,89**	**2,00**	**10,92**	**1,18**	**1,98**
Population (17-34 or that finished their studies <15 years ago) with University Studies or More					
Total	5,79%	5,41%	8,62%	4,79%	5,55%
Males	9,57%	8,93%	16,33%	7,87%	8,31%
Females	2,69%	2,09%	3,40%	2,33%	3,42%
Gap (Male-Female)	**6,88**	**6,84**	**12,93**	**5,54**	**4,89**

2015

	EU28	Western Europe	Eastern Europe	Northern Europe	Southern Europe
Total Population (17-34 or that finished their studies <15 years ago)					
Total	2,73%	2,30%	4,51%	2,38%	2,37%
Males	4,24%	3,74%	7,30%	3,48%	3,41%
Females	1,24%	0,84%	1,71%	1,36%	1,35%
Gap (Male-Female)	**3,00**	**2,90**	**5,59**	**2,12**	**2,06**
Population (17-34 or that finished their studies <15 years ago) with less than University Studies					
Total	2,43%	1,25%	5,45%	1,68%	2,49%
Males	3,82%	2,15%	8,20%	2,38%	3,85%
Females	0,97%	0,34%	2,13%	0,99%	1,09%
Gap (Male-Female)	**2,85**	**1,81**	**6,07**	**1,39**	**2,76**
Population (17-34 or that finished their studies <15 years ago) with University Studies or More					
Total	5,43%	5,73%	6,58%	4,60%	5,07%
Males	9,23%	9,60%	12,80%	7,53%	7,96%
Females	2,42%	2,17%	2,29%	2,39%	2,91%
Gap (Male-Female)	**6,81**	**7,43**	**10,51**	**5,14**	**5,05**

2. Gender Gaps in the percentage of workers among individuals who choose educational fields related to ICT jobs.

The second gap analysed was the gender gap in the percentage of workers who undertook ICT-related studies. Table 7 shows the differences in terms of labour market activity of those individuals who acquired the educational profile described above.

Table 6 Gender Gaps in the Percentage of Individuals who work among those who undertook education in Maths, Statistics, Computing and Engineering

2011

	EU25	Western Europe	Eastern Europe	Northern Europe	Southern Europe
Total Population (17-34 or that finished their studies <15 years ago)					
% Working	75,42%	87,31%	68,63%	79,29%	73,10%
% Working Males	78,18%	88,23%	72,90%	81,24%	74,00%
% Working Females	67,08%	83,01%	54,78%	74,73%	71,25%
Gap (Male-Female)	**11,10**	**5,22**	**18,12**	**6,51**	**2,75**
Population (17-34 or that finished their studies <15 years ago) with less than University Studies					
% Working	65,44%	82,69%	62,62%	66,58%	61,48%
% Working Males	69,23%	82,89%	67,57%	67,16%	62,86%
% Working Females	53,40%	81,13%	46,54%	65,51%	58,01%
Gap (Male-Female)	**15,83**	**1,76**	**21,03**	**1,65**	**4,85**
Population (17-34 or that finished their studies <15 years ago) with University Studies or More					
% Working	85,23%	89,02%	84,51%	85,60%	80,02%
% Working Males	87,11%	90,41%	86,96%	87,42%	80,93%
% Working Females	79,78%	83,43%	76,55%	80,70%	78,31%
Gap (Male-Female)	**7,33**	**6,98**	**10,41**	**6,72**	**2,62**

2015

	EU28	Western Europe	Eastern Europe	Northern Europe	Southern Europe
Total Population (17-34 or that finished their studies <15 years ago)					
% Working	79,64%	84,96%	77,76%	82,16%	72,45%
% Working Males	82,14%	86,74%	81,46%	84,86%	73,34%
% Working Females	71,21%	76,97%	61,93%	75,73%	70,23%
Gap (Male-Female)	**10,93**	**9,77**	**19,53**	**9,13**	**3,11**
Population (17-34 or that finished their studies <15 years ago) with less than University Studies					
% Working	68,99%	79,92%	69,14%	66,83%	60,33%
% Working Males	72,14%	81,34%	73,48%	70,40%	61,17%

% Working Females	55,94%	70,62%	48,93%	58,36%	57,28%
Gap (Male-Female)	**16,20**	**10,72**	**24,55**	**12,04**	**3,89**
Population (17-34 or that finished their studies <15 years ago) with University Studies or More					
% Working	85,76%	86,51%	88,31%	88,32%	79,43%
% Working Males	88,30%	88,53%	91,60%	90,66%	81,55%
% Working Females	78,07%	78,27%	75,61%	82,73%	75,12%
Gap (Male-Female)	**10,23**	**10,26**	**15,99**	**7,93**	**6,43**

The percentage of individuals who work among those who undertook non-ICT-related studies and for people who studied in any educational field was also analysed. As a result, we can check whether or not there are differences in the effect of the type of studies on employability.

EU28		
Total Population (17-34 or that finished their studies <15 years ago)		
	Non ICT-related	**All education**
% Working	71,35%	71,66%
% Working Males	75,13%	75,55%
% Working Females	67,98%	68,03%
Gap (Male-Female)	**7,15**	**7,52**
Population (17-34 or that finished their studies <15 years ago) with less than University Studies		
	Non ICT-related	**All education**
% Working	63,09%	63,23%
% Working Males	68,36%	68,51%
% Working Females	57,69%	57,67%
Gap (Male-Female)	**10,67**	**10,84**
Population (17-34 or that finished their studies <15 years ago) with University Studies or More		
	Non ICT-related	**All education**
% Working	82,29%	82,48%
% Working Males	85,80%	86,03%
% Working Females	79,69%	79,65%
Gap (Male-Female)	**6,11**	**6,38**

To assess that the differences between the effect of ICT-related and non ICT-related studies on employability were statistically significant, a binary regression model was performed, which is included at the end of the methodology section.

3. Gender gaps in the incidence of workers in ICT jobs among those who undertook (University) education related to them

We are interested in the magnitude of men, and particularly women, who undertook ICT-related studies but for different reasons did not work in the ICT sector. The indicator of the type of studies in 2015 had a limitation and, therefore, leaves out those over 34 years old who studied more than 15 years ago. Due to that realization, we included another taxonomy based on ICT-intensive sectors and employment in ICT-intensive occupations. As a result, we define ICT related jobs in a wide sense, more closely to the idea of digital economy.

To define this methodology, we have followed the European Commission's JRC technical note: "ICT Employment Statistics in Europe: Measurement Methodology" (Sabadash 2012)[239], that concludes:

"(...) the ICT employment landscape can be captured from three different angles: employment in ICT-intensive sectors, employment in ICT-intensive occupations and people employed with ICT-specific skills.(...) That is to say, it goes from a relatively static sector approach to a more flexible framework that allows us to capture ICT-related labour outside the ICT sector and, furthermore, outside standard ICT occupations, as follows. The ICT sector taxonomy can be related to neoclassical growth accounting literature and also to those EC policy initiatives that focus on the production of ICT goods and services and ICT capital deepening. The ICT occupations taxonomy goes beyond the ICT-producing sector and reflects the employment dynamics determined by the deployment of ICT-enabled innovations in an economy-wide context. These two taxonomies identify ICT employment in its official manifestation in either industry or occupational frameworks and capture those workers directly involved with ICT hardware and software design, production and maintenance. (...)

Each of the above three taxonomies has its drawbacks and unavoidably leaves out certain aspects of ICT employment. In order to capture ICT employment with greater precision, it is recommended to mix industry, occupations and skills in generating a cross-tabulation."

To analyse the opting out phenomenon we have defined two areas including people with ICT skills (ICT-related studies):

- Employment in the ICT-intensive sector. We used the J sector as the ICT sector (only 1 digit available for the sector according to NACE Rev. 2, same as in 2013).
- Employment in digital occupations. (3 digits available for the ISCO-08 classification).
    - ICT specific jobs in any sector of activity (such as "133 Information and communications technology services managers")
    - Highly skilled jobs in the ICT sector (NACE Rev. 2 J sector), that will include CEOs, managers or salespersons working in ICT organizations.

239 Sabadash, 'ICT Employment Statistics in Europe'.

Table 7 ICT specific jobs in any sector

ISCO-08 CODE	OCCUPATIONS
133	Information and communications technology service managers
25	**Information and communications technology professionals**
251	Software and applications developers and analysts
252	Database and network professionals
311	Physical and engineering science technicians
35	**Information and communications technicians**
351	Information and communications technology operations and user support technicians
352	Telecommunications and broadcasting technicians
742	Electronics and telecommunications installers and repairers

Table 8 Highly skilled jobs in the ICT sector (NACE Rev. 2 J sector)

ISCO-08 CODE	OCCUPATIONS
1	*MANAGERS*
11	**Chief executives, senior officials and legislators**
112	Managing directors and chief executives
12	**Administrative and commercial managers**
121	Business services and administration managers
122	Sales, marketing and development managers
134	Professional services managers
2	*PROFESSIONALS*
21	**Science and engineering professionals**
211	Physical and earth science professionals
212	Mathematicians, actuaries and statisticians
214	Engineering professionals (excluding electrotechnology
215	Electrotechnology engineers
216	Architects, planners, surveyors and designers
23	**Teaching professionals**
231	University and higher education teachers
232	Vocational education teachers
233	Secondary education teachers
234	Primary school and early childhood teachers
235	Other teaching professionals
24	**Business and administration professionals**
241	Finance professionals
242	Administration professionals
243	Sales, marketing and public relations professionals
3	*TECHNICIANS AND ASSOCIATE PROFESSIONAL*
31	**Science and engineering associate professionals**
33	**Business and administration associate professionals**

331	Financial and mathematical associate professionals
332	Sales and purchasing agents and brokers
333	Business services agents
334	Administrative and specialised secretaries
335	Regulatory government associate professional
4	*CLERICAL SUPPORT WORKERS*
41	**General and keyboard clerks**
411	General office clerks
412	Secretaries (general)
413	Keyboard operators
42	**Customer services clerks**
421	Tellers, money collectors and related clerks
422	Client information workers
43	**Numerical and material recording clerks**
431	Numerical clerks
432	Material-recording and transport clerks
44	**Other clerical support workers**
441	Other clerical support workers
5	*SERVICE AND SALES WORKERS*
72	**Metal, machinery and related trades workers**
721	Sheet and structural metal workers, moulders and welders, and related workers
722	Blacksmiths, toolmakers and related trades workers
723	Machinery mechanics and repairers
74	**Electrical and electronic trades workers**
741	Electrical equipment installers and repairers
8	*PLANT AND MACHINE OPERATORS AND ASSEMBLERS*
81	**Stationary plant and machine operators**
811	Mining and Mineral Processing Plant Operators
812	Metal Processing and Finishing Plant Operators
813	Chemical and Photographic Products Plant and Machine Operators
82	**Assemblers**
821	Assemblers

We therefore suggest speaking about digital jobs instead of ICT related jobs, in comparison with the approach of the 2013 study.[240]

Table 10 presents the gender gap in the percentage of people who work in digital jobs by type of studies; firstly as a percentage of the working population, and then as a percentage of the total population.

240 All analysis have been done for the year 2015 and the year 2011 to allow for methodologically accurate analysis of trends. Although data for 2011 will not be exactly the same as the data provided in the 2013 study due to the methodological changes, concepts are the same and the analysis for the new study is more complete and suitable for the new approach of the study "Women in the Digital Age", since it do not limited to the ICT (NACE rev. 2 J) sector.

Table 9 Gender Gaps in the Percentage of Individuals who work in digital jobs

as % of working population

2011

	EU25	Western Europe	Eastern Europe	Northern Europe	Southern Europe
Total Population working in digital jobs					
% Working	5,41%	6,32%	2,83%	6,48%	4,72%
% Working Males	7,76%	9,41%	3,81%	9,41%	6,49%
% Working Females	2,61%	2,80%	1,65%	3,22%	2,37%
Gap (Male-Female)	**5,15**	**6,61**	**2,16**	**6,19**	**4,12**
Population working in digital jobs with less than University Studies					
% Working	5,00%	5,85%	2,07%	5,01%	6,49%
% Working Males	7,10%	8,53%	2,64%	7,13%	9,46%
% Working Females	2,39%	2,77%	1,27%	2,42%	2,70%
Gap (Male-Female)	**4,71**	**5,76**	**1,37**	**4,71**	**6,76**
Population working in digital jobs with University Studies or More					
% Working	8,68%	9,33%	5,97%	10,04%	7,52%
% Working Males	13,48%	14,27%	9,79%	15,75%	11,30%
% Working Females	3,97%	3,88%	2,94%	4,71%	3,93%
Gap (Male-Female)	**9,51**	**10,39**	**6,85**	**11,04**	**7,37**

2015

	EU28	Western Europe	Eastern Europe	Northern Europe	Southern Europe
Total Population working in digital jobs					
% Working	5,83%	6,81%	3,62%	7,04%	4,83%
% Working Males	8,49%	10,40%	5,03%	10,14%	6,80%
% Working Females	2,71%	2,82%	1,87%	3,61%	2,32%
Gap (Male-Female)	**5,78**	**7,58**	**3,16**	**6,53**	**4,48**
Population working in digital jobs with less than University Studies					
% Working	4,96%	5,64%	2,45%	5,54%	6,07%
% Working Males	7,15%	8,53%	3,22%	7,76%	8,90%
% Working Females	2,25%	2,41%	1,33%	2,78%	2,40%
Gap (Male-Female)	**4,9**	**6,12**	**1,89**	**4,98**	**6,5**
Population working in digital jobs with University Studies or More					
% Working	9,34%	10,58%	7,44%	10,23%	7,37%
% Working Males	14,82%	16,46%	12,56%	16,17%	11,49%
% Working Females	4,11%	4,19%	3,23%	4,93%	3,65%
Gap (Male-Female)	**10,71**	**12,27**	**9,33**	**11,24**	**7,84**

as % of total population

2011

	EU25	Western Europe	Eastern Europe	Northern Europe	Southern Europe
Total Population working in digital jobs					
% Working	3,47%	4,35%	1,67%	4,46%	2,73%
% Working Males	5,41%	6,90%	2,47%	6,85%	4,28%
% Working Females	1,53%	1,80%	0,87%	2,09%	1,18%
Gap (Male-Female)	**3,88**	**5,1**	**1,6**	**4,76**	**3,1**
Population working in digital jobs with less than University Studies					
% Working	3,40%	4,25	1,30%	3,56%	4,06%
% Working Males	5,23%	6,56%	1,85%	5,33%	6,68%
% Working Females	1,49%	1,89%	0,69%	1,62%	1,47%
Gap (Male-Female)	**3,74**	**4,67**	**1,16**	**3,71**	**5,21**
Population working in digital jobs with University Studies or More					
% Working	7,11%	7,88%	4,86%	8,35%	5,76%
% Working Males	11,52%	12,50%	8,36%	13,57%	9,11%
% Working Females	3,13%	3,15%	2,31%	3,80%	2,88%
Gap (Male-Female)	**8,39**	**9,35**	**6,05**	**9,77**	**6,23**

2015

	EU28	Western Europe	Eastern Europe	Northern Europe	Southern Europe
Total Population working in digital jobs					
% Working	3,82%	4,73%	2,30%	5,06%	2,76%
% Working Males	6,01%	7,62%	3,53%	7,69%	4,37%
% Working Females	1,63%	1,85%	1,07%	2,45%	1,17%
Gap (Male-Female)	**4,38**	**5,77**	**2,46**	**5,24**	**3,2**
Population working in digital jobs with less than University Studies					
% Working	3,42%	4,12%	1,64%	4,03%	3,67%
% Working Males	5,32%	6,53%	2,40%	5,97%	6,06%
% Working Females	1,42%	1,68%	0,77%	1,90%	1,26%
Gap (Male-Female)	**3,9**	**4,85**	**1,63**	**4,07**	**4,8**
Population working in digital jobs with University Studies or More					
% Working	7,72%	8,97%	6,24%	8,71%	5,60%
% Working Males	12,80%	14,45%	11,15%	14,28%	9,24%
% Working Females	3,27%	3,43%	2,60%	4,06%	2,65%
Gap (Male-Female)	**9,53**	**11,02**	**8,55**	**10,22**	**6,59**

Table 11 shows two types of data. The first type of data shows the percentage of men and women who are working in digital jobs by age groups and that distribution in the labour market according to whether or not they are working in the ICT sector (J sector) or in other sectors. We present this information as percentage of working population.

The second type of data presented is of the percentage of men and women who are working in digital jobs by age groups, but as a percentage of total population. This allows a comparison between digital jobs and other jobs, inactive people and unemployed.

Due to the age limitation of the ICT-related studies' variable, we filter in both cases of tertiary education which include individuals who have completed University Studies and individuals who have completed more than University Studies. Besides that, the tables report the gender gap in the percentage of those who work in digital jobs for each age interval.

Table 10 Labour Market Distribution of individuals in digital jobs by Age and Gender

as % of working population with tertiary education

2011

WOMEN						
		EU25	**Western Europe**	**Eastern Europe**	**Northern Europe**	**Southern Europe**
All	**Total digital jobs**	**3,97%**	**3,88%**	**2,94%**	**4,71%**	**3,93%**
	% working in the ICT sector	57,07%	53,47%	75,82%	52,83%	59,87%
	% working in other sectors	42,93%	46,53%	24,18%	47,17%	40,13%
< 30 years old	**Digital jobs**	**4,69%**	**4,27%**	**4,68%**	**5,14%**	**4,92%**
	% working in the ICT sector	64,93%	59,88%	84,37%	57,30%	66,74%
	% working in other sectors	35,07%	40,12%	15,63%	42,70%	33,26%
30-44 years old	**Digital jobs**	**4,61%**	**4,56%**	**2,79%**	**5,71%**	**4,74%**
	% working in the ICT sector	56,47%	52,08%	74,40%	53,95%	59,12%
	% work in other sectors	43,53%	47,92%	25,60%	46,05%	40,88%
45 years or older	**Digital jobs**	**2,64%**	**2,84%**	**1,58%**	**3,31%**	**1,86%**
	% working in the ICT sector	50,15%	50,92%	56,93%	46,67%	53,19%
	% working in other sectors	49,85%	49,08%	43,07%	53,33%	46,81%

MEN						
		EU25	**Western Europe**	**Eastern Europe**	**Northern Europe**	**Southern Europe**
All	**Total digital jobs**	**13,48%**	**14,27%**	**9,79%**	**15,75%**	**11,30%**
	% working in the ICT sector	47,94%	42,76%	60,25%	49,48%	52,71%
	% working in other sectors	52,06%	57,24%	39,75%	50,52%	47,29%
< 30 years old	**Digital jobs**	**16,92%**	**18,58%**	**13,14%**	**17,20%**	**16,50%**
	% working in the ICT sector	50,21%	43,09%	64,97%	52,88%	51,78%
	% working in other sectors	49,79%	56,91%	35,03%	47,12%	48,22%
30-44 years old	**Digital jobs**	**15,27%**	**16,11%**	**10,99%**	**18,19%**	**13,14%**
	% working in the ICT sector	51,33%	45,95%	61,61%	52,66%	56,11%
	% working in other sectors	48,67%	54,05%	38,39%	47,64%	43,89%
45 years or older	**Digital jobs**	**10,00%**	**11,06%**	**5,30%**	**12,14%**	**7,02%**
	% working in the ICT sector	40,33%	38,03%	46,83%	41,50%	44,41%
	% working in other sectors	59,67%	61,97%	53,17%	58,50%	55,59%

Gender gap in the proportion of those who work in digital jobs					
	EU25	**Western Europe**	**Eastern Europe**	**Northern Europe**	**Southern Europe**
All	9,51	10,39	6,85	11,04	7,37
< 30 years old	12,23	14,31	8,46	12,06	11,58
30-44 years old	10,66	11,55	8,2	12,48	8,4
45 years or older	7,36	8,22	3,72	8,83	5,16

2015

WOMEN						
		EU28	**Western Europe**	**Eastern Europe**	**Northern Europe**	**Southern Europe**
All	**Total digital jobs**	**4,11%**	**4,19%**	**3,23%**	**4,93%**	**3,65%**
	% working in the ICT sector	56,23%	50,96%	72,04%	51,08%	64,28%
	% working in other sectors	43,77%	49,04%	27,96%	48,92%	35,72%
< 30 years old	**Digital jobs**	**4,74%**	**5,00%**	**4,83%**	**4,24%**	**4,92%**
	% working in the ICT sector	62,11%	52,53%	76,86%	61,86%	68,53%

	% working in other sectors	37,89%	47,47%	23,14%	38,14%	31,47%
30-44 years old	**Digital jobs**	**4,56%**	**4,46%**	**3,24%**	**5,96%**	**4,27%**
	% working in the ICT sector	57,03%	52,06%	73,43%	51,66%	62,81%
	% working in other sectors	42,97%	47,94%	26,57%	48,34%	37,19%
45 years or older	**Digital jobs**	**3,20%**	**3,46%**	**2,09%**	**4,16%**	**2,18%**
	% working in the ICT sector	50,15%	48,04%	60,52%	44,18%	64,72%
	% working in other sectors	49,85%	51,96%	39,48%	55,82%	35,28%

MEN						
		EU28	**Western Europe**	**Eastern Europe**	**Northern Europe**	**Southern Europe**
All	**Total digital jobs**	**14,82%**	**16,46%**	**12,56%**	**16,17%**	**11,49%**
	% working in the ICT sector	47,74%	40,33%	62,55%	50,26%	53,83%
	% working in other sectors	52,26%	59,67%	37,45%	49,74%	46,17%
< 30 years old	**Digital jobs**	**17,31%**	**20,35%**	**16,86%**	**14,63%**	**15,23%**
	% working in the ICT sector	48,98%	39,70%	66,06%	52,21%	54,69%
	% working in other sectors	51,02%	60,30%	33,94%	47,79%	45,31%
30-44 years old	**Digital jobs**	**16,58%**	**17,96%**	**14,20%**	**19,00%**	**13,48%**
	% working in the ICT sector	51,29%	44,11%	64,34%	51,78%	56,54%
	% working in other sectors	48,71%	55,89%	35,66%	48,22%	43,46%
45 years or older	**Digital jobs**	**11,98%**	**13,89%**	**7,22%**	**13,81%**	**8,07%**
	% working in the ICT sector	41,70%	36,25%	51,67%	46,93%	47,90%
	% working in other sectors	58,30%	63,75%	48,33%	53,07%	52,10%

Gender gap in the proportion of those who work in digital jobs					
	EU28	**Western Europe**	**Eastern Europe**	**Northern Europe**	**Southern Europe**
All	10,71	12,27	9,33	11,24	7,84
Less than 30 years old	12,57	15,35	12,03	10,39	10,31
30-44 years old	12,02	13,5	10,96	13,04	9,21
45 years or older	8,78	10,43	5,13	9,65	5,89

as % of total population with tertiary education

2011

WOMEN						
		EU25	**Western Europe**	**Eastern Europe**	**Northern Europe**	**Southern Europe**
All	**Total digital jobs**	**3,13%**	**3,15%**	**2,31%**	**3,80%**	**2,88%**
	Other jobs	75,71%	78,05%	76,26%	76,85%	70,40%
	Inactive	16,04%	15,48%	16,72%	15,44%	17,17%
	Unemployed	5,11%	3,32%	4,71%	3,91%	9,56%
< 30 years old	**Digital jobs**	**3,39%**	**3,35%**	**3,30%**	**4,05%**	**2,80%**
	Other jobs	68,78%	75,03%	67,10%	74,71%	54,11%
	Inactive	18,31%	16,58%	19,68%	14,35%	24,11%
	Unemployed	9,52%	5,04%	9,92%	6,89%	18,98%
30-44 years old	**Digital jobs**	**3,90%**	**3,97%**	**2,42%**	**4,81%**	**3,79%**
	Other jobs	80,62%	83,24%	84,35%	79,35%	76,28%
	Inactive	10,71%	9,78%	9,94%	12,19%	11,04%
	Unemployed	4,76%	3,01%	3,29%	3,65%	8,88%
45 years or older	**Digital jobs**	**2,01%**	**2,18%**	**1,18%**	**2,58%**	**1,37%**
	Other jobs	74,18%	74,51%	73,27%	75,51%	72,16%
	Inactive	21,06%	20,61%	23,81%	19,41%	22,59%
	Unemployed	2,75%	2,70%	1,74%	2,49%	3,88%

MEN						
		EU25	**Western Europe**	**Eastern Europe**	**Northern Europe**	**Southern Europe**
All	**Total digital jobs**	**11,52%**	**12,50%**	**8,36%**	**13,57%**	**9,11%**
	Other jobs	73,92%	75,11%	77,09%	72,58%	71,47%
	Inactive	9,81%	9,33%	10,43%	9,33%	10,92%
	Unemployed	4,74%	3,06%	4,12%	4,52%	8,50%
< 30 years old	**Digital jobs**	**12,59%**	**14,71%**	**10,13%**	**13,55%**	**9,56%**
	Other jobs	61,83%	64,47%	66,99%	65,24%	48,36%
	Inactive	16,62%	15,39%	14,06%	13,52%	25,04%
	Unemployed	8,96%	5,42%	8,83%	7,69%	17,04%
30-44 years old	**Digital jobs**	**14,18%**	**15,32%**	**10,46%**	**17,00%**	**11,54%**
	Other jobs	78,71%	79,78%	84,69%	76,44%	76,24%
	Inactive	2,68%	2,03%	2,17%	3,10%	3,55%
	Unemployed	4,43%	2,87%	2,68%	3,45%	8,67%
45 years or older	**Digital jobs**	**8,30%**	**9,35%**	**4,17%**	**10,05%**	**5,72%**
	Other jobs	74,66%	75,15%	74,63%	72,78%	75,78%
	Inactive	13,91%	13,11%	18,77%	13,37%	14,10%
	Unemployed	3,13%	2,39%	2,43%	3,80%	4,40%

Gender gap in the proportion of those who work in digital jobs					
	EU25	Western Europe	Eastern Europe	Northern Europe	Southern Europe
All	8,39	9,35	6,05	9,77	6,23
< 30 years old	9,2	11,36	6,83	9,5	6,76
30-44 years old	10,28	11,35	8,04	12,19	7,75
45 years or older	6,29	7,17	2,99	7,47	4,35

2015

WOMEN						
		EU28	Western Europe	Eastern Europe	Northern Europe	Southern Europe
All	**Total digital jobs**	**3,27%**	**3,43%**	**2,60%**	**4,06%**	**2,65%**
	Other jobs	76,22%	78,34%	77,69%	78,42%	69,89%
	Inactive	15,22%	14,57%	16,25%	14,27%	16,49%
	Unemployed	5,29%	3,66%	3,47%	3,24%	10,97%
< 30 years old	**Digital jobs**	**3,41%**	**3,79%**	**3,46%**	**3,48%**	**2,69%**
	Other jobs	68,62%	72,14%	68,12%	78,73%	51,98%
	Inactive	19,02%	17,88%	21,40%	12,73%	26,03%
	Unemployed	8,95%	6,19%	7,02%	5,06%	19,30%
30-44 years old	**Digital jobs**	**3,83%**	**3,88%**	**2,76%**	**5,10%**	**3,33%**
	Other jobs	80,17%	83,13%	82,46%	80,49%	74,76%
	Inactive	10,63%	9,54%	11,85%	11,48%	10,48%
	Unemployed	5,37%	3,45%	2,93%	2,93%	11,42%
45 years or older	**Digital jobs**	**2,51%**	**2,74%**	**1,66%**	**3,31%**	**1,63%**
	Other jobs	75,82%	76,58%	77,61%	76,33%	72,86%
	Inactive	18,60%	18,14%	19,19%	17,89%	19,89%
	Unemployed	3,07%	2,53%	1,54%	2,46%	5,62%

MEN						
		EU28	Western Europe	Eastern Europe	Northern Europe	Southern Europe
All	**Total digital jobs**	**12,80%**	**14,45%**	**11,15%**	**14,28%**	**9,24%**
	Other jobs	73,59%	73,35%	77,60%	74,07%	71,14%
	Inactive	8,88%	8,53%	8,10%	8,23%	10,68%
	Unemployed	4,72%	3,67%	3,15%	3,41%	8,94%
< 30 years old	**Digital jobs**	**12,84%**	**15,62%**	**13,14%**	**12,06%**	**8,43%**
	Other jobs	61,34%	61,2	64,76%	70,38%	46,92%
	Inactive	16,44%	15,98	14,56%	11,09%	25,97%
	Unemployed	9,34%	7,19	7,54%	6,47%	18,68%

30-44 years old	**Digital jobs**	**15,41%**	**16,89%**	**13,68%**	**17,98%**	**11,80%**
	Other jobs	77,52%	77,11%	82,64%	76,66%	75,71%
	Inactive	2,88%	2,82%	1,57%	2,86%	3,82%
	Unemployed	4,19%	3,18%	2,12%	2,50%	8,67%
45 years or older	**Digital jobs**	**10,20%**	**12,04%**	**6,08%**	**11,77%**	**6,64%**
	Other jobs	74,93%	74,64%	78,17%	73,44%	75,60%
	Inactive	11,59%	10,48%	13,84%	12,04%	12,34%
	Unemployed	3,27%	2,83%	1,91%	2,75%	5,42%

Gender gap in the proportion of those who work in digital jobs					
	EU28	**Western Europe**	**Eastern Europe**	**Northern Europe**	**Southern Europe**
All	9,53	11,02	8,55	10,22	6,59
< 30 years old	9,43	11,62	9,68	8,58	5,74
30-44 years old	11,58	13,01	10,92	12,88	8,47
45 years or older	7,69	9,3	4,42	8,46	5,01

Finally, Table 12 shows people who undertook education in ICT-related studies and are working in digital jobs. Again, since we are using a variable with a filter, this information is only available for individuals up to 34 of age or who have completed their studies in the last 15 years.

Table 11 Gender Gaps in the Percentage of Individuals who work in digital jobs and undertook education in Maths, Statistics, Computing and Engineering

2011

	EU25	**Western Europe**	**Eastern Europe**	**Northern Europe**	**Southern Europe**
Total Population working in digital jobs with ICT-related studies					
% Working	1,55%	1,69%	1,81%	1,21%	1,52%
% Working Males	2,52%	2,82%	2,93%	2,06%	2,18%
% Working Females	0,46%	0,38%	0,46%	0,35%	0,74%
Gap (Male-Female)	**2,06**	**2,44**	**2,47**	**1,71**	**1,44**
Population working in digital jobs with ICT-related and less than University Studies					
% Working	0,76%	0,94%	0,96%	0,27%	0,77%
% Working Males	1,25%	1,60%	1,43%	0,46%	1,22%
% Working Females	0,16%	0,18%	0,20%	0,08%	0,19%
Gap (Male-Female)	**1,09**	**1,42**	**1,23**	**0,38**	**1,03**

Population working in digital jobs with ICT-related and University Studies or More					
% Working	3,08%	3,28%	3,34%	2,51%	3,24%
% Working Males	5,89%	5,81%	6,81%	4,73%	5,37%
% Working Females	0,87%	0,74%	0,75%	0,66%	1,46%
Gap (Male-Female)	**5,02**	**5,07**	**6,06**	**4,07**	**3,91**

2015

	EU28	Western Europe	Eastern Europe	Northern Europe	Southern Europe
Total Population working in digital jobs with ICT-related studies					
% Working	1,60%	1,89%	1,90%	1,05%	1,46%
% Working Males	2,48%	3,23%	3,16%	1,79%	2,28%
% Working Females	0,40%	0,40%	0,38%	0,31%	0,53%
Gap (Male-Female)	**2,08**	**2,83**	**2,78**	**1,48**	**1,75**
Population working in digital jobs with ICT-related and less than University Studies					
% Working	0,70%	0,90%	0,74%	0,29%	0,75%
% Working Males	1,17%	1,58%	1,13%	0,49%	1,20%
% Working Females	0,11%	0,13%	0,08%	0,07%	0,14%
Gap (Male-Female)	**1,06**	**1,45**	**1,05**	**0,42**	**1,06**
Population working in digital jobs with ICT-related and University Studies or More					
% Working	2,99%	3,64%	3,50%	2,02%	2,70%
% Working Males	5,64%	6,56%	7,20%	3,88%	4,88%
% Working Females	0,72%	0,79%	0,63%	0,54%	0,92%
Gap (Male-Female)	**4,92**	**5,77**	**6,57**	**3,34**	**3,96**

The Opt-Out Phenomenon – From digital jobs to inactive state

1. People who previously worked in digital jobs but are now inactive

To calculate the opt-out phenomenon in men and women we combined the graduates who worked in digital jobs but now do not with the graduates who are working in digital jobs at the moment.

The aim of this analysis is to know the percentage of people with tertiary education who, for different reasons, have been forced to leave and have not continued their professional career in the ICT sector (excluding those unemployed). Table 13 presents these statistics by gender and age interval, both for all countries and for groups of European countries.

We also include the same analysis for people with university education who work or worked in non-digital jobs to make comparisons.

Table 12 Percentage of individuals who previously had a digital job and are now inactive

*as % of working population in **digital jobs** with tertiary education (17-64 years)*

2011

All	4,82%

WOMEN					
	EU25	**Western Europe**	**Eastern Europe**	**Northern Europe**	**Southern Europe**
All	***109.155***	***19.248***	***16.942***	***50.445***	***22.520***
Less than 30 years old	*17.801*	*1.681*	*2.224*	*9.957*	*3.940*
30-44 years old	*56.270*	*11.964*	*7.039*	*24.729*	*12.537*
45 years or older	*35.085*	*5.604*	*7.679*	*15.759*	*6.042*
All	**7,60%**	**3,87%**	**10,56%**	**11,11%**	**6,93%**
Less than 30 years old	5,33%	1,63%	3,70%	9,76%	5,74%
30-44 years old	7,26%	4,59%	9,98%	10,61%	5,97%
45 years or older	10,72%	4,21%	26,41%	13,25%	13,07%

MEN					
	EU25	**Western Europe**	**Eastern Europe**	**Northern Europe**	**Southern Europe**
All	***178.220***	***52.644***	***12.365***	***61.992***	***51.219***
Less than 30 years old	*30.040*	*4.913*	*2.110*	*9.887*	*13.130*
30-44 years old	*27.058*	*3.122*	*2.122*	*10.176*	*11.638*
45 years or older	*121.122*	*44.609*	*8.133*	*41.929*	*26.451*
All	**3,94%**	**2,66%**	**3,22%**	**4,72%**	**6,06%**
Less than 30 years old	3,40%	1,39%	1,86%	3,78%	8,47%
30-44 years old	1,19%	0,34%	1,05%	1,58%	2,38%
45 years or older	8,82%	6,40%	11,97%	10,33%	13,08%

Gender Gap	**3,66%**

2015

All	5,05%

WOMEN					
	EU28	**Western Europe**	**Eastern Europe**	**Northern Europe**	**Southern Europe**
All	**151.590**	**55.546**	**24.112**	**45.473**	**26.460**
Less than 30 years old	25.050	8.983	4.789	5.291	5.987
30-44 years old	79.068	27.371	14.559	25.208	11.930
45 years or older	47.472	19.192	4.763	14.974	8.543
All	**8,59%**	**8,73%**	**11,06%**	**8,45%**	**7,10%**
Less than 30 years old	6,73%	6,15%	7,38%	5,87%	8,43%
30-44 years old	8,67%	9,25%	13,02%	9,04%	5,29%
45 years or older	9,88%	9,90%	11,54%	8,85%	11,19%

MEN					
	EU28	**Western Europe**	**Eastern Europe**	**Northern Europe**	**Southern Europe**
All	**221.368**	**113.225**	**10.606**	**61.188**	**36.348**
Less than 30 years old	33.867	17.582	720	10.980	4.585
30-44 years old	37.188	17.075	1.939	10.522	7.652
45 years or older	150.313	78.568	7.948	39.687	24.111
All	**3,94%**	**4,43%**	**1,70%**	**4,11%**	**3,87%**
Less than 30 years old	3,42%	3,91%	0,49%	4,38%	3,23%
30-44 years old	1,38%	1,56%	0,54%	1,46%	1,47%
45 years or older	7,82%	7,76%	6,87%	7,68%	8,73%

Gender Gap	**4,65**

*as % of working population in **no digital jobs** with tertiary education (17-64 years)*

2011

All	8,01%

WOMEN					
	EU25	**Western Europe**	**Eastern Europe**	**Northern Europe**	**Southern Europe**
All	**9,56%**	**8,01%**	**10,46%**	**10,72%**	**10,15%**
Less than 30 years old	8,04%	5,36%	8,70%	8,16%	11,78%
30-44 years old	7,33%	5,91%	7,28%	9,10%	7,63%
45 years or older	13,54%	11,74%	16,81%	13,81%	13,63%

MEN					
	EU25	**Western Europe**	**Eastern Europe**	**Northern Europe**	**Southern Europe**
All	**6,17%**	**5,84%**	**5,85%**	**6,14%**	**6,95%**
Less than 30 years old	5,94%	4,15%	2,99%	6,11%	11,62%
30-44 years old	2,02%	1,72%	1,61%	2,28%	2,43%
45 years or older	10,46%	9,82%	13,34%	10,01%	11,02%

Gender Gap	**3,39**

2015

All	7,48%

WOMEN					
	EU28	**Western Europe**	**Eastern Europe**	**Northern Europe**	**Southern Europe**
All	**9,04%**	**7,79%**	**9,93%**	**9,66%**	**9,60%**
Less than 30 years old	7,90%	6,05%	8,35%	7,55%	11,29%
30-44 years old	7,30%	6,22%	8,53%	7,84%	7,38%
45 years or older	11,82%	10,42%	13,23%	12,68%	12,19%

MEN					
	EU28	**Western Europe**	**Eastern Europe**	**Northern Europe**	**Southern Europe**
All	**5,54%**	**5,24%**	**4,19%**	**5,67%**	**6,72%**
Less than 30 years old	6,05%	5,63%	2,14%	5,24%	11,52%
30-44 years old	2,13%	2,08%	1,39%	2,02%	2,78%
45 years or older	8,69%	7,66%	9,26%	9,41%	9,67%

Gender Gap	**3,50**

We compare men and women who previously had a digital job and are now inactive in order to estimate the productivity loss that the greater number of females leaving digital jobs meant for the EU. That is, we defined the annual productivity gain for Europe that would have happened if women remained in digital jobs at the same rate as men.

In the 2013 report, we define the productivity gain for the EU as a result of promoting women to the ICT sector, and a gain that would have occurred if women who studied ICT-related fields and who are currently not working were to work in the ICT sector with the same productivity as men given the level of Average Productivity in the ICT sector. Since the 2015 LFS only provides the educational background of women who are 35 years and younger or who studied less than 15 years ago, the data this year is not representative of the whole population, but only for those specific populations.

As a result, in this study we replicate this calculation using the current data from both the 2011 and 2015 LFS to see the evolution. Taking into consideration that the opt-out phenomenon is more common among women ages 30 to 45, we recognize that this data will not capture the whole problem.

We have, therefore, designed a new indicator to complement the previous one, based on a mix of employment in the ICT-intensive sector and of employment in digital occupations, defined as "digital jobs".

Since in 2013 we calculated the productivity gain of more women entering the sector and this year we provided the economic cost of the female opt-out phenomenon, we found that both datasets complement each other and provide a wider view of the situation of women in the digital field. This indicator will describe the economic impact of the female opting-out phenomenon from digital jobs in Europe.

2. Annual productivity loss

In the table below, the annual productivity loss for the EU as a result of females leaving digital jobs is displayed. To calculate it, we used the gender gap derived from Table 7 which showed the percentage of people who worked in digital jobs and are now inactive.

With that gender gap, we then estimated how many women left the sector out of the total number of women in digital jobs both before and now. To define the loss of productivity, we took numbers from the 2017 PREDICT dataset[241] and the average productivity in the ICT sector in 2014 to calculate the annual productivity loss without these women.

241 The 2017 PREDICT Dataset represents the most comprehensive information system available on ICT industries and their Research and Development. It provides a detailed analysis of the state of ICT R&D and other macroeconomic variables in the European Union and in the major competing economies (https://ec.europa.eu/jrc/en/predict/ict-sector-analysis-2017/data-metadata).

Table 13. Estimation of the productivity loss due to the gender gap in the opt-out phenomenon in the digital sector

Women in digital jobs		
With tertiary education	1.764.602	
Gender Gap	4,65%	
Gender gap (absolute value)	**82.054**	
With secondary or tertiary education	3.036.503	
Gender Gap	4,92%	5,60%[242]
Gender gap (absolute value)	**149.396**	170.044
Average productivity ICT sector in 2014	€ 94.830[2]	
PRODUCTIVITY ANNUAL LOSS		
With tertiary education	**€ 7.781.180.156**	
With secondary or tertiary education	**€ 14.167.217.711**	

To verify the gender gap, we performed a Lineal Probability Model (LPM). This model estimates the effect of women with secondary or tertiary education on the probability of having previously worked in digital jobs and are now inactive.

On average, all other things being equal, the probability of having worked in digital jobs and now being inactive for women with that education level is 4,92 percentage points higher than for men (the same result as expected from the descriptive analysis). When we include control variables in the model, the probability increases to 5,6 percentage points. Findings suggest that on average, and all other things equal, women in the ICT sector have higher probability to be inactive than men.

MODEL	**Without CONTROL variables**	**With CONTROL variables**
DEPENDENT VARIABLE	WORK IN DIGITAL JOBS PREVIOUSLY AND BE INACTIVE NOW	
FEMALE	0.049 (0.004)***	0.056 (0.004)***
AGE 15-19		-0.0002

242 Coefficient from a LPM with control variables: age, university studies and group of countries.

		(0.010)
AGE 20-24		0.043
		(0.006)***
AGE 25-29		0.022
		(0.005)***
AGE 30-34		0.013
		(0.003)***
AGE 40-44		-0.005
		(0.003)*
AGE 45-49		-0.007
		(0.003)**
AGE 50-54		0.004
		(0.003)
AGE 55-59		0.074
		(0.006)***
AGE 60-64		0.428
		(0.011)***
UNIVERSITY STUDIES		-0.022
		(0.003)***
EASTERN		0.004
		(0.003)
NORTHERN		-0.006
		(0.004)***
SOUTHERN		0.008
		(0.003)***
Constant	0.057	0.029
	(0.002)***	(0.003)***
Observations	92,921	92,921
R-squared	0.007	0.176
r2_a	0.007	0.176
Residual Std. Error	3.013 (df = 92919)	2.744 (df = 92906)
F Statistic	625.906*** (df = 1; 92919)	1,415.284*** (df = 14; 92906)

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1
Base case: Male, No university studies, Age 35-30, Western Europe

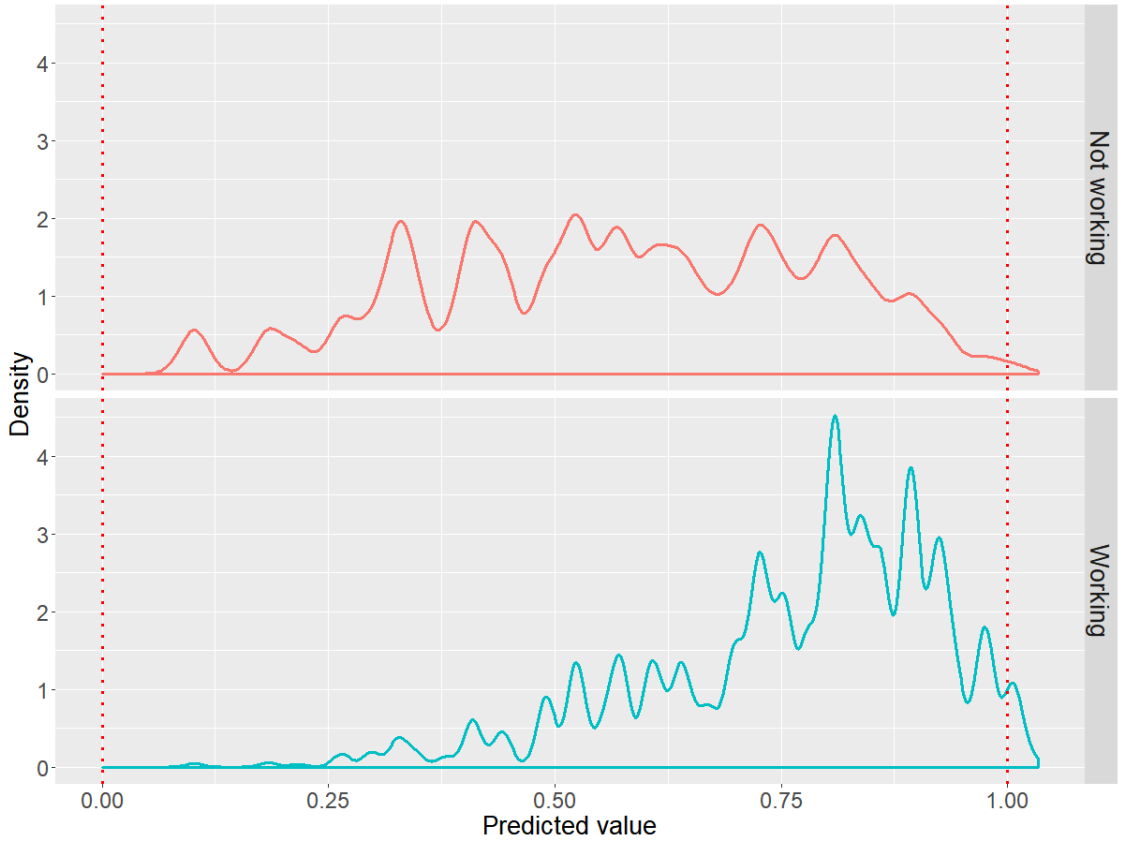
The effects of ICT-related studies on employability

This analysis was also made by using the microdata of the LFS 2015. For this section, the yearly data for all member states was used (Iceland, Norway and Switzerland were excluded). A subset of the dataset was made by including the following populations: population aged 17 to 65; population with, at least, upper secondary education (more than level 3 in the ISCED 2011 code); and population with information about the field of the study (those aged 17 to 34, or older than 35 but who finished their studies in the last 15 years). The observations were weighted using the variable COEFF of the LFS-2015

dataset[243]. As a result, 763.515 observations have been used in the analysis out of the total 2,981,372 observations of the LFS-2015.

ICT-related studies are supposed to have a positive impact on employment. In this analysis, the effect of having ICT-related studies is assessed for both men and women to check whether there is a significant difference depending on gender. To perform the analysis a Linear Probability Model (LPM) was used. The main limitations of LPMs are:

1. There is inherent heteroscedasticity; however, it does not bias OLS and the usual robust standard errors are easily estimated.
2. The Average Partial Effects (APE) are constant. While constant APE are never realistic, this is especially true in the LPM because, theoretically, the APE must approach zero as the predicted probability approaches either 0 or 1. To asses if this is a problem in this case, we will compare the coefficients of the LPM to the APE estimated for a LOGIT model using the procedure described by Karaca-Mandic, Norton, & Dowd (2012).
3. OLS fitted values may be less than 0 and more than 1, but it makes no sense for probabilities. In this specific case this does not seem to be a big problem as seen in the following figure. Only a very small percentage of the fitted values fall outside of the unit interval.



243 As a result, a small number of observations (9.728) without the WEIGTH variable and 78.682 observations with WEIGHT equal to zero have also been excluded.

We have specified two models: a base model using only the interaction of gender and ICT-related studies, and another model controlling for several variables related to the individuals, namely, whether or not they have had tertiary studies, group of age and the region where they live.

The full specification of the LPM with control variables is as follows:

$$Work_i = \beta 0 + \beta_1 Female_i + \beta_2 STEM_i + \beta_3 STEM_i x\, Female_i + \beta_4 University_i + \beta_5 Age\ groupp_i + \beta_6 Region_i + \in$$

The coefficients of interest are β_2 which shows the effect of having ICT-related studies for men and β_3, the interaction between being female and having ICT-related studies, which shows the difference between women and men who have had ICT-related studies.

The results of the analysis can be seen in the following table. We stick to the coefficients of the LPM, including control variables. On average, and everything else equal, the probability of working for women without ICT-related studies is 8 percentage points lower than for men. The interaction terms between gender and ICT-related studies are shown in grey shadow. This findings suggest that, on average, and all other things equal, having ICT-related studies for men increases the probability of working by 2 percentage points. For women, the probability of being employed with ICT-related studies decreases 1 percentage point (0.02-0.03 x 100). All the results are statistically significant. These are very close to the APE LOGIT results of 3 percentage points and -2 percentage points for men and women, respectively.

MODEL	**LPM**	**LOGIT coefficients**	**LOGIT APE**	**LPM**	**LOGIT coefficients**	**LOGIT APE**
	Without CONTROL variables			**With CONTROL variables**		
DEPENDENT VARIABLE	WORK					
FEMALE	-0.07 (0.002)***	-0.35 (0.010)***	-0.07 (0.002)***	-0.08 (0.002)***	-0.49 (0.011)***	-0.08 (0.002)***
ICT-related STUDIES (MEN)	0.07 (0.005)***	0.42 (0.031)***	0.07 (0.005)***	0.02 (0.004)***	0.20 (0.034)***	0.03 (0.005)***
ICT-related STUDIES (WOMEN)			0.03 (0.010)***			-0.02 (0.010)*
ICT-related STUDIES (WOMEN vs MEN)	-0.04 (0.011)***	-0.27 (0.056)***		-0.03 (0.010)***	-0.29 (0.063)***	
UNIVERSITY STUDIES				0.08 (0.002)***	0.50 (0.012)***	0.08 (0.002)***
AGE 15-19				-0.54 (0.005)***	-2.72 (0.030)***	-0.54 (0.005)***
AGE 20-24				-0.32 (0.003)***	-1.71 (0.022)***	-0.32 (0.003)***
AGE 25-29				-0.09 (0.003)***	-0.65 (0.022)***	-0.10 (0.003)***

AGE 30-34				-0.03 (0.003)***	-0.27 (0.022)***	-0.04 (0.003)***
AGE 40-44				0.01 (0.003)*	0.07 (0.033)**	0.01 (0.004)**
AGE 45-49				-0.00 (0.005)	0.02 (0.044)	0.00 (0.005)
AGE 50-54				-0.00 (0.005)	-0.02 (0.048)	-0.00 (0.006)
AGE 55-59				-0.06 (0.008)***	-0.49 (0.057)***	-0.07 (0.009)***
AGE 60-64				-0.26 (0.013)***	-1.55 (0.059)***	-0.28 (0.013)***
EASTERN				-0.05 (0.002)***	-0.29 (0.012)***	-0.05 (0.002)***
NORTHERN				0.03 (0.003)***	0.22 (0.017)***	0.03 (0.003)***
SOUTHERN				-0.16 (0.002)***	-0.90 (0.013)***	-0.16 (0.002)***
Constant	0.75 (0.001)***	1.11 (0.007)***		0.89 (0.003)***	2.10 (0.023)***	
Observations	763,515	763,515	763,515	763,515	763,515	763,515
R-squared	0.008			0.181		
r2_a	0.00764			0.181		

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1
The APE of the LOGIT model for interaction terms is estimated as described by Karaca-Mandic, Norton, & Dowd (2012)
Standard erros in APE is calculated at the means of the explanatory variables using the delta method (Karaca-Mandic, Norton, & Dowd, 2012)
Base case: Male, No university studies, No STEM studies, Age 35-30, Western Europe

The model without the control variable suggests that the effect of ICT-related studies for men is 7 percentage points and for women around 3 percentage points (0.07-0.04x100). The model with the control variables is expected to provide more accurate results by excluding some confounding variables from the error term. In fact, the R squared value is much higher suggesting a much better fit than the base model. It is difficult to guarantee that there are no other confounding variables in the error term that are related at the same time with ICT-related studies and employability, thus biasing the results. Therefore, based on our results, it is challenging to establish the true causal relationship between ICT-related studies in employability and gender.

The control variables are working as expected with almost identical results for both models, the LPM and the LOGIT. Having university studies increases the probability of working by 8 percentage points. Compared to the base group of 35 to 39 year olds, older and younger populations decrease the probability of working by up to 26 and 54 percentage points respectively. Citizens in Northern Europe have a slightly higher probability of working compared to Western Europe, while citizens in Eastern, and particularly Southern, Europe have a lower probability of working compared to the same region (5 and 16 percentage points respectively).

In brief, despite their limitations, our results suggest that on average, all other things equal, having university studies has a positive impact on employability for both men and women (8 percentage points). Having ICT-related studies, however, only seems to have a positive effect on men (around 3 percentage points), while for women the effect is negative (around 2 percentage points).

European Survey on Working Conditions

Gender Gaps in the ICT and non-ICT sectors

In this part of the study, in addition to presenting descriptive differences in gender with respect to job conditions, we also estimate a different set of job conditions for men and women working in the ICT sector.

The analysis was made using the microdata of the European Survey of Working Conditions 2015, which covers 34 European Countries and contains individual information on issues such as employment status, working time duration and organisation, work organisation, learning and training, physical and psychosocial risk factors, health and safety, work-life balance, worker participation, earnings and financial security, as well as work and health. We used the latest wave, 2015, to have a more accurate picture of the whole analysis. In the analysis, 33 countries[244] have been included.

Given its European coverage as well as its main aim, this survey is particularly appropriate for the analysis of Gender Differences in Work Conditions, which is the focus of this section of the study. In what follows, we select all those workers working in the ICT sector from all countries and try to describe male and female workers in this sector to establish whether and how job conditions differ by gender. In all cases, the observations are weighted using the cross-national weights (w5) that make an adjustment to post-stratification weights to ensure that each country is represented in proportion to the size of its in-work population.

1. Gender Differences in the ICT Sector – Demographics and some Job Characteristics

We start by presenting gender differences in demographics and job characteristics of males and females working in the ICT sector with respect to those working in other Service Sectors. More precisely, under the non-ICT Service Sector we include the following sectoral activities: K (Financial and insurance activities), L (Real estate activities), M (Professional, scientific and technical activities except for 71 and 72, which are in the ICT sector), N (Administrative and support service activities), O (Public administration and defence), P (Education), Q (Human health and social work activities) and S (Other service activities).

244 Countries include: EU27, Norway, Croatia, the Former Yugoslav Republic of Macedonia, Turkey, Albania, Montenegro and Kosovo.

Table 14 shows the gender differences in the ICT sector by regional distribution, while Table 15 reports the same differences but in the European non-ICT Service Sectors, which allows us to compare demographics to job characteristics in both sectors. Countries are categorized into 4 groups according to their geographical location. The distribution of countries among regions is the following:

- Western Europe: Belgium, Germany, France, Luxemburg, Netherlands, Austria.
- Eastern Europe: Bulgaria, Czech Rep., Hungary, Poland, Romania, Slovakia.
- Northern Europe: Denmark, Estonia, Ireland, Latvia, Lithuania, Finland, Sweden, the UK, Norway.
- Southern Europe: Greece, Spain, Italy, Cyprus, Malta, Portugal, Slovenia, Croatia, Albania, Kosovo, FYROM, Montenegro.

Table 14 Gender Differences in ICT sector – Demographics and Job Characteristics (2015)

	Western		Eastern		Northern		Southern	
% of Women	34,49%		39,19%		28,37%		27,62%	
	Men	**Women**	**Men**	**Women**	**Men**	**Women**	**Men**	**Women**
Demographic Characteristics								
Average Age	41,7	37,5	35,1	35	42,1	37,5	41	38.0
Primary	1,60%	6,24%	0,00%	0,00%	0,16%	0,00%	1,57%	0.42%
Secondary + non-tertiary	34,86%	37,50%	27,51%	38,08%	28,17%	29,92%	39,85%	50.00%
University	63,54%	56,26%	72,49%	61,92%	71,67%	70,08%	58,59%	49.58%
Head of the Household	77,91%	41,62%	87,91%	43,95%	82,82%	39,42%	68,52%	38.46%
Job Characteristics								
Average Monthly Earnings (in Euros)	2692,94	1855,49	1082,02	584,83	3554,41	2189	1314,88	1233,7
Managers and Professionals	68,03%	44,79%	49,10%	45,92%	71,04%	70,11%	58,40%	53,08%
Technicians and assoc. Professionals	21,12%	19,63%	39,62%	9,45%	25,18%	8,79%	28,32%	18,80%
Clerical	0,98%	16,40%	4,84%	28,48%	0,60%	11,38%	5,64%	22,41%
Services and Sales	2,90%	3,85%	2,37%	16,15%	0,97%	1,19%	2,25%	4,54%
Manual Labour	6,98%	15,34%	4,07%	0,00%	2,22%	8,54%	5,39%	1,18%
Female Bosses	11,58%	18,40%	3,55%	43,06%	22,95%	47,87%	23,23%	30,44%
Mostly Female Co-workers	2,33%	27,22%	1,12%	19,62%	2,12%	19,23%	5,94%	30,42%
Permanent	79,38%	81,03%	81,49%	69,11%	84,83%	78,66%	78,82%	72,15%

Contract								
Temporary Contract	17,12%	18,97%	12,52%	24,94%	14,04%	20,87%	18,05%	10,84%
Small Firm (1-9 workers)	40,61%	34,56%	57,17%	12,75%	29,00%	23,71%	56,02%	48,15%
Medium Firm (10-99 workers)	41,80%	36,57%	30,36%	59,92%	44,14%	39,62%	34,49%	34,87%
Large Firm (100 or more workers)	17,59%	28,87%	12,47%	27,33%	26,87%	36,67%	9,49%	16,98%
Private Sector	88,28%	86,89%	89,52%	70,11%	89,90%	89,14%	84,11%	82,99%
Public Sector	7,13%	11,64%	4,54%	26,88%	6,62%	8,86%	8,06%	10,23%

Table 15 Gender Differences in non-ICT Services Sectors – Demographics and Job Characteristics (2015)

% of Women	**Western**		**Eastern**		**Northern**		**Southern**	
	64,71%		67,51%		61,02%		61,48%	
	Men	**Women**	**Men**	**Women**	**Men**	**Women**	**Men**	**Women**
Demographic Characteristics								
Average Age	44,5	43,2	44,3	42,9	43,5	43,4	44,8	43,4
Primary	1,67%	1,48%	0,79%	0,46%	0,18%	1,63%	4,38%	4,46%
Secondary + non-tertiary	48,93%	60,39%	56,72%	53,40%	41,26%	43,51%	56,75%	53,28%
University	49,41%	38,13%	42,49%	46,14%	58,56%	54,86%	38,88%	42,25%
Head of the Household	78,58%	42,25%	79,67%	40,04%	70,83%	47,01%	75,35%	37,71%
Job Characteristics								
Average Monthly Earnings (in Euros)	2214,07	1501,08	537,57	494,45	2896,96	2069,55	1579,51	1030,39
Managers and Professionals	35,93%	28,79%	29,55%	44,77%	49,80%	42,40%	31,35%	37,06%
Technicians and assoc. Professionals	25,14%	27,02%	18,35%	12,91%	15,50%	15,32%	17,53%	13,80%
Clerical	9,80%	13,14%	5,61%	9,62%	6,59%	11,36%	16,96%	17,78%
Services and Sales	13,89%	17,93%	24,69%	19,63%	18,25%	22,20%	19,55%	16,54%
Manual Labour	15,23%	13,12%	21,80%	13,07%	9,86%	8,72%	14,62%	14,82%
Female Bosses	28,14%	54,35%	18,85%	64,25%	34,78%	70,66%	22,96%	52,76%

Mostly Female Co-workers	21,32%	73,35%	15,03%	74,44%	22,18%	74,24%	15,54%	64,60%
Permanent Contract	81,90%	82,30%	75,44%	78,94%	84,83%	86,12%	78,16%	71,68%
Temporary Contract	13,36%	14,29%	17,74%	14,81%	12,67%	9,76%	15,82%	18,00%
Small Firm (1-9 workers)	24,87%	33,81%	33,89%	37,12%	25,24%	23,11%	40,49%	43,46%
Medium Firm (10-99 workers)	53,99%	50,02%	55,22%	53,03%	46,17%	57,61%	46,61%	45,26%
Large Firm (100 or more workers)	21,15%	16,17%	10,89%	9,85%	28,58%	19,28%	12,90%	11,28%
Private Sector	47,34%	49,10%	45,72%	42,14%	51,07%	38,07%	50,31%	50,79%
Public Sector	37,20%	32,36%	50,19%	52,43%	41,61%	54,71%	45,58%	42,73%

2. Gender Differences in Work Conditions in the ICT versus Non-ICT Sectors – Descriptive

This section presents a descriptive analysis of gender differences observed in each of the following aspects related to working conditions:

(i) Training
(ii) Flexible schedule
(iii) Wages
(iv) Satisfaction
(v) Work environment
(vi) Stress
(vii) Discrimination.

The responses to the questions take a value of 1 when the individual answers positively to the question (i.e. agrees or says "yes"), and 0 if the answer is negative. Therefore, the mean values are always between 0 and 1. These mean values for men and women give us an idea of the different experiences that men and women have in the ICT sector.

Training is measured with the question of whether training has been provided (or paid for) by their employer. For flexible schedule, if arranging to take an hour or two off work for personal matters is easy. Overall satisfaction includes if workers consider they are well-paid and how satisfied they are with working conditions in their main paid job. We use a continuous variable for wages which contains information about hourly wages.

With regards to work environment, three questions stand out in our preliminary analysis: (1) if the organisation motivates them to give their best job performance, (2) if they are able to apply their own ideas in their work and (3) if their immediate manager encourages them to participate in important decisions. With respect to stress, participants are asked a couple of questions, including whether they have enough time to get the job done and if they experience stress in their work. Finally, concerning discrimination, participants are asked if they have experienced discrimination on the basis of their sex.

Table 16 Gender Differences in Work Conditions in the ICT and non-ICT Service Sectors (2015)

	ICT		non-ICT Services	
	Female	**Male**	**Female**	**Male**
***Training paid for or provided by your employer or by yourself if self-employed* (1=agree)**				
Western	0,44	0,48	0,52	0,53
Eastern	0,56	0,48	0,45	0,41
Northern	0,45	0,44	0,63	0,56
Southern	0,49	0,46	0,43	0,41
***Would you say that for you arranging to take an hour or two off during working hours to take care of personal or family matters is … ?* (1=easy)**				
Western	0,74	0,83	0,55	0,7
Eastern	0,6	0,73	0,59	0,62
Northern	0,87	0,9	0,72	0,77
Southern	0,67	0,75	0,62	0,7
***Hourly Wage* (in Euros)**				
Western	14,12	14,67	11,56	14,06
Eastern	3,66	5,79	3,64	3,91
Northern	13,86	20,77	14,84	17,31
Southern	9,4	7,74	8,55	11,37
***Agree/Disagree: I am well paid for the work I do?* (1=agree)**				
Western	0,63	0,6	0,49	0,54
Eastern	0,71	0,76	0,5	0,48
Northern	0,66	0,63	0,54	0,59
Southern	0,43	0,44	0,46	0,51
***On the whole, how satisfied are you with working conditions in your main paid job?* (1= positive)**				
Western	0,86	0,92	0,85	0,86
Eastern	0,87	0,92	0,9	0,86
Northern	0,95	0,94	0,88	0,89
Southern	0,76	0,88	0,85	0,87
***The organisation I work for motivates me to give my best job performance* (1=agree)**				
Western	0,67	0,67	0,63	0,63
Eastern	0,55	0,74	0,59	0,65
Northern	0,73	0,69	0,69	0,64
Southern	0,67	0,6	0,64	0,68
***You are able to apply your own ideas in your work* (1=agree)**				
Western	0,64	0,7	0,54	0,61
Eastern	0,45	0,64	0,5	0,52
Northern	0,59	0,84	0,66	0,68

Southern	0,61	0,73	0,58	0,62
Your immediate manager/supervisor encourages you to participate in important decisions **(1=agree)**				
Western	0,55	0,65	0,43	0,51
Eastern	0,41	0,66	0,49	0,44
Northern	0,42	0,72	0,52	0,58
Southern	0,59	0,54	0,43	0,5
You have enough time to get the job done **(1=agree)**				
Western	0,75	0,76	0,7	0,73
Eastern	0,66	0,53	0,78	0,8
Northern	0,69	0,68	0,63	0,65
Southern	0,6	0,69	0,78	0,78
You experience stress in your work **(1=agree)**				
Western	0,27	0,27	0,27	0,24
Eastern	0,3	0,24	0,27	0,21
Northern	0,21	0,23	0,3	0,27
Southern	0,43	0,27	0,26	0,28
Have you experienced discrimination on the basis of your sex? **(1=agree)**				
Western	0,041	0	0,035	0,017
Eastern	0,012	0	0,021	0,005
Northern	0,056	0,006	0,029	0,031
Southern	0,098	0,002	0,03	0,009

3. Estimation of Differences in Working Conditions – Men versus women in the ICT sector and women in ICT versus women in non-ICT sectors

The aim of this analysis was twofold:

1. Firstly, we select men and women working in the ICT sector and estimate each of the working condition variables controlled by different factors (age, educational level, etc.), including an indicator for females. The coefficient of such an indicator reveals whether gender differences persist when we compare similar men and women in terms of the control variables.

2. We select women working in both the ICT and non-ICT sectors and estimate whether differences among these women persist when we compare similar women in terms of age, education, type of contract, occupation and type of sector (public/private).

For the two estimations, the dependent variables reflecting working conditions are binary (1 or zero) except for hourly wages, where a logic model is used. The coefficient of the female indicator reveals whether gender differences persist when we compared similar men and women in terms of the included controls. In addition, we reported odd-ratios: a value of 1 (or not significantly different from 1) would reveal no gender difference in the estimated variable. A smaller value would reflect a lower position of women with respect to men. For the estimation of wages, we used the standard Ordinary Least Square Estimator.

As the number of observations, particularly for some of the groups of countries, is very low, we estimated all countries together in the estimation, although indicators for each of the four groups were also included as controls.

Table 17 shows in the first column the coefficients of gender differences in the ICT sector for each of the working condition variables described in the column on the left. Only those coefficients with at least one * are significantly different from zero. A coefficient lower than one would reflect poorer conditions for females with respect to men in the ICT sector.

The second column estimates the difference in working conditions between females in the ICT versus non-ICT sectors, which share demographics and job characteristics (age, education, occupation, type of contract, firm size and type of sector).

Table 17 Estimation of Differences in Working Conditions (2015)

	Men vs. Women in ICT	ICT vs. non-ICT for Women	Men vs. Women in non-ICT
Training paid for or provided by your employer or by yourself if self-employed	0.992 (0.201)	0.697 (0.174)*	1.111 (0.064).
Would you say that it is easy for you to arrange to take an hour or two off during working hours to take care of personal or family matters?	0.731 (0.255)	1.695 (0.183)**	0.633 (0.067)***
***Hourly Wage* (in Euros)**	-0.117 (0.039)**	0.007 (0.033)	-0.13 (0.011)***
No controls in Hourly Wage	-0.177 (0.047)***	0.13 (0.043)**	-0.195 (0.015)***
Agree/Disagree: I am well paid for the work I do	0.949 (0.208)	1.356 (0.173)	0.873 (0.062)*
On the whole, how satisfied are you with working conditions in your main paid job?	0.661 (0.358)	0.91 (0.251)	0.949 (0.092)
The organisation I work for motivates me to give my best job performance	1.677 (0.221)*	1.158 (0.171)	1.013 (0.066)
You are able to apply your own ideas in your work	0.609 (0.231)*	0.914 (0.183)	0.79 (0.066)***
Do you have enough time to get the job done	1.005 (0.23)	1.056 (0.187)	0.885 (0.072).
Do you experience stress in your work	1.318 (0.234)	0.982 (0.18)	1.102 (0.071)

Have you experienced discrimination on the basis of your sex?	27.03 (0.723)***	1.415 (0.421)	1.641 (0.227)*

Note: In addition to the indicator for female (in (1)) and for the ICT sector (in (2)), all estimations include three age groups, three controls for occupation, one control for university education, one control for temporary contract, two controls for firm size and one control for public/private.

Gender Gaps Among Entrepreneurs in the ICT and non-ICT sectors

This analysis was made using, once again, the 2015 European Survey of Working Conditions. In this case, we are only interested in entrepreneurs, so we filtered our sample. As a result, the numbers of observations, particularly in the ICT sector, is reduced, so we will refer to all European countries as a whole without making differences across groups of countries. We divided our analysis in two sections according to demographics and job characteristics or working conditions. In all cases, the observations are weighted using the cross-national weights (w5) which make an adjustment to post-stratification weights to ensure that each country is represented in proportion to the size of its in-work population.

1. Gender Differences among entrepreneurs in the ICT/non-ICT Sector – Demographics and some job characteristics

Table 18 shows gender differences between entrepreneurs in both the ICT and non-ICT sectors. In this first section, we focus on demographics and job characteristics. The following results are shown: the percentage of female entrepreneurs in ICT and non-ICT sectors; demographics and job characteristics in entrepreneur females and males in the ICT sector and the differences between female entrepreneurs in the ICT sector (column 1) and those entrepreneurs in Service Sectors other than ICT (column 3).

Table 18 Descriptive for Entrepreneurs and non-Entrepreneurs (2015)

	ICT				**Non-ICT**	
	Entrepreneurs		**Non-Entrepr.**		**Entrepreneurs**	
% of Females	23,41%		34,20%		51,64%	
Demographic Characteristics						
	Men	**Women**	**Men**	**Women**	**Men**	**Women**
Average Age	45,8	42,9	39,6	36,6	48,3	46,5
Primary	0%	0,33%	1,40%	3,70%	0,93%	2,11%
Secondary + non-tertiary	25,73%	16,81%	35,98%	38,14%	49,39%	49,91%
University	74,27%	82,87%	62,62%	58,16%	49,68%	47,98%
Head of the Household	81,11%	42,47%	76,96%	40,28%	77,85%	46,61%
Job Characteristics						
Average Monthly Earnings	3049,64	1902,65	2508,01	1695,31	2558,61	1775,02

(in Euros)						
Managers and Professionals	72,27%	83,35%	62,91%	46,54%	43,86%	40,62%
Technicians and assoc. Professionals	26,06%	14,65%	25,13%	15,97%	27,97%	15,31%
Clerical	0,27%	0,37%	2,85%	20,94%	1,80%	1,64%
Services and Sales	0,00%	0,33%	2,88%	5,57%	13,43%	28,45%
Manual Labour	1,40%	1,30%	6,24%	10,98%	12,95%	13,98%
Mostly Female Co-workers	0,50%	19,99%	3,24%	25,23%	13,38%	72,69%
Small Firm (1-9 workers)	88,32%	87,77%	26,80%	19,91%	88,58%	92,34%
Medium Firm (10-99 workers)	10,28%	11,79%	49,69%	45,65%	10,27%	6,22%
Large Firm (100 or more workers)	1,40%	0,45%	23,52%	34,45%	1,15%	1,44%
Private Sector	86,12%	89,46%	88,50%	83,91%	90,40%	85,23%
Public Sector	6,82%	5,22%	7,03%	13,84%	2,44%	5,32%

2. Gender Differences in Working Conditions among entrepreneurs in the ICT and non-ICT Sectors

Table 19 presents the gender differences among entrepreneurs, as well as a comparison between female entrepreneurs in ICT and non-ICT sectors. We restricted the analysis of working conditions to satisfaction, wages, feeling of job well done and stress. In this way, some of the working conditions we used previously were not included, such as recognition of the institution about one's work, because that condition did not make much sense. Since the total number of records of female entrepreneurs as a whole is very low (69 observations in the ICT sector), we grouped all 33 countries together and described average conditions for entrepreneurs for all 33 European countries.

For all the variables, the value is 1 when the individual responds positively to the question (i.e. agrees or says "yes") and zero otherwise. Therefore the mean values are always between 0 and 1. These (weighted) mean values show the different experiences encountered by men and women as entrepreneurs in both ICT and non-ICT sectors.

Regarding overall satisfaction, participants answered how satisfied they are with working conditions in their main paid job. Wages was measured by a continuous variable which contains information about hourly wages. With respect to their work environment, participants answered a question regarding whether their job gives them the feeling of a job well done. Finally, to measure the level of stress, participants were asked if they experience stress at work.

We cannot estimate differences in the ICT sector for entrepreneurs when we consider similar workers in terms of education, age and type of firm because the number of observations, particularly for females, is very low.

Table 19 Differences in Working Conditions – Entrepreneurs in the ICT and Non-ICT Sectors (2015)

	ICT				non-ICT	
	Entrepreneurs		non-Entrepreneurs		Entrepreneurs	
	Female	Male	Female	Male	Female	Male
On the whole, how satisfied are you with working conditions in your main paid job?						
(1=positive)	0,87	0,94	0,87	0,91	0,9	0,87
Your job gives you the feeling of work well done						
(1=agree)	0,95	0,9	0,82	0,82	0,92	0,92
You experience stress in your work						
(1=agree)	0,23	0,28	0,3	0,24	0,22	0,27
Hourly Wages						
(in Euros)	13,34	19,03	12,16	13,77	14,56	17,16
Sample Size	69	208	417	720	968	688

StackOverflow survey

The StackOverflow developers' survey is a comprehensive survey of 45 questions made to 56,033 coders in 173 countries. The results of the survey should be taken carefully because the sample does not accurately represent the whole population due to the self-selection bias[245]. Still, the large sample size, the largest of any survey to software developers around the world), makes it a very useful dataset and we think that it is worth using to extract some interesting insights.

We made a descriptive analysis of different variables included in the survey.

We also made a regression of the perception of programming ability depending on gender and controlling by experience. The programming ability is a self-reported variable ranging from 1 to 10. We ran a level model and a semi-elasticity model. While the level model gives the absolute increase in the value of the ability depending on gender, the semi-elasticity model gives the percentage increase of the perceived ability depending on gender. We think that the semi-elasticity is a better fit in this case. The results are shown in the following table. On average, females feel that their ability is 10.4% lower compared to men with all other things equal and the control being experience range.

245 For instance it could be biased against developers who don't speak English, or who don't like taking English-language surveys.

OLS Regression results

	Dependent variable:			
	programming_ability		log_programming_ability	
	No control	Control experience	No control	Control experience
	(1)	(2)	(3)	(4)
genderFemale	-0.880***	-0.496***	-0.169***	-0.104***
experience_range_factor1 - 2 years		0.842***		0.218***
experience_range_factor2 - 5 years		1.752***		0.385***
experience_range_factor6 - 10 years		2.464***		0.493***
experience_range_factor11+ years		2.993***		0.559***
Constant	7.143***	5.032***	1.932***	1.505***
Observations	18,714	18,625	18,714	18,625
R^2	0.011	0.250	0.013	0.236
Adjusted R^2	0.011	0.249	0.013	0.235
Residual Std. Error	1.656 (df = 18712)	1.442 (df = 18619)	0.293 (df = 18712)	0.258 (df = 18619)
F Statistic	217.058*** (df = 1; 18712)	1,238.789*** (df = 5; 18619)	254.454*** (df = 1; 18712)	1,147.337*** (df = 5; 18619)
Note:				*p<0.1; **p<0.05; ***p<0.01

The Teaching and Learning International Survey

The Teaching and Learning International Survey (TALIS) is the first international survey that provides a voice to teachers and school principals where participants complete questionnaires about issues, such as the professional development they have received. We used the 2013 dataset as that it is the most recent one available. The survey includes questions about the formal education program and professional development activities, as well as about the ICT skills of the teachers and how these skills improve their work. TALIS sets a minimum sample size of 4.000 teachers and 200 school principals per country and is, therefore, a very rich and reliable source of information on the whole population of teachers and principals in a given country. The analysis has been made for the following set of countries and regions: Netherlands, Bulgaria, Latvia, Italy, Croatia, France, Finland, Estonia, Spain, England (United Kingdom), Romania, Slovak Republic, Czech Republic, Flanders (Belgium), Sweden and Denmark.

We used the survey to analyse the level of ICT skills, whether teachers feel that they need additional ICT training, and the level of technology that was included in their formal education depending on the gender.

Annex III. Workshop

On 12 December 2017 a working session between DG Connect, Iclaves (contractor) and external stakeholders took place to discuss the findings of the study and possible recommendations.

Agenda

09:30 Welcome and introductions

09:40 DG Connect's Gender Equality in Digital Strategy

10:00 Presentation of the Women in Digital Age study

10:30 Q&A Discussion

11:00 Elaborating possible recommendations

a. How to increase the number of girls in STEM studies
b. The acquisition of advanced digital skills by girls and women
c. Gender differences in attitudes towards technologies and risks and benefits of new technologies and social media to achieve greater gender equality
d. Breaking the glass ceiling in the digital era
e. Empowering women in the digital entrepreneurship ecosystem

12:30 Conclusions

Q&A Discussion & Recommendations

How to increase the number of girls in STEM studies

Facts

- Despite the growing demand of ICT specialists and digital profiles, the % of Europeans with ICT-related education, at all levels, is decreasing (Males: 4.95% (2011) – 4.24% (2015), Females: 1.63% (2011) – 1.24% (2015) as the % of the total population).
- Having tertiary studies do increase employability of both men and women, regardless of the field BUT the effect of tertiary ICT-related studies on employability is small and positive for men and slightly negative for women (Population with tertiary education working by fields of studies (2015). Men: 88.3% (ICT fields) – 85,8% (other educational fields), Women: 78.1% (ICT fields) – 79,7% (other educational fields)).
- Even when women graduate in ICT-related studies, very few enter the sector. Females make up 13% of the tertiary graduates in ICT-related fields working in digital jobs. This share was 15% in 2011.

- Women are 11.8% of workers in digital jobs with ICT-related studies, that is, those workers with technical backgrounds. In 2011, women represented around 14% of these workers.
- A men is 8 times more likely to have a technical job in the digital sector than a women (in 2011 it was 6.8 times).

Discussion points

- There is a general agreement that 12 to 16 years old is a critical age for encouraging females to persuade in STEM studies.
- It is important to design strategies targeting specific age ranges. Initiatives should address girls until 12, from 12 to 16, and also girls during tertiary studies.
- Not only girls should be considered when talking about education and training in digital topics. Training for women of all ages is also relevant to guarantee their participation in the digital sphere.
- Role models (celebrities or success women from STEM fields) should promote STEM studies .
- Men should also promote .
- School curriculum should be updated to include digital skills
- Some studies suggest that the later the decision regarding career paths (formal educational paths) is made, the more likely female choose STEM. This could be promoted from the EC.
- Stereotypes about ICT-related studies are still strong ("the geek").
- It is necessary to create – or use- new channels to connect with girls. The digital education offer must reach girls wherever they are – the example of Ironhack, a case study, is a good example of this).
- Media should promote positive images of this field for women.
- Parents have an important role to play.
- High-level interest in enforcing regulations to promote .
- Supporting local activities is crucial, but, at the same time, increasing coordination and cooperation at the global level to overcome fragmentation is required: It would be important to create a transnational community of stakeholders where girls are part and connected.
- Involving businesses is important not only for gender bias awareness but also to introduce potential female STEM students at early stages in a real world environment. Career profiles also must cover actual industrial requirements.

Ideas

- Promote after-school programmes.
- Revising CVs in schools.
- Teen girls focused hackathon (named differently).

- Ted-talks style talks from role models.
- Promoting (cool) role models and mentoring.
- Those activities have to be:
    - Practical
    - Hands-on
    - Girls only
    - Social orientated
    - With the support of the community
    - Sustained in time

The acquisition of advanced digital skills by girls and women

Facts

- Around 25% of male Europeans and 27% of female Europeans have no or low digital skills. From a gender perspective, the positive news is that the gender gap among the youngest is narrowing. When it comes to basic skills, there is no gender gap among those under 55 years.
- When considering advanced digital skills, girls below 24 years surpass their male counterparts by 3 percentage points. In the other age groups, a gender gap negatively affecting women still persists.
- Concerning advanced digital skills, differences between countries are huge. The biggest gaps in absolute terms occur in Luxemburg, the Netherlands and Austria, countries with some of the highest percentage of people with above basic skills. There are no gender gaps between males and females with basic digital skills in Belgium, Denmark and Germany, and between males and females with above basic digital skills in Slovakia and Malta.
- Women are more questioning with their own skills than men. Women consider themselves to be sufficiently skilled for their daily life (75% men vs. 68% women), a future job (77% men vs. 70% women), the use of public online services (69% men vs. 61% women) and performing online learning activities (67% men vs. 62% women) at a lesser extent than men consider themselves.

Discussion points

- It is important to design strategy targeting specific age ranges.
- Involving businesses is also important not only for gender bias awareness but also to introduce potential female STEM students at early stages in a real world environment.
- Career profiles also should and must cover actual industrial requirements.
- Creating new channels to connect with girls (go where girls are).
- Supporting local activities but, at the same time, increasing coordination and cooperation at the global level to overcome fragmentation.

Ideas

- Role models – break geek stereotyping.
- Career trainings.
- Code-week focused on girls and women.
- Mentoring in schools.
- Better access to funding on these programmes.
- It would be worth further analyzing both the causes and the implications of gender differences in attitudes towards technologies. Particularly, it would be necessary to have datasets on the evolution of perceptions, if possible, by country in order to see the cultural effect.

Gender differences in attitudes towards technologies and risks and benefits of new technologies and social media to achieve greater gender equality

Facts

- Women tend to be less informed than men about new technologies and show higher concerns about their negative impacts,
    - 78% of men vs. 72% of women think that the most recent digital technologies have a positive impact on the economy,
    - 66% of men vs. 62% of women think that the most recent digital technologies have a positive impact on the society,
    - 70% of men vs. 63% of women think that the most recent digital technologies have a positive impact on you quality of life.
- The lack of women in teams developing technology has an impact on innovation:
    - A direct evidence can be found in examples of failed, inadequate or unfortunate products and services (e.g. ignoring females' needs).
    - Indirect benefits are more complex to prove, but there is evidence that diversity increases performance and innovation. Concretely, research teams with higher levels of diversity, from both a gender and nationality standpoint, have higher levels of R&D intensity and efficiency.
- Considering the growing importance of big data and algorithms in our lives, if no action is taken, the impact of the lack of diversity in technology is likely to be very relevant. For example, substantial changes in the labour market should be expected. While AI will displace lots of workers, including knowledgeable and high-skilled workers, it will also create new job opportunities in emergent technology fields. It might have a more negative impact on women than men.
- According to the public consultation's results, media are seen as the most powerful channel to raising awareness.
- The question whether technology is improving women's lives or if it is imposing new and more complex challenges, probably doesn't' have an unequivocal answer. In principle, technology is inherently neutral, but it replicates and greatly

amplifies existing discrimination, prejudices and stereotypes. Technology reflects the values of its developers, and of the information they draw from (data sources and users).

Discussion points

- It would be worth further analyzing both the causes and the implications of gender differences in attitudes towards technologies.
- Technology is not biased. Social bias on technology just continues.
- Women are skeptical about self-driving cars.
- Country specific datasets would be useful to understand the perception of technology in relation with cultural specific factors.
- A study to understand if the perception issue to risks associated by ICTs is age related.

Ideas

- Entrepreneurship training programmes.
- Underline economic benefits and promote professional certifications.

Breaking the glass ceiling in the digital era

Facts

- Workers with digital occupations leave the sector less than average worker, except for women aged 30 to 44, who leave their jobs more than the average (8.7% vs. 7.3%). A general lower drop-out rate is consistent with the fact that this is a sector with better wages and working conditions, but also suggests that it is particularly difficult for women who are trying to reconcile their professional and personal lives.
- A slowdown in the growth of women's participation in executive positions in listed companies has occurred and improvements regarding female's participation in boards are concentrated in few European countries.
- In 2015, considering the number of women leaving digital jobs (170,044 people) and the average per person productivity of the ICT sector (94,830 €), the productivity loss for the European economy of women leaving their digital jobs to become inactive was 16.2 bln Euro.
- The percentage of female executives in publicly listed companies in the EU ranges from 5.4% in Austria to 34.8% in Estonia.
- In 2014, the number of female CEOs in STOXX 600 companies was 21 (3.5%). The Information Technology sector was the only sector without any women as CEO. In the Telecommunication Services sector, only 9.5% of CEO positions were occupied by women.
- In 2015, 21.4% of workers in the ICT sector had female bosses in Europe (2 p.p. more than in 2010). Evidence suggests that companies with significant female critical mass on decision making positions have better governance styles, drive

more creative and diverse innovation processes and could also deliver financial benefits.

Discussion points

- Gender action plan for companies.
- Need data to highlight technical areas preferred by women in the sector to guide possible policies.
- Gender parity in panels
- Hard core changes in maternity leave and other social measures.
- Elaborate equal opportunities guide and best practices for companies.

Ideas

- Minimum number of women in selection processes.
- Company transparency in internal policies and gender data: establishing measurable targets in companies and public administration.
- Back-in policies for women leaving the sector.
- Aware rising activities, particularly in the potential impact of harassment in female career choices.
- Need to evaluate the impact of quotas in ICT.
- Equal opportunities and data to measurement of gender equality.

Empowering women in the digital entrepreneurship ecosystem

Facts

- According to the 2015 Female Entrepreneurship Index, the global percentage of female businesses running within the technology sector has decreased by 19%.
- Biases also play a very important role in the entrepreneurial world: male entrepreneurs are 60% more likely to attain pitch competition than women.
- Globally, only 7.4% of investors and 7.2% of angels who have invested in one o more start-ups are women.
- Research suggests that female-owned digital startups are more likely to be successful than those of their male counterparts and investments in female-founded startups perform 63% better than exclusively male-founded startups. However, the global percentage of female businesses running within the technology sector decreased by 19% in 2015.

Discussion points

- Levels of digital entrepreneurship are extremely low throughout Europe.
- Even incubators and acceleration programs that want to set gender targets have difficulties finding female projects with high potential.
- There is a real lack of pool talent.

- Businesses must key to attract women. Need to involve companies in setting in the courses.

Ideas

- Regulatory framework promotes equality particularly in parental leave and child care.
- Support actions in the long term vision.
- The role of media is a very relevant role to play.
- It is important to understand the role of female in media specifically for the ICT sector and in general to promote measures for change.
- Success of policies and initiatives should be measured and evaluated.
- More quantitative data to understand the evolution of the female life-cycle are required,
    - Data throughout all educational stages
    - Longitudinal data on education and labor market
    - More open data

Next Steps

From the discussion, three main areas have emerged on which recommendations and concrete measures are to be followed up on:

- There are many **data gaps** to be filled
    - Number of women who apply for ICT skills in tertiary skills
    - Preferred tech sectors (AI, robotics, cybersecurity etc) of women
    - Media programme statistics of women's participation
    - Start-ups
    - Longitudinal data
- **Perceptions** of tech sector
    - By age
    - By culture
    - By men
    - Of new technologies and risks
    - Media perception
    - Sustainability
- Gender mainstreaming in **policies**
    - Equal opportunities
    - Panelwatch
    - Targets

List of tables

List of figures

Bibliography

A. Beninger. 'High Potentials in Tech-Intensive Industries: The Gender Divide in Business Roles'. *Retrieved March* 12 (2014).

Accenture. 'Getting to Equal 2017'. Accenture, 2017. https://www.accenture.com/t20170306T223143__w__/us-en/_acnmedia/PDF-45/Accenture-IWD-2017-Research-Getting-To-Equal.pdf.

AngelList. 'AngelList Database', 2014. http://gendergapgrader.com/studies/angel-investing/.

———. 'Gender Gap in Start-Ups and Access to Financing', October 2014. http://gendergapgrader.com/studies/angel-investing/.

Atomico, Slush. 'The State of European Tech. 2016 Edition', November 2016. http://www.slush.org/news/state-european-tech-2016-future-invented-europe/.

A.W. Brooks, L. Huang, S.W. Kearney and F.E. Murray. 'Investors Prefer Entrepreneurial Ventures Pitched by Attractive Men. Proceedings of the National Academy of Sciences', March 2014. http://www.pnas.org/content/111/12/4427.full.pdf.

Babson College et al. 'GEM - Global Entrepreneurship Monitor. Global Report 2016/2017', February 2017. http://www.gemconsortium.org/report/49812.

Balanskt, A., and Engelh, K. 'Computing Our Future: Computer Programming and Coding. Priorities, School Curricula and Initiatives across Europe'. European Schoolnet, October 2015. http://www.eun.org/c/document_library/get_file?uuid=3596b121-941c-4296-a760-0f4e4795d6fa&groupId=43887.

Bolukbasi, Tolga, Kai-Wei Chang, James Y. Zou, Venkatesh Saligrama, and Adam T. Kalai. 'Man Is to Computer Programmer as Woman Is to Homemaker? Debiasing Word Embeddings'. In *Advances in Neural Information Processing Systems*, 4349–4357, 2016. http://papers.nips.cc/paper/6228-man-is-to-computer-programmer-as-woman-is-to-homemaker-debiasing-word-embeddings.

Caliskan, Aylin, Joanna J. Bryson, and Arvind Narayanan. 'Semantics Derived Automatically from Language Corpora Contain Human-like Biases'. *Science* 356, no. 6334 (2017): 183–186.

Castaño, Cecilia, and Juliet Webster. 'Understanding Women's Presence in ICT: The Life Course Perspective'. *International Journal of Gender, Science and Technology* 3, no. 2 (2011): 364–386.

CincoDías Newspaper. 'Wallapop y IronHack Lanzan Un Programa de Captación de Talento de Mujeres', March 2017. http://cincodias.elpais.com/cincodias/2017/03/07/tecnologia/1488890917_500138.html.

Commission, European, DG Communications Networks, Content & Technology, and Iclaves S. L. *Women Active in the ICT Sector Final Report ; a Study*. Luxembourg: Publ. Office of the Europ. Union, 2013. http://dx.doi.org/10.2759/27822.

Datta, A., Tschantz, M. C., and Datta, A. 'Automated Experiments on Ad Privacy Settings'. *2015*, 2015.

Dood, S.D, and J. Keles. 'Expanding the Networks of Disadvantages Entrepreneurs', October 2014. https://www.oecd.org/cfe/leed/Expanding%20the%20networks%20of%20disadvantaged%20entrepreneurs.pdf.

Eastman, M., Rallis, D. 'The Tipping Point: Women on Boards and Financial Performance', December 2016. https://www.msci.com/documents/10199/fd1f8228-cc07-4789-acee-3f9ed97ee8bb.

EBAN - The European Trade Association for Business Angels, Seed Funds, and other Early Stage Market Players. 'European Early Stage Market Statistics 2015', May 2016. http://www.eban.org/wp-content/uploads/2016/06/Early-Stage-Market-Statistics-2015.pdf.

EIGE - European Institute for Gender Equality. 'Gender in Entrepreneurship', January 2017.

http://eige.europa.eu/sites/default/files/documents/ti_pubpdf_mh0216899enn_pdfweb_20170124125308.pdf.
empirica. 'High-Tech Leadership Skills for Europe. Towards an Agenda for 2020 and Beyond'. European Commission, March 2017. http://eskills-scale.eu/fileadmin/eskills_scale/all_final_deliverables/scale_e-leadership_agenda_final.pdf.
Ernst & Young. 'Women. Fast Forward. The Time for Gender Parity Is Now', January 2015. http://www.ey.com/Publication/vwLUAssets/ey-women-fast-forward-thought-leadership/$FILE/ey-women-fast-forward-thought-leadership.pdf.
Ernst and Young. 'Disrupting the Disruptors. Disrupting Youth Entrepreneurship with Digital and Data: The Digital Opportunity to Empower Young Entrepreneurs for Growth', 2016. http://www.ey.com/Publication/vwLUAssets/EY-disrupting-the-disruptors/$FILE/EY-disrupting-the-disruptors.pdf.
———. 'It's Who You Know: Women Entrepreneurs and the Impact of Networks', 2013. http://www.ey.com/Publication/vwLUAssets/EY_Its_who_you_know_Women_entrepreneurs_and_the_impact_of_networks/$FILE/EY-Its-who-you-know-Women-entrepreneurs.pdf.
European Commission. 'Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions: A New Skills Agenda for Europe', 10 June 2016. A new skills agenda for Europe. COM(2016) 381 final. http://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:52016DC0381&from=EN.
———. 'Directive of the European Parliament and the Council on Improving the Gender Balance among Non-Executive Directors of Companies Listed on Stock Exchanges and Related Measures', November 2012. http://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:52012PC0614&from=EN.
———. 'Human Capital: Digital Inclusion and Skills'. Europe's Digital Progress Report 2017. European Commission, 2017. http://ec.europa.eu/newsroom/document.cfm?doc_id=44390.
———. 'Strategy for Equality between Women and Men 2010-2015', September 2010. http://ec.europa.eu/justice/gender-equality/files/documents/strategy_equality_women_men_en.pdf.
European Commission. Directorate General for Entrerpise and Industry. 'Statistical Data on Women Entrepreneurs in Europe', September 2014. http://ec.europa.eu/growth/tools-databases/newsroom/cf/itemdetail.cfm?item_id=7992.
European Commission Directorate-General for Justice and Consumers. 'EC Strategic Engagement for Gender Equality 2016-2019', December 2015. http://ec.europa.eu/anti-trafficking/sites/antitrafficking/files/strategic_engagement_for_gender_equality_en.pdf.
———. 'Gender Balance on Corporate Boards. Europe Is Cracking the Glass Ceiling', October 2015. http://ec.europa.eu/justice/gender-equality/files/womenonboards/factsheet_women_on_boards_web_2015-10_en.pdf.
European Parliament. Directorate-General for Internal Policies. 'Women's Entrepreneurship: Closing the Gender Gap in Access to Financial and Other Services and in Social Entrepreneurship', June 2015. http://www.europarl.europa.eu/RegData/etudes/STUD/2015/519230/IPOL_STU(2015)519230_EN.pdf.
European Parliament. Equality and Diversity Unit. 'Women in the European Parliament', March 2017. http://www.europarl.europa.eu/RegData/publications/2017/0001/P8_PUB(2017)0001_EN.pdf.
European Political, and Strategy Centre (EPSC). 'The Future of Work. Skills and Resilience for a World of Change'. Strategic Note. European Political Strategy Centre

(EPSC), 10 June 2016. http://ec.europa.eu/epsc/sites/epsc/files/strategic_note_issue_13.pdf.
European Schoolnet, and DIGITALEUROPE. 'The E-Skills Manifesto 2016'. European Schoolnet and DIGITALEUROPE. December 2015. Accessed 17 May 2017. http://eskills4jobs.ec.europa.eu/c/document_library/get_file?uuid=b080500a-8df5-4275-b374-6532e08f2da4&groupId=2293353.
Expansión, Financial Newspaper. 'Wallapop Se Alía Con Ironhack Para Potencias La Presencia de La Mujer En El Sector TIC', March 2017. http://www.expansion.com/economia-digital/companias/2017/03/07/58bea729e5fdeab75f8b45d9.html.
F. M. Amatucci. *Women Business Angels: Theory and Practice. Handbook of Research on Business Angels, p. 92*, 2016.
Fanshawe, Simon. 'Startup DNA'. Wayra UK & Astar-Fanshawe, 2015. http://wayra.co.uk/wp-content/uploads/2015/06/startupDNA-executive-summary-Final.pdf.
Federal Ministry for Economic Cooperation and Development. 'Women's Pathways to the Digital Sector: Stories of Opportunities and Challenges'. Germany: Federal Ministry for Economic Cooperation and Development (BMZ) , Germany, 2017. www.bmz.de/en/publications/type_of_publication/weitere_materialien/study_eSkills4girls.pdf.
G. Stengel. Forbes. 'Is Change in the Wind for Women Entrepreneurs Raising Capital?', April 2016. https://www.forbes.com/sites/geristengel/2016/04/13/is-change-in-the-wind-for-women-entrepreneurs-raising-capital/#238e9b2a5eaf.
G. Teare, N. Desmond. TechCrunch. 'The First Comprehensive Study on Women in Venture Capital and Their Impact on Female Founders', April 2016. https://techcrunch.com/2016/04/19/the-first-comprehensive-study-on-women-in-venture-capital/.
G. Teare. TechCrunch. 'In 2017, Only 17% of Startups Have a Female Founder', April 2017. https://techcrunch.com/2017/04/19/in-2017-only-17-of-startups-have-a-female-founder/.
Gaucher, Freisen, and Kay. 'Evidence That Gendered Wording in Job Advertisements Exists and Sustains Gender Inequality'. *Journal of Personality and Social Psychology* Advance online publication. doi: 10.1037/a0022530 (7 March 2011). about:blank.
Genbeta Newspaper. 'Wallapop y IronHack Ofrecerán 200,000 Euros En Becas Para Formar a 100 Mujeres En Tecnología', March 2017. https://www.genbeta.com/actualidad/wallapop-y-ironhack-ofreceran-200-000-euros-en-becas-para-formar-a-100-mujeres-en-tecnologia.
Grant Thornton. 'Women in Business', March 2017. https://www.grantthornton.global/globalassets/1.-member-firms/global/insights/article-pdfs/2017/grant-thornton_women-in-business_2017-report.pdf.
Harvard Business Review. '4 Factors That Predict Startup Success, and One That Doesn't', May 2016. https://hbr.org/2016/05/4-factors-that-predict-startup-success-and-one-that-doesnt.
———. 'How Diversity Can Drive Innovation', December 2013. https://hbr.org/2013/12/how-diversity-can-drive-innovation.
'How Can We Close the Digital Gender Gap?' *ITU News Magazine*, 2016. http://www.itu.int/en/itunews/Documents/2016-04/2016_ITUNews04-en.pdf.
INJUVE - Ministerio de Sanidad, Servicios Sociales e Igualdad. 'Becas Wallapop', March 2017. http://www.injuve.es/convocatorias/becas/becas-wallapop.
International Gender Champions. 'International Gender Champions. Annual Report', October 2016. http://genderchampions.com/content/uploads/2016/11/Annualreport-Final.pdf.
J. E. Tinkler, M. C. Ku, K. B. Whittington, A. R. Davies. 'Gender and Venture Capital Decision-Making: The Effects of Technical Background and Social Capital on

Entrepreneurial Evaluations', May 2015. http://gender.stanford.edu/sites/default/files/vc_gender_clayman1113.pdf.
Karaca-Mandic, Pinar, Edward C Norton, and Bryan Dowd. 'Interaction Terms in Nonlinear Models'. *Health Services Research* 47, no. 1 Pt 1 (February 2012): 255–74. https://doi.org/10.1111/j.1475-6773.2011.01314.x.
King, Eden B., Michelle R. Hebl, Jennifer M. George, and Sharon F. Matusik. 'Understanding Tokenism: Antecedents and Consequences of a Psychological Climate of Gender Inequity'. *Journal of Management* 36, no. 2 (2010): 482–510.
Kollmann, T., and S. Hensellek. 'European Startup Monitor', 2016. http://europeanstartupmonitor.com/fileadmin/esm_2016/report/ESM_2016.pdf.
Korn Ferry Institute. 'Second-Generation Gender Bias', May 2015. http://www.kornferry.com/institute/second-generation-gender-bias.
Kuziemski, Maciej. 'It's Make or Break Time for Artificial Intelligence. Here's How We Can Make It Work'. *World Economic Forum* (blog), 5 May 2017. https://www.weforum.org/agenda/2017/05/artificial-intelligence-will-make-or-break-us-heres-how-we-need-to-respond/.
L. Hayrapetyan, A. Nunes & K. Khachatryan. 'Factors That Influence Female Entrepreneurs in the European Union. XVII Encuentro AECA', September 2016. https://bibliotecadigital.ipb.pt/bitstream/10198/14211/1/107c.pdf.
La Vanguardia Newspaper. 'Wallapop Se Alía Con IronHack Para Formar a Mujeres En Programación', March 2017. http://www.lavanguardia.com/vida/20170307/42629284972/wallapop-se-alia-con-ironhack-para-formar-a-mujeres-en-programacion.html.
Lambrecht, Anja, and Catherine Tucker. 'Algorithmic Bias? A Study of Data-Based Discrimination in the Serving of Ads in Social Media PRELIMINARY', 2016. https://www.ftc.gov/system/files/documents/public_events/966823/lambrechttucker_algorithmicbias_final.pdf.
'Leaders & Daughters 2017'. Egon Zehnder, 2017. https://s3-eu-west-1.amazonaws.com/public-gbda/Leaders_Daughters_Final.pdf.
Lee, Linda-Eling, Ric Marshall, Damion Rallis, and Matt Moscardi. 'Women on Boards: Global Trends in Gender Diversity on Corporate Boards'. *Research Insights. MSCI ESG Research*, 2015.
M. Ewens & R. R. Townsend. 'Can Access to Capital Explain the Entrepreneurship Gender Gap?.', April 2017. https://papers.ssrn.com/sol3/papers.cfm?abstract_id=2953011.
Margolis, Jane, and Allan Fisher. *Unlocking the Clubhouse: Women in Computing*. Cambridge, Mass: MIT Press, 2002.
McKinsey&Company. 'Women Matter 2016. Reinventing the Workplace to Unlock the Potential of Gender Diversity', December 2016. http://www.mckinsey.com/global-locations/europe-and-middleeast/france/en/latest-thinking/women-matter-2016.
Mercer. 'When Women Thrive. Technology Industry Perspective', January 2017. https://www.mercer.com/our-thinking/helping-women-thrive-an-imperative-for-the-tech-industry.html.
Nielsen. 'The 2016 Nielsen Social Media Report', 17 January 2017. http://www.nielsen.com/us/en/insights/reports/2017/2016-nielsen-social-media-report.html.
OECD. 'Background Report. Conference on Improving Women's Access to Leadership', March 2016. https://www.oecd.org/daf/ca/OECD-Women-Leadership-2016-Report.pdf.
———. 'Entrepreneurial Activities in Europe. Expanding Networks. OECD Employment Policy Paper', March 2015. http://www.oecd-ilibrary.org/docserver/download/5jrtpbz29mjh-en.pdf?expires=1496329942&id=id&accname=guest&checksum=78EE37CE72F2478AF5BE23CF57B6B7E3.
———. 'Entrepreneurship at a Glance', 2016. http://www.oecd-ilibrary.org/industry-and-services/entrepreneurship-at-a-glance-2016_entrepreneur_aag-2016-en.

———. ‘Talis 2013 - Complete Database’, 2013. http://stats.oecd.org/Index.aspx?datasetcode=talis_2013%20.
Pax Ellevate Global Women’s Index Fund. ‘Invest in Her’, 2017. http://paxworld.com/system/storage/19/87/1/6611/gwif_brochure.pdf.
PitchBook. ‘Female-Founded, VC-Funded’, March 2017. https://files.pitchbook.com/pdf/PitchBook-VC-Funded-Female-Founded-Datagraphic-v6.1.pdf.
R Core Team. *R: A Language and Environment for Statistical Computing*. Vienna, Austria: R Foundation for Statistical Computing, 2016. https://www.R-project.org/.
R. Justo, D.R. DeTienne & P. Sieger. ‘Failure or Voluntary Exit? Reassessing the Female Underperformance Hypothesis. Journal of Business Venturing’, May 2015. https://www.researchgate.net/profile/Philipp_Sieger/publication/275644395_Failure_or_Voluntary_Exit_Reassessing_the_Female_Underperformance_Hypothesis/links/5734a5f208ae298602decb17.pdf.
Reuters Institute for the Study of Journalis. ‘Digital News Report 2016’, 2016. http://reutersinstitute.politics.ox.ac.uk/sites/default/files/Digital-News-Report-2016.pdf?utm_source=digitalnewsreport.org&utm_medium=referral.
Rhode, Deborah L., and Amanda K. Packel. ‘Diversity on Corporate Boards: How Much Difference Does Difference Make’. *Del. J. Corp. L.* 39 (2014): 377.
———. ‘Diversity on Corporate Boards: How Much Difference Does Difference Make’. *Del. J. Corp. L.* 39 (2014): 377.
Robert Madelin. ‘Opportunity Now: Europe’s Mission to Innovate’. European Union: European Commission, 15 July 2016. https://ec.europa.eu/epsc/sites/epsc/files/strategic_note_issue_15.pdf.
Roberts, Matthew, De Pril, Kevin. ‘Gender Diversity on European Boards. Realizing Europe’s Potential: Progress and Challenges’, April 2016. http://european.ewob-network.eu/wp-content/uploads/2016/04/EWoB-quant-report-WEB-spreads.pdf.
Roland Berger. ‘Digital Equality? Women in the Digital Revolution’. *Journée de La Femme Digitale*, March 2017. https://www.rolandberger.com/publications/publication_pdf/womendigital_12_final.pdf.
Roure, J., and A. de San José. ‘AEBAN 2016. Business Angels Report’. AEBAN, May 2016. http://www.aeban.es/sites/aeban.es/files/Informe%20Business%20Angels%20AEBAN%202016.pdf.
Ruiz-Jiménez, Jenny María, and María del Mar Fuentes-Fuentes. ‘Management Capabilities, Innovation, and Gender Diversity in the Top Management Team: An Empirical Analysis in Technology-Based SMEs’. *BRQ Business Research Quarterly* 19, no. 2 (2016): 107–121.
S. Terjesen, A. Lloyd. ‘The 2015 Female Entrepreneurship Index’, 2015. https://thegedi.org/female-entrepreneurship-index-2015-report/.
S. Thébaud. ‘Gender Status Beliefs in Entrepreneurship and Innovation: Are Women Entrepreneurs Penalized?’ Princeton University, 2014. http://faculty.chicagobooth.edu/workshops/orgs-markets/past/pdf/thebaud.pdf.
Sabadash, Anna. ‘ICT Employment Statistics in Europe: Measurement Methodology’. *European Commission Joint Research Centre Institute for Prospective Technological Studies*, 2012. ftp://ftp.jrc.es/pub/EURdoc/JRC76385.pdf.
Sarsons, H., & Xu, G. Harvard University, Department of Economics. ‘Confidence Men? Gender and Confidence: Evidence among Top Economists’, July 2015. https://scholar.harvard.edu/files/sarsons/files/confidence_final.pdf.
Schneider, Julia, and Verena Eckl. ‘The Difference Makes a Difference: Team Diversity and Innovati ve Capacity’, 29 July 2016. https://www.oecd.org/sti/015%20-%20SKY_Schneider_Eckl_201607025.pdf.
Stackoverflow. ‘Developer Survey Results 2016’, March 2016. https://insights.stackoverflow.com/survey/2016#overview.
Statista. ‘Social Media Advertising Expenditure as Share of Digital Advertising Spending Worldwide from 2013 to 2017’, n.d.

https://www.statista.com/statistics/271408/share-of-social-media-in-online-advertising-spending-worldwide/.

Steve Henn. 'When Women Stopped Coding'. *NPR. Planet Money*, 21 October 2014. https://ondemand.npr.org/anon.npr-mp3/npr/me/2014/10/20141022_me_when_women_stopped_coding.mp3?orgId=1&topicId=1019&d=273&p=3&story=357629765&t=progseg&e=357998917&seg=12&siteplayer=true&dl=1.

Studio, R. 'RStudio: Integrated Development Environment for R'. *RStudio Inc, Boston, Massachusetts*, 2012.

T. Hüsing, et al. 'E-Leadership: Digital Skills for SMEs', 2015. http://eskills-guide.eu/fileadmin/promote/documents/eleadership_digital_skills_fin.pdf.

———. 'E-Leadership: E-Skills for Competitiveness and Innovation Vision, Roadmap and Foresight Scenarios', March 2013. http://eskills-vision.eu/fileadmin/eSkillsVision/documents/VISION%20Final%20Report.pdf.

'The E-Skills Manifesto'. y European Schoolnet and DIGITALEUROPE, 2014. http://eskills4jobs.ec.europa.eu/c/document_library/get_file?uuid=ace0176a-9950-47a0-ab3d-b94d3015f8f3&groupId=2293353.

V. Zarya. 'Venture Capital's Funding Gender Gap Is Actually Getting Worse', March 2017. http://fortune.com/2017/03/13/female-founders-venture-capital/.

W. Adema et al. 'Enhancing Women's Economic Empowerment through Entrepreneurship and Business Leadership in OECD Countries', October 2014. http://www.oecd.org/gender/Enhancing%20Women%20Economic%20Empowerment_Fin_1_Oct_2014.pdf.

www.votewatch.eu. 'Powerful but Divided: The EU Parliamentarians Who Influence Digital and Telecommunication Policy', March 2017. http://www.votewatch.eu/blog/powerful-but-divided-the-eu-parliamentarians-who-influence-digital-and-telecommunication-policy/.

York, Alex. 'Social Media Demographics for Marketers'. Sprout Social, 6 March 2017. http://sproutsocial.com/insights/new-social-media-demographics/.

European Commission

Women in Digital Age

Luxembourg, Publications Office of the European Union 2018

Number of Pages : 215

ISBN: 978-92-79-77625-0

DOI: 10.2759/526938

DOI: 10.2759/526938
ISBN: 978-92-79-77625-0