



NEW SKILLS 한 WORK J.P.Morgan

Around the world, employers, educators, policymakers, training organisations and others have recognized the critical importance of tackling the skills gap. Through our \$250 million, five-year New Skills at Work initiative, JPMorgan Chase & Co. is using our resources, expertise and global reach to help inform and accelerate demand-driven skills training. Launched in 2013, New Skills at Work is providing data-driven analyses, engaging employers in sector partnerships, and supporting training programs that are aligned with local demand.

Visit www.jpmorganchase.com/skillsatwork to sign up for updates on our programs



A report by empirica Gesellschaft für Kommunikationsund Technologieforschung mbH with support from JPMorgan Chase & Co.

empirica Gesellschaft für Kommunikations- und Technologieforschung mbH (https://www.empirica.com) is an independent research and consulting company with a strong international orientation. Since 1988, empirica has been working for numerous clients in five business areas: eSkills & Work, Energy, Research & Innovation, Digital Health & Care, Inclusive Society. We conceptualise, analyse, moderate and provide food-for-thought. Through scientifically based data collection and evaluation in dialogue with decision-makers and stakeholders from politics, business, science and society, we shape options for action for the future.

Report contributors:

Daniel Schmidtmann, Research Consultant, empirica Karsten Gareis, Senior Research Consultant, empirica Tobias Hüsing, Senior Research Consultant, empirica Eriona Dashja, Research Consultant, empirica Werner B. Korte, Director, empirica

Terms of use and disclaimer

The *diversITy series* of reports presents information collected and compiled by empirica, supported by J.P. Morgan, on the technology skills training landscape in seven target countries: Spain, Germany, the United Kingdom, Ireland, Poland, France and South Africa. External sources of information and data have been credited accordingly where applicable.

The term *Information and Communications Technology* (ICT) *sector* used in this report refers to the technology or digital sector in all target countries.

The term *ICT skills* used in this report comprises of two main categories:

ICT user skills: the capabilities required for effective application of ICT systems and devices by the individual. ICT users apply systems as tools in support of their own work, which is in most cases not ICT. At the general level, they cover "digital literacy": the skills required for the confident and critical use of ICT for work, leisure, learning and communication.

ICT practitioner skills: The capabilities required for researching, developing and designing, managing, producing, consulting, marketing and selling, integrating, installing and administrating, maintaining, supporting and servicing ICT systems.

The term *ICT skills training* refers to programmes and initiatives aimed at improving or upgrading peoples' skills and knowledge in ICT user and practitioner skills.

The term *ICT specialists* refers to the European Commission's definition of ICT specialists as workers whose main job involves ICT and who can deal with a wide range of tasks concerning corporate ICT systems. The terms *ICT specialists* and *ICT workers* are used interchangeably in this report.

This report has been supported by the JPMorgan Chase Foundation, the contents and opinions in this paper are those of the authors alone and do not reflect the views of the JPMorgan Chase Foundation, JPMorgan Chase & Co, or any of its affiliates.

© empirica, 2019. Reproduction is authorized provided the source is acknowledged.

List of Abbreviations

B-BBEE	Broad-Based Black Economic Empowerment
BME	Black and Minority Ethnic
CNNum	Conseil national du numérique
DE	Germany
e-CF	European e-Competence Framework
ES	Spain
FR	France
FUN	France Université Numérique
GPS	Good Practice Showcase
ICT	Information and Communications Technology
IE	Ireland
iNeSi	iKamva National e-Skills Institute
ISCO	International standard classification of occupations
LDSP	Local Digital Skills Partnership
MICT	Media, Information and Communication Technologies
MOOC	Massive Open Online Courses
NEET	Young people not in employment, education, or training
NEMISA	National Electronic Media Institute of South Africa
NeSPA	National e-Skills Plans of Action
NGO	Non-Governmental Organisation
NP-PSET	National Plan for Post-School Education and Training
NRP	National Reform Programme
NSDSs	National Skills Development Strategies
ONS	Office for National Statistics
PIPS	Polish Information Processing Society
PL	Poland
POEJ	Programa Operativo de Empleo Juvenil
POISES	Programa Operativo de Inclusión Social y de la Economía Social
STEM	Science, Technology, Engineering and Mathematics
TPE	Technical and Professional Education
UK	United Kingdom
VET	Vocational Education and Training
ZA	South Africa

Table of contents

PREFACE	1
EXECUTIVE SUMMARY	2
PART 1	14
PART 2 THE ICT WORKFORCE	18
PART 3 DIVERSITY IN ICT EDUCATION	25
PART 4 POLICY	47
PART 5 COUNTRY BRIEFS	50
PART 6 RECOMMENDATIONS: THE FUTURE OF DIVERSE ICT TRAINING	72
CONCLUSION	87
APPENDIX	90
ENDNOTES	97

Preface

The work product of the diversITy project informs policy development on the European and national level and provides practical recommendations to non-profit organisations and training providers. An initial assessment and evaluation of identified ICT skills training programmes in the target countries produced a repository of 96 inclusive programmes of which 22 Good Practice Showcases (GPS). Brief descriptions of them are available on the diversITy online repository at www.eskills4diversity.com. In addition to the online repository of cases, we produced seven country reports for each target country, discussing in-depth each country's ICT skills gap and unique policy and training landscape. In each report, we showcased a set of best practices, setting a benchmark for other training providers to learn from. Rounding off our series of diversITy country reports is a final report, summarising the key findings from the target countries, reporting strengths and weaknesses of various approaches, and identifying challenges and recommendations for ICT skills training programmes as well as policy makers.

The ICT job market is growing rapidly and with it the need for qualified personnel. As of today, the gap between demand and supply of ICT jobs is widening yearly. The challenge for education, industry and policy makers is to fulfil the rising demand of skilled ICT workers. At the same time, an unfulfilled potential of a diverse population is left untapped. ICT workforce potential can be found among women, adults in career transitions, young persons at risk of social exclusion and not in education, employment or training, or persons from difficult socio-economic backgrounds such as minorities or migrants. In this context, this report examines ICT skills trainings programmes for such a diverse population in seven countries.

With regard to country specific educational systems, the report assesses the taxonomy of training programmes, highlights good practice showcases from each country and programme type. It further derives challenges and success factors that organisations, educational institutions, industry, and governments can use to ensure a sustainable growth and diversity in the ICT job market supply.



Executive summary

The diversITy project carried out an evaluation and assessment of ICT skills and training programmes which support diverse populations to enter the labour market. It identified and analysed ICT training programmes that aim to prepare and place jobseekers into meaningful tech jobs, with a focus on diverse target groups, including women, youth at risk of social exclusion or from difficult socio-economic backgrounds, migrants or unemployed adults changing careers. The target countries are Germany, France, the United Kingdom, Ireland, Spain, Poland and South Africa.

The work product of the diversITy project aims to inform policy development on the European and national level and provide practical recommendations to non-profit organisations and training providers. An initial assessment and evaluation of identified ICT skills training programmes in the target countries produced a repository of 96 inclusive programmes of which 22 Good Practice Showcases (GPS) with brief descriptions available on the diversITy online repository at www.eskills4diversity.com.

The ICT job market is growing rapidly and with it the need for qualified personnel. As of today, the gap between demand and supply of ICT jobs is widening yearly. The challenge for education, industry and policy makers is to fulfil the rising demand of skilled ICT workers. At the same time, an unfulfilled potential of a diverse population is left untapped. ICT workforce potential can be found among women, adults in career transitions, young persons at risk of social exclusion, not in education, employment or training, or persons from difficult socio-economic backgrounds such as minorities or migrants.

Diversity in the Workforce

Diversity in the workforce / workplace describes companies hiring employees from different backgrounds, regardless of race, religion, culture, gender, sex, education, disability or other. Companies that create inclusive workplaces are more successful and a relationship between diversity and business performance persists.¹ Higher levels of diversity also bring competitive advantages for companies to attract and retain diverse talent.

Diverse groups that the report has taken into account were young people not in employment, education or training (NEETs), women, minorities, people from socio-economically disadvantaged backgrounds and people with disabilities.

The average amount of NEETs (aged 15-24 years) in Europe (EU28) is 11.6%. Some of the assessed countries have higher rates (France, Ireland, Spain), while others are slightly below (Poland, UK). The two outliers are Germany, with a low rate of 6.7%, and South Africa with a high rate of 31.2%².

Gender diversity in the ICT workforce is a challenge. The share of women in the ICT workforce in Europe is only 16% versus 46% of the entire workforce. Only around 19% of computer science students are female and this low level of representation persists through higher education and in the workplace.

The following figure shows the example case on gender diversity for the UK also providing information on the top 5 ICT occupations for men compared to those for women. The comparable figures for the other countries under review as to the share of men and women in the ICT workforce and their respective share among the ICT graduates are at very similar levels.



Source: empirica calculations (2018) based on Eurostat data and ONS data. * = Bachelor's or equivalent level

Across the EU28, the average gender employment rate gap indicates that there is a difference between the overall level of employment for women and men of 10.5 percentage points. In France it is 6.7, Germany 9.5, Spain 10.5, Ireland 10.7 and Poland 12.9. South Africa's gender employment gap is 11.4.

The labour market situation for minorities is reflected in the non-native employment rate gap, the difference between the native-born EU employment rate and the non-native-born EU employment rate. The average EU 28 gap is 8.3 percentage points. Germany has a gap rate of 10.6, France 13.4, UK 6.0, Ireland 6.8, Poland 1.5 and Spain 4.1. This indicator does not apply to South Africa and comparable data was not available.

In terms of people with disabilities participating in the workforce, the disability employment rate gap indicates the difference between the employment rate of disabled and non-disabled people. On average, the EU28 disability employment rate gap is 19.6 percentage points. Ireland's gap is at 31.1, Poland's at 30 and the UK's at 27.8. Germany's gap is at 20.6, Spain at 16.2, and France at 9.9. In comparison, South Africa's gap is only at 1.4. It shall be noted, however, that the definition of "disability" varies heavily between these countries.



Figure 2 Employment rates among different groups in the EU 28, European Countries and South Africa 2017

Source: empirica (2018), based on Eurostat, OECD and Statistics South Africa Data * does not apply for South Africa

Diversity in the ICT workforce

Despite the prominence of the topic "diversity", and specifically gender diversity, the share of women in the ICT workforce remains low. In only three EU member states, the majority of scientists and engineers are women: Lithuania (58% female), Bulgaria (54%) and Latvia (52%). In comparison to the share of women in the overall workforce, this is a concern. Of the six European countries, the one with the smallest difference between ICT and overall workforce is Ireland. Interestingly, South Africa's composition of the overall workforce features less women than its MICT sector. In all countries under review, two things have become evident: 1) the workforce outside of core ICT occupations, e.g. media industry, or interdisciplinary fields like bio-informatics is much more gender diverse (30%+) and 2) Ireland and Spain, the two countries with the highest proportion of women in ICT (of the six European countries), also have the highest share of "core ICT practitioners at associate/technician level". This leads to the conclusion that representation of women in the core ICT sector is bound to low qualified jobs on one side and an issue of image on the other side. While many women appear interested in tech-related jobs, core ICT topics appear uninteresting to them. Causes for this can be found in cultural perceptions of women in ICT but further in the lack of attraction of classic ICT education. For the other target groups, reliable and comparable data does not exist.



Figure 3 Percentage of women in the overall workforce and ICT workforce in European countries and South Africa -2017

Source: empirica (2018), based on Eurostat and Statistics South Africa data

* South Africa includes MICT sector (Media, Information and Communication Technologies)

The ICT workforce: demand today and in the future

Based on our calculations, the six European countries under review in our study are today facing a shortage of 477,000 ICT specialists at different skills levels. This could increase up to 1.26 million in 2020 and 1.67 million potential vacancies in 2025. According to labour force survey data broken down by the ISCO classification (international standard classification of occupations), currently the majority of these jobs is available for mid level skills (47.9%) and low level skills (30.7%). Positions requiring high level skills make up 21.4% of the workforce. At the same time, ICT professionals in management, architecture and analysis, the high level skills, experienced the biggest growth since 2011, 11.9% per year. Lower level skill positions such as mechanics and servicers, have also increased by 8.2% per year.³

Diversity in ICT education and training: inclusive ICT training programmes

Based on a comprehensive survey, the diversITy project identified over 400 ICT skills training initiatives in the seven countries aiming at underrepresented and target groups. In the end, 22 training projects were selected as 'good practice showcases' (GPS). During the assessment, six types of training were identified based on the content of the curriculum, the duration, the way of teaching and the accessibility: Classroom, Online, Bootcamps, Workshops, Experiential, and Mentorships. Most GPS use combinations of these or multiple methods that address different training needs such as cognitive and non-cognitive (transversal) skills, or experience.



Country	Identified	Target Fit	Selected	GPS*
Germany	66	38	14	3
France	59	40	22	4
Spain	115	65	15	3
Poland	47	29	18	3
UK	57	29	10	3
Ireland	92	63	10	3
South Africa	51	38	17	3
Total	487	302	106	22
*GPS = Good Practice Showcase				

The report identifies advantages and barriers of various training taxonomies and provides examples of existing training programmes applying these various types. While most promising training programmes include a mix of taxonomies, the highest success for learners can be found among such programmes offering mentorships and experiential training. Key factors in the success of programmes are affordability, accessibility, flexibility in curricula according to industry demands, and work placements.

Educational routes / pathways

In spite of differences in educational systems throughout the assessed countries, the report has identified a number of common pathways into ICT labour for the diverse population.

• Academic Education

Overall, the most traditional pathway for students is a university degree in Computer Science or a related subject.

• Vocational Education and Training / Apprenticeships

This includes employment contracts that combining an occupational company placement and theory-based learning at a college or training provider. These exist at various educational levels and can lead to apprenticeship degrees and qualification for further university education.

• Lifelong Learning

Lifelong learning includes training at various career stages that enable new skills to be learnt or to improve further upon existing ones.

• Industry Led Training

IT vendors provide this type of training. It often leads to certification which strengthens existing qualification level. Prior knowledge often is a requirement.

• Career Transition / Conversion Programmes / Lateral Entry

These are programmes targeted at a wide audience seeking to transition into technology careers, for example students with backgrounds other than ICT, and older workers who want to re-start their careers.

The success rates that each pathway has on diversity in ICT can only be recognised against a country's specific background. For instance, some countries like Germany will stress the vocational education and training more heavily than others. While university education is unanimously viewed as the dominating pathway into ICT labour, experts agree that a shift towards other pathways is required to meet the current demands for ICT jobs.

ICT Training Taxonomies

Classroom

Traditional, instructor-led training in a classroom setting. Example Programmes: Web@académie, Maharishi Institute, Code First: Girls

Bootcamps

Intensive training programmes generally lasting for a few days to several months.

Example Programmes: WebForce3, Code4Jobs BKK Bootcamp

Workshops

One to three days training sessions on specialised topics.

Example Programmes: ReDi School, BBC Make it Digital, TecnoLab

• Online

Training on online platforms, includes but is not limited to massive open online courses (MOOCs).

Example Programmes: NetAcad, Empleo Digital, Wild Code School

• Experiential

A mix of technical and experiential learning, including classroom-oriented learning and company placements.

Example Programmes: Simplon.co, Fast Track to IT, Generation

• Mentorships

A mentor responsible for providing 1:1 guidance in inclusive training programmes.

Example Programmes: IT for SHE, JOBLINGE goes MINT, Maisons Digitales

Target groups

The inclusive ICT training programmes identified address different **target groups**. These include:

- Women
- Unemployed job seekers
- NEETs
- Low income
- Career changers
- Minority groups
- Refugees
- Persons with disabilities

Figure 4 Target groups of inclusive ICT training programmes – Example Spain 2018



Source: diversITy Survey, empirica (2017)

They also include **different types of actors** in different constellations such as:

- Training providers
- Public sector / government
- Nonprofits
- IT vendors
- Other industry
- SMEs
- Unions



Figure 5 Stakeholder active in inclusive ICT training programmes – Example Germany 2018

Source: diversITy Survey, empirica (2017)

Improving diversity in ICT training

A number of measures / practices have been identified to improve diversity in the ICT labour market and workforce. Actions are required on educational, policy, and industry level, including a shift towards new pathways besides the traditional university education.

• Skills Gap and Hiring Processes

Three imminent issues exist: (1) Current hiring processes are based on skillset rather than mind-set, despite the rising importance of transversal skills. (2) Changes to the educational system are required to improve transversal skills. (3) The discrepancy between job description and actual job requirements is widening.

• System of New Credentials

A set of new credentials could contain elements like certification, digital badges as an online representation of a skill an individual earned, portfolios and standardised curricula.

• New Digital Degrees

Newly developed digital degrees in vocational education and training, and apprenticeships or (partial) amendments of existing ones to update these to present needs and standards can deliver a practically oriented workforce within a comparatively short amount of time.

• Flexibility in Education

Traditional education routes need quicker and more flexible adaptations to new needs and standards in a fast pacing industry. Openness towards ICT training programmes outside formal education is needed together with an improved permeability of these, which could help in paving the way towards formal education.

Permeability

Permeability of inclusive ICT trainings into the formal VET, although seen as important, still is an exception since options to achieve this are rare. Industry associations together with policymakers should develop official examination standards and tests that allow graduates from inclusive ICT trainings the opportunity to enter state-recognised traditional education.

• Institutionalising Data Collection

A newly developed "skills profile" together with regular audits and coordinated (ICT) skills demand and supply data collection and compilation into national and European statistics would help to better identify more reliably the existing and future supply and demand trends in ICT skills.

Collaboration

Training programmes and industry need to work hand in hand to improve content and structure, including work placements and mentorships.

• Creating a Hub

A system of effective communication toward collaboration, e.g. sharing and replicating successful good practices can strengthen stakeholder engagement.

• Realise the Value of Diversity

Many studies have demonstrated the value of diversity. Policymakers and industry need to make an effort to create and support programmes with the goal of including all underrepresented target groups.

Policy

Developing key priorities for inclusive ICT policies and addressing the issue of ICT training, job placement and sustainable labour market integration for a diverse tech workforce requires coordinated and joint action. Governments in the countries under review have announced and launched different types of policy strategies to address these challenges. Many of these strategies have either been launched recently and are therefore difficult to assess, or they set the policy framework (and nothing more) for things to happen in the future. Several of these policy strategies are associated to funding programmes (national as well as European ones) which provide opportunities for the creation of inclusive ICT training programmes.

In brief, the overarching principle of advisable policy actions includes such policies that provide a financial framework for stakeholders to act in. One of the more successful measures is the **Grande École du Numérique** whose model could be replicable in other countries. It is a multi-stakeholder partnership founded by the Ministry for the Economy and Finance in **France** which aims to promote development of innovative ICT training offers outside of the business schools and technical universities. Its main approach is issuing a label to ICT training programmes that meet a range of criteria concerning inclusiveness and diversity. Providers of labelled programmes can receive a grant of up to 80% of costs from Grande École du Numérique. The "Grande École du Numérique" label (GEN) is awarded per course and not per structure. The same project leader can apply for the certification of several training courses. The label is valid for three years.

Of the assessed countries, policy action varies heavily. While **Germany** focuses on the general labour market, industry and work, by integrating refugees into the labour market using ICT jobs, **Spain's** focus lies on the long term unemployed and socially deprived groups, using ICT to promote job opportunities.

Ireland, Poland and UK address the ICT challenge by focusing on their educational system: creating and expanding apprenticeships and traineeship and the vocational education system. UK's digital strategy prioritises public-private partnerships with both the industry and the NGO sector. It is accompanied by the Tech Talent Charter and local Digital Skills Partnerships.

Several of these policy strategies are associated to funding programmes (national as well as European ones) which offer more or less clear opportunities for funding specific activities in the area of inclusive ICT training for the creation of a more diverse workforce. These policy programmes set the policy framework (and nothing more) for things to happen.

Addressing the challenges arising from the ambition for a more diverse tech workforce through related inclusive ICT programmes at a large scale will require action to be taken at different levels (European, national, regional, local) and in different areas (curricula / programme co-creation, operation quality labeling, certification etc.).

European Commission

The European Commission has started a number of activities in the area of ICT skills development and training and diversity:

Women in Digital: This activity launched by the European Commission at the Digital4Her conference in June 2018 includes a larger number of actions as part of a Commission strategy that will facilitate an increase in the participation of women in the ICT sector and occupations. The actions will focus on three main areas: challenging stereotypes, promoting digital skills and education and advocating for more women entrepreneurs. Actions related to these focal points are to be implemented in the course of the next two years.⁴

The Digital Skills and Jobs Coalition (DSJC): The Digital Skills and Jobs Coalition brings together Member States, companies, social partners, non-profit organisations and education providers, who take action to tackle the lack of digital and ICT skills in Europe. Actions range from training unemployed people, giving MOOCs for teachers, offering coding classes for children or cutting-edge training for ICT specialists. The Coalition also shares and promotes digital and ICT skills initiatives through the European Digital Skills Awards which can be replicated and scaled up across Europe. Each year the European Commission highlights excellent initiatives that help improve the digital skills of citizens, the labour force, ICT professionals, girls and women as well as in education through the European Digital Skills Awards. A further European initiative - the Digital Opportunity traineeships scheme - which started in 2018 - is a pilot project giving students and recent graduates an opportunity to get hands-on training in digital fields such as cybersecurity, artificial intelligence, coding or digital marketing. Member States can support collaboration between the different actors in their country on developing digital skills by bringing them together in national coalitions. The Digital Skills and Jobs Coalition has established a Governing Board which provides strategic leadership and gives high-level advice to improve the functioning and the impact of the Coalition as well as monitoring its overall progress. The Governing Board advocates the views of the Coalition partners at European level, and acts as a link between pledgers⁵, national Coalitions and social partners.⁶ The Digital Skills and Jobs Coalition currently has around 400 members.

Skills Agenda for Europe: On 10 June 2016, the European Commission adopted a new Skills Agenda for Europe. The agenda aims to make sure that people develop the skills necessary for the jobs of today and tomorrow. In the Skills Agenda for Europe the Commission invited all Member States to develop <u>national digital skills</u> <u>strategies</u> by mid-2017 and to set up <u>national coalitions</u> to support their implementation. By 2019, officially 23 more or less active national coalitions exist under the umbrella of the pan-European Digital Skills and Jobs Coalition. The other EU Member States still lack these. To support the development of national strategies, a group composed of Member State experts have put together a menu of challenges to be addressed and potential actions that could form part of a digital skills strategy – the so-called "shared concept".⁷

Conclusion

The demand for skilled ICT workers at all levels is increasing rapidly. Consensus exists that action is needed to overcome the existing and continuously rising skills shortage and gap, which can be observed in all European countries and globally. Low-skilled school leavers, school dropouts, workers with outdated skills but also individuals with diverse backgrounds and women as a large untapped resource, provide enormous potential to alter and help close the skills gap. Inclusive training programmes, such as the ones assessed for this report, can help. Such training programmes are an important step of educational journeys. However, at present these are "too little and too few". They need to become larger in scale and sustainable in operation.

Out of over 400 training programmes we looked at, 22 qualified as Good Practice Showcases. Many training programmes struggle to provide proper teaching methods and content to prepare individuals from diverse target groups for the ICT track and career. This needs to change. A systematic overhaul of many existing programmes is needed in terms of content structure, teaching methods, collaborations with industry partners and/or the formal educational system.

Moreover, there is a need to better integrate ICT skills training in existing educational streams and at the same time, due to fast paced developments in ICT industry, education and training need to become more flexible and up-to-date. Here, inclusive ICT training programmes have an advantage compared to formal education and training.

Sustainability

Over the course of this report, we have identified a number of inclusive ICT training programmes, many of which developed interesting approaches and promising concepts. Unfortunately, some of these programmes are threatened due to difficulties in funding. Thus, sustainability should be a top priority in designing inclusive ICT training. The key to sustainability lies within a strong collaboration with industry, policy and providers, to establish the necessary structures. These structures are of financial, bureaucratic and practical nature.

Aspects for training programmes include:

- work with the right partners, specifically from industry as (potential) future employers,
- design and update programmes together with industry,
- link to vocational education and training (VET) to make best use of a promising pathway to employment with the chance for their students to obtain a universally recognised formal degree,
- closely cooperate with employment agencies and obtain necessary accreditations to be able to secure long-term funding,
- decide on whether and how certification can add value,
- make use of tax-based or other types of government instruments for incentivising and funding training activities in general and specifically inclusive ICT training programmes and where appropriate.

Practical experience

The most important aspects of training are mentorship and practical experience. It is necessary to develop long lasting concepts of up-to-date curricula, work placement integration and financial incentives and structures through governments which can help create the necessary eco-system of actors needed and provide the necessary framework conditions and a sufficient (financial) basis for operation.

For training providers two of the most important aspects of training are:

- teach "transversal" skills in addition to technical ICT skills,
- implement well functioning mentorship using role models.

Furthermore, it is of the utmost importance to raise the awareness of diversity, and at a young age promote career pathways including vocational education and training and apprenticeships to children and their parents to help them make informed choices.

Policy instruments and industry input

In the cases where individuals have dropped out of the formal education system, more and larger-scale inclusive ICT training programmes need to be developed. This requires the support from governments and industry to address these target groups to make a difference and create significant impact. Governments need to provide funding channels and funding mechanisms with clear application criteria to training providers, while industry partners need to provide input into the development such criteria and offer help in the development of training programmes.

The future of ICT trainings

At the same time, permeability to formal education and training could help opening up further opportunities at a later stage and help secure jobs even more specifically in times of crisis. While the demand of ICT jobs is already high and even growing, the potential for an inclusive workforce to enter the ICT labour market exists.

The present project has revealed that practitioners active in this field should consider – amongst others – some key points for the creation of a good inclusive ICT training programme. These require a team of actors to

- set up supportive policy and funding framework conditions together with an appropriate stakeholder ecosystem,
- address the ICT and STEM 'enrolment funnel' to boost enrolment of girls and women in ICT and STEM, by promoting tech jobs and opportunities for girls from kindergarten to university and job start in the labour market, offer activity spaces and funding for the co-creation and regular updating of inclusive ICT training programmes in partnership between training providers and industry,
- increase permeability of inclusive ICT trainings into the formal VET,
- develop light-weight certification options as quality labels for inclusive ICT training making it easier for graduates from inclusive ICT training programmes to enter the labour market. A first step would include commissioning the development of a 'guide to alternative certification' to training providers throughout Europe which would help to make best use of these,
- support setting up cross-organisational and cross-regional mentor networks,
- investigate whether tax-based funding can operate as incentive to further training in companies, and
- demonstrate good practice of inclusive ICT training programmes.

Key Recommendations

Skills Gap and Hiring Process

Many of the existing issues in the demand and supply of ICT labour are based on a skills gap of cognitive vs. non-cognitive skills and issues of skills matching. Existing degrees in the educational systems teach cognitive skills but lack non-cognitive ones. While the educational side need to adapt their curricula and adopt more transversal skills and include work placement, companies will also need to understand better the job market and their own job requirements. Using this approach, companies can attract and encourage different target groups that might have fewer technical skills but are highly motivated to learn them. Companies need to overhaul their hiring processes. We found a widening discrepancy between job descriptions and actual job requirements. The assessment of job requirements also feeds into the development of future ICT "skills profiles".

The European e-Competence Framework (e-CF) is recommended for use here. In 2016, the e-CF became a European standard and was published officially as the European Norm EN 16234-1. The e-CF provides a reference of 40 competences as applied at the Information and Communication Technology (ICT) workplace, using a common language for competences, skills, knowledge and proficiency levels that can be understood across Europe. It is associated to 30 European ICT Professional Role Profiles built on the e-CF. These provide a generic set of typical roles performed by ICT Professionals in any organisation, covering the full ICT business processes and would be helpful in developing "skills profiles" for inclusive ICT training activities.

 According to employers, ICT skills training should also address the development of behavioural and mind-set skills. This approach helps to prepare trainees for actual situations encountered at work. One of the main reasons experiential trainings are successful is because they address a need employers feel is not being met by traditional educational institutions. New digital degrees, VET and apprenticeships Based on a better understanding of industry demand and "skills profiles", new digital degrees can be developed, specifically non-tertiary degrees such as vocational education and training and apprenticeships. This approach could deliver a practically oriented workforce within a comparatively short amount of time. These types of degrees can be specifically attractive for the target group of NEETs or youth at the risk of social exclusion. However, not only the development of such degrees is key to the shortage of ICT workers. Currently, in many of the assessed countries, VET and apprenticeships are rather unattractive. A concentrated marketing campaign can address the lack of awareness. Yet, only industry can boost the attractiveness of such degrees, by allowing better career options and a better permeability into higher paid positions for existing workers.

Creating a Hub

One way of engaging stakeholders is by forming a system for effective communication toward collaboration, ensuring that programmes meet actual need, and expand, replicate, and share best practices. An example is the Tech Talent Charter in the UK, which is a commitment by organisations to a set of undertakings that aim to deliver greater diversity in the tech workforce of the UK, one that better reflects the make-up of the population. Signatories of the charter make a number of pledges in relation to their approach to recruitment and retention.

Promote the Value of Diversity

More companies, especially SMEs, need to realise the value of a diverse workforce: Many studies have shown that diverse teams outperform others, generate more money and uncover more angles. Diversity is not restricted to the inclusion of women but also older, younger, and otherwise different (minorities, NEETs, different field of study) people. Policymakers together with industry need to make an effort to create and support programmes with the goal of including students from all underrepresented target groups.

Flexibility in Education

The traditional education route is still seen as the most trusted pathway into ICT labour, the majority of the ICT workforce consists of workers with a university degree background. Yet, industry complains about (a) the lack of up-to-date specific programming skills and (b) the lack of transversal skills. The underlying issue is the lack of work placements and the fast developing ICT landscape. In order to meet these demands, flexibility in the traditional education would be required, i.e. more work placements for students and a higher flexibility in designing university curricula. Nevertheless, also other educational routes such as apprenticeships, and vocational education and training are often based on long lasting curricula as well.

- ICT vendor certificates are important for young people and adults who want to transition into the ICT sector. For career transitioning youth and adults, employers considered – specifically ICT vendor - certificates to be relevant for most technological job profiles. However, for most employers such certificates are only relevant if obtained from reputable national or international training institutions.
- For individuals who do not have an academic degree and who have dropped out of school or college, ICT training programmes should ideally introduce options of studying ICT-related subjects. Evidence from our survey shows that most such programmes are targeted specifically to young learners. For younger cohorts, training programmes like these emphasise the importance of opening pathways to explore future possibilities in ICT education.

- Job applicants with well-developed transversal skills are better positioned to be recruited by employers. These transversal skills range from effective communication and coordination, problem-solving, negotiation, teamwork and collaboration, and decision making. Employers indicated that graduates and trainees with no prior work experience tend to lack such skills. The prevailing perception among employers is that higher education institutions in many countries do not sufficiently address the need for experiential or practical learning.
- Mixed or integrated approaches to training are the most desirable for both trainees and employers, particularly those in an experiential learning setting. However, only well-structured programmes with significant support from sponsors and businesses can provide this type of integrated training.
- Substantial long-term success can be achieved by integratability / connectivity to the local educational system. Training programmes should achieve certifications that allow their learners to enter the traditional educational system.
- Business support is especially relevant for designing curricula of training programmes for both technical and soft skill-sets because employer-driven programmes respond better to market demands for ICT and work-relevant skills.

Part 1 Diversity in the workforce

Diversity in the workforce / workplace describes companies hiring employees from all sorts of different backgrounds, regardless of race, religion, culture, gender, sex, education, disability or other. Realising the value of a diverse workforce is key to understanding the importance of it. Companies that create inclusive workplaces are more successful and a relationship between diversity and business performance persists. Higher levels of a diverse workplace also bring competitive advantages for companies that can attract and retain such diverse talent.^{8,9,10,11}

This chapter presents an overview of indicators for diverse target groups in the general workforce across the six European countries assessed, and South Africa. Indicators of workforce participation include the percentage of young people not in employment, education, or training (NEET). As an indicator for the labour market situation of ethnic minorities, the share of non-native born outside of the EU was used. For women and people with disabilities, workforce participation is measured by employment rate gaps.

Young people not in employment, education or training (NEET)

The amount of young people not in employment, education or training, aged 15-24 years, (NEET) in the assessed countries hovers around the average of Europe (EU28), which is 11.6%. Some countries are above (France, Ireland, Spain), while others are slightly below (Poland, UK). The two outliers are Germany, with a low of 6.7%, and South Africa with a high of 31.2%.

Minor differences are visible in the age group 20-34. Here, the EU28 average is 17.2% while the overall range is between 7.8% in Sweden and 29.5% in Italy. Spain and France are above the average (20.8% and 18.2%), Poland sits at the average (17.1%), Ireland is slightly below (16.1%) and UK and Germany rank below the average (13.7% and 11.9%).



Source: empirica, based on Eurostat and OECD data (2017)



Source: Eurostat

Figure 7 NEETs (20-34 years)

Minorities

As an indicator for the labour market situation of ethnic minorities, the share of non-native born outside of the EU was used. The non-native employment rate gap indicates the difference between the native-born EU employment rate and the non-native born EU employment rate. On average, the gap is 8.3 percentage points. The gap is significantly higher in Germany (10.6) and France (13.4) among other things due to the high level of refugees. The UK and Ireland fall below the average with 6 and 6.8 respectively. The lowest non-native employment gap can be witnessed in Poland (1.5), followed by Spain (4.1). Both countries have a significantly lower share of nonnatives born outside the EU than the other compared countries.

Figure 8 Non-native employment rate gap



*does not apply to South Africa

People with disabilities

In terms of people with disabilities participating in the workforce, the disability employment rate gap indicates the difference between the employment rate of disabled and non-disabled people. On average, the share of people with disabilities in employment is 19.6 percentage points lower (EU28) than for people without disabilities. Ireland (31.1), Poland (30) and the UK (27.8) have a far higher employment gap than the average. Germany ranks around the average (20.6) while Spain ranks below (16.2). In comparison to the other countries, France's disability employment rate gap is 9.9 (ranking 3rd in Europe). South Africa has a reported gap of just 1.4. In general, the measured number for people with disabilities can be highly different between countries since no standards apply.

Figure 9 Disability employment rate gap



Women

The gender employment rate gap indicates the difference in the overall level of employment between men and women. Across the EU28, the average gap is 10.5 percentage points. Of the assessed countries, France has the smallest difference between male and female employment rates (6.7) followed by Germany (7.6) and UK (9.5). Spain and Ireland are at the average EU28 level (10.5 and 10.7), while Poland is above the average (12.9). In comparison to the EU28 average, the gender employment rage gap in South Africa is 11.4 and thus only slightly higher.





Source: empirica, based on Eurostat and OECD data (2017)

Gender diversity in the ICT workforce

While the overall gap between the male and female employment rate is on average 10.5 percentage points, women in ICT are still rare. In only three EU member states, the majority of scientists and engineers are women: Lithuania (58% female), Bulgaria (54%) and Latvia (52%). Less than one third of scientists and engineers were women in Luxembourg (25%), Finland (28%), Hungary (31%) and Austria (32%)¹³.

Germany

The share women currently in ICT training schemes is 8% and the share of women in computer science fields is 14.5%. The share of female graduates in the wider field of science, mathematics and computing is 38.3%.

Spain

The share of women in the overall workforce in Spain is 46%. In contrast, the share of women in the ICT workforce is 19%.

France

In France, the share of women in the ICT workforce is 16.6% and the share of women in the wider digital sector is 27% compared to an overall workforce of 48% women.

Ireland

Across all fields of study, 52% of graduates are women compared to only 21% female ICT graduates. Ireland's overall workforce comprises of 46% women, yet in ICT, only 31% are women.

Poland

The share of female ICT graduates is 18% and the eventual share of women in the ICT workforce is even lower: 13.5%

South Africa

41% of the MICT (Media, Information and Communication Technologies) sector employees are female¹⁴ Computer science is the field of study with the third lowest share of women (after military sciences and engineering).

United Kingdom

The UK has a 16% share of women in its ICT workforce and the share of female ICT graduates is 17% vs. 42% of ICT related fields of study.



Source: empirica calculations (2018) based on Eurostat data and ONS data. * = Bachelor's or equivalent level

Part 2 The ICT workforce

In this part, we assess the labour market situation for ICT occupations in all examined countries. This includes a first overview of the ICT workers demand and supply and a forecast of developments until 2025 with a break down by country.

In 2016, empirica's forecasts, of ICT jobs and demand potential have already indicated a high number of future vacant jobs (Figure 9)¹⁵. However, only 16% of all future vacant jobs were foreseen at the highly qualified positions in ICT management, architecture and analysis. In contrast, 84% of all jobs are for all other ICT professionals. This indicates that more than three quarters of jobs are available for lower and mid-level jobs. Overall, these open and upcoming vacancies provide a high potential to bring diversity into the ICT workforce. Table 1 shows a breakdown of ICT specialist skills levels according to the international standard classification of occupations (ISCO). Table 2 highlights the ISCO codes behind the grouping of skills levels. The following pages illustrate the ICT workforce situation by skill level for the six assessed European Countries. A direct comparison with South Africa is not possible due to the lack of comparable data. For South Africa, in 2017, Media, Information and Communication Technologies (MICT) sector employers reported about 7,200 vacancies. 63% of these are for the category "professionals", 29% for "technicians and associate professions" and 3% for "managers".

Figure 12 ICT jobs potential



Source: Hüsing, T., Korte, W., Dashja, E.: e-Skills in Europe - Trends and Forecasts for the European ICT Professional and Digital Leadership Labour Markets (2015-2020). empirica, 2016

Table 1 ICT Specialists by skill level according to ISCO (International standard classification of occupations)				
Level	ISCO (International standard classification of occupations)			
High	Management, architecture & analysis			
Mid	Core ICT practitioners – professional level			
Mid	Other ICT practitioners – professional level			
Lower	Core ICT practitioners – associate / technician level			
Lower	Other ICT practitioners – associate / technician level			

Table 2 Eurostat: ICT specialists according to ISCO

Management, architecture & analysis
133 ICT Service managers
2511 Systems analysts
Core ICT practitioners – professional level
2512 Software developers
2513 Web and multimedia developers
2514 Application programmers
2519 Software and multimedia developers and analysts not elsewhere classified
2521 Database designers and administrators
2522 Systems administrators
2523 Computer network professionals
2529 Database and network professionals n.e.c.
Other ICT practitioners – professional level
2152 Electronic engineers
2153 Telecommunication engineers
2166 Graphic and multimedia designers
2356 Information technology trainers
2434 ICT sales professionals
Core ICT practitioners – associate / technician level
3511 ICT operations technicians
3512 ICT user support technicians
3513 Computer network and systems technicians
3514 Web technicians
Other ICT practitioners – associate / technician level
3114 Electronics engineering technicians
3521 Broadcasting and audio-visual technicians
3522 Telecommunications engineering technicians
7421 Electronics mechanics and servicers



Source: empirica (2017), based on Eurostat data



Figure 14 ICT workforce in Europe 2016

In 2011, the biggest group of ICT workers in Europe was the core ICT practitioners at professional level. According to ISCO this falls under the mid level skills. The second biggest group was the core ICT professional at associate/technician level, requiring lower level skills. The highest level of skills requirement, the group of management, architecture and analysis was the fourth biggest group of ICT professionals in 2011.

In 2016, by far the profession with the most workers was core ICT practitioners at professional level. The second biggest group was core ICT practitioners at associate/technician level, followed closely by other ICT practitioners at professional level and the group of management, architecture and analysis.

Source: empirica (2017), based on Eurostat data



servicers, fifth biggest group, has increased by 43.6%, on average, this group grows by 8.2% per year. The sixth biggest group, other ICT practitioners at associate/technician level, has grown by 15.2% and 2.9% on average per year respectively.

In terms of skill levels and educational routes/pathways, academic education is by far the most common entry into ICT occupations. Academic education is required for high level skill positions which make up 21.4% of the workforce. The further 47.9% of mid level skill positions are vacated by mainly academic graduates as well. This tier also allows entry for apprentices and VET graduates, depending on the degree and level of qualification. The lower level skill positions make up 30.7% of the workforce. Pathways into this tear of ICT employment include VET education, apprenticeships, or industry-led trainings.

For an additional breakdown of each ICT workforce's composition of the six assessed European countries, please see the appendix.

Forecast

A snapshot of total ICT workers demand and supply was calculated based on Eurostat data available for six of the seven assessed countries followed by forecasting development until 2025. Due to the lack of comparable data, South Africa could not be included in this overview. The results indicate an existing ICT skills gap already today and a significant increase in demand of ICT workers until 2025 throughout all countries. At the same time, the supply level only increases marginally until 2025. These developments are going to result in a dramatic ICT skills gap in 2025. The shortage of skills is highlighted red in the figure below. It describes the shortage that remains when all expected domestic ICT graduates enter the labour market. It does not take account of the lateral entries, i.e. people without a domestic degree or those trained outside the vocational and higher education system to become an IT specialist.



Figure 16: ICT workers in Europe, demand and supply until 2025

Source: empirica (2017), based on Eurostat data

Demand

Since comparable data is only available for the six European countries on this issue, the graph illustrates the demand for each of those. The highest total demand of ICT workers until 2025 will occur in the UK, Germany and France. These are also the countries with the highest growth rate in demand. The lowest demand is to be found in Ireland, while Poland's and Spain's demand is moderate in comparison. Figure 17 ICT workers demand until 2025 per country



Source: empirica(2017), based on Eurostat data

Figure 18 ICT workers supply until 2025 per country



Source: empirica (2017), based on Eurostat data

Supply

On the supply side of ICT workers until 2025, Germany and France face a partially drastic decline while all other countries are able to increase their supply. The country with the highest increase rate in ICT worker supply is Poland. Overall, the UK produces the most ICT workers in total but nowhere near its own demand.



Part 3 Diversity in ICT Education

Based on a comprehensive survey, the diversITy project identified over 400 ICT skills training initiatives in seven target countries: Germany, France, Spain, Poland, UK, Ireland, and South Africa. After further review, 22 'good practice showcases' were selected. This report outlines the essence of the findings. This section provides an overview of the identified training taxonomy of inclusive ICT trainings with corresponding good practice showcase examples.

()+

countries





ICT skills training

Diverse training programmes

The following figure provides an overview of the number of training programmes towards diverse underrepresented and vulnerable target groups. In four rounds, the diversITy project identified training programmes (1), narrowed them down to fit the project targets (2), applied further selection criteria (3), and finally selected 'Good Practice Showcases' (GPS) (4).



'Good Practice Showcases' selected as examples

We identified over 400 inclusive ICT skills training programmes. Based on a comprehensive survey, 22 good practice showcases were selected

Today, a shortage of skilled ICT workers exists with many of the hard-to-fill vacancies requiring specific university degrees and additional qualification gained by lifelong learning and additional training. However, a great number of open ICT jobs also exist on mid and lower-tier skill levels, accessible for VET graduates, apprentices, graduates from industry-led trainings and career transition programmes.

Most traditional pathways into the labour market – school followed by training and employment – have proven to struggle to reach the necessary scale and quality to fill vacancies in ICT jobs. fail. Inclusive ICT programmes use new and experimental approaches to reach out to people left out by the current system. They provide education to and possibilities for the excluded to enter a growing labour market that is in demand of ICT workers. Inclusive ICT training programmes close a gap left by the formal education and training system.

In the UK, a House of Commons Committee Report shaped the phrase "digital skills crisis" and urged concerted action from industry, schools, universities, and the government to prevent the worsening of the crisis.¹⁶ Such a digital skills crisis is imminent in all of the assessed countries with a minor exemption of Poland. In Germany and other countries, ICT vacancies are reportedly some of the hardest to fill.¹⁷ Thus, countries go as far as to "import" skilled ICT workers, worsening the situation in other economies.

The lack of diversity in the current ICT workforce causes concern and presents a waste of opportunity, as it does not sufficiently use the untapped potential of a diverse workforce to address the skills shortage. Moreover, it creates a serious case of inequality as career opportunities in a thriving segment of the labour market are not fully accessible to large shares of the population.

In many labour markets, the majority of ICT occupations do not typically require an academic education. Yet the majority of employers prefers academic degrees. This leads to an increased discrepancy between job descriptions and actual job requirements. Many of the existing issues in the demand and supply of ICT labour are based on a skills gap of cognitive vs. non-cognitive skills and issues of skills matching. Therefore, a significant potential for training programmes exists to help meet the demand for ICT skills. Diverse target groups of unemployed job seekers, persons with low income, older job seekers, youths not in education or training (NEETs), minorities, refugees, or persons with disabilities provide an untapped potential to fill ICT vacancies. With around 890,000 refugees entering Germany in 2015 alone¹⁸, there has been a renewed emphasis on measures for recruitment and training of ICT workers. The ICT sector also struggles from a significant underrepresentation of women on all levels. On average only 16% of ICT workers in Europe are women, compared to 41% in South Africa. Women with a minority or refugee background face a doubled burden: on average, the OECD employment rate for native-born women is 4.5 percentage points higher than foreign-born.¹⁹ The gap between employment rates of South Africa's White and non-White working age population is over 21 percentage points.

A 2017 Microsoft study states that girls' interest in science appears in early adolescence (around age 11) but drops significantly between 16 and 18 years of age. The survey identifies three main factors behind this decline in interest during orientation:

- A lack of female role models;
- A perception of gender inequalities in STEM careers. More than one in two girls reported that she would dare to embark on a career in STEM if she was assured that the employment opportunities for men and women were equal;
- Perceptions associating ICT and other STEM professions with an abstract nature at the expense of social and creative activities.²⁰

To overcome this, practical experience and hands-on exercise have demonstrated the strongest positive impact, followed by peer group approval and teacher mentors. $^{\rm 21}$

Obstacles seem to be apparent at all major stages of the talent pipeline. One major problem is well described in the UK: "Only 7% of the girls who take STEM GCSEs will go on to qualify at Level 4 in a Core STEM area, this is drastically lower than the 24% of boys who will leave education with these qualifications. This represents a real risk to the future STEM labour force and will likely exacerbate the current skills crisis." ²² A further example comes from a survey commissioned by the Tech Partnership. They found that 50% of women in tech were actively discouraged from entering a technology career by people close to them and 76% said they did not view technology as an attractive career path at school (even though 100% reported that they had since enjoyed their career in ICT).²³ For Scotland there is evidence that the majority of women with ICT and other STEM subject qualifications do not go on to work in related areas: In Scotland, 73% of female

STEM graduates are lost from STEM occupations, compared to only 48% of males.²⁴ In the 2015/16 season, women made up 52% of apprenticeships, but only 18% of apprenticeships in ICT.²⁵

The existing shortages are not only related to a lack of candidates with appropriate formal qualification, i.e.

technical skills, but also with transversal and crosssectoral skills, i.e. transversal skills like social skills, creativity, teamwork, cultural awareness and more.²⁶ This indicates a substantial skills mismatch in the demand and supply of ICT-related skills.²⁷

Overall, it is possible to tackle the shortage of ICT workers by developing inclusive training programmes for the diverse target groups, taking into account the required skills (technical and non-technical). This report presents the identified taxonomies for ICT training together with a set of advantages and disadvantages and corresponding 'good practice showcases' to illustrate the practical implementation.

Pathways into ICT labour market

Traditional Education



The most traditional pathway into the ICT workforce in all countries is a university degree in Computer Science or a related subject. An undergraduate or Bachelor's degree can be obtained in three years time, optionally complemented by a one to two year graduate or Master's degree. Most of the graduates working in the ICT sector have a university degree.



Vocational Education and Training / Apprenticeships

Employment contracts for young people, which involve a mix of theorybased learning in an apprentice training centre / vocational school and occupational training on the employer's premises. Dual training usually lasts two to four years. Depending on the country, the number of (potential) ICT degrees varies heavily.

Lifelong Learning



Trainings provide an important pathway into ICT labour for individuals who do not have an academic degree or certificate of education. This includes, but is not limited to, those individuals who have an interest in technology and who dropped out of school or college and unemployed adults seeking to transition into technology careers. The pathway also helps individuals to retain labour.

Examples

Vocational Education and Training / Apprenticeships

Microsoft Partner Apprenticeship Programme – Get On

Target participants: Young people aged 16-24 who do not hold degree qualifications

Description: The Microsoft Partner Apprenticeship is a vocational training programme aimed at young people preparing them for IT roles. In a typical one year apprenticeship, Microsoft supports training providers by supporting the training design and delivery, including access to certifications, e-learning, curricula and more.

Apprentices are recruited into a Microsoft partner or customer company prior to the start of the training. The programme is split between in-house training and application of the gained knowledge in the workplace. The training is provided in week-blocks or day releases, depending on the flexibility of the partners, including a mix of training taxonomies, like classroom training, workshops, online using Microsoft Technology (Lync) as a virtual classroom and assessment tool.

The learning aims at building a skill-set as quickly as possible while giving time for experiential learning. It aims for apprentices to perform 90-100 percent of the full role within 6 months of starting the traineeship. The final 6 months involve completing the curriculum and building further knowledge and experience. Once qualified, apprentices are regarded as IT professionals with opportunities to progress to higher apprenticeships or degree level qualifications.

Goal/Outcome: Over 7,500 apprentices started their career through this route at over 5,000 employers. Currently, 3,500 apprentices start the programme each year. 92% of apprentices stay with the company where they trained.

Country: United Kingdom

Website: https://partner.microsoft.com/engb/Training/apprenticeships

Industry-led Training



Employers consider Industry-led / ICT vendor trainings as useful further training certificates but also as standalone proof of skills. The certificates enjoy a high reputation and are accepted and valued, specifically if obtained from reputable international ICT vendors. Fees charged by providers can be substantial, but these can often be subsidised or fully paid for by third parties such as Labour Offices.

Career Transition / Conversion Programmes / Lateral Entry



Many students who enrol in ICT skills training have an educational background in subjects other than Computer Science, such as Humanities or Social Sciences. They may choose to do so for better career prospects or stable and higher-paying jobs. A number of training programmes are specifically targeting people who face problems in finding a quality job aligned to their education, and may be interested in changing towards a career in ICT. In addition, some programmes are targeting women who are interested in re-starting their career in ICT after a family break.

Examples

Industry-led Training

Cisco Networking Academy

Target participants: All interested students

Description: The Cisco Networking Academy offers a platform for individual learners but also a partner platform for other training programmes.

The course content reaches from entry level to expert level courses on networking, security, IoT, operating systems, programming, business, and more.

Cisco Networking Academy courses are designed to prepare learners for Cisco Certification and other industry recognized certification exams. Such certifications are highly valued by employers globally, as they demonstrate skills, relevant to many industries.

Goal/Outcome: In 20 years, 9.2 million students participated in 180 countries. The academy partners with more than 22,000 educators. 70% of advanced learners obtain new or better jobs.

Country: Global

Website: https://www.netacad.com/

Career Transition / Conversion Programmes / Lateral Entry

Amazon Web Services (AWS) re:Start

Target participants: Former members of the military reserves, veterans, service leavers, and service spouses

Pathway: Career transition

Description: Participants who join the AWS re:Start programme complete technical training classes, delivered by QA Consulting and supported by AWS certified instructors. They learn about cloud computing and how to architect, design, and develop cloud-based applications using AWS. They also learn how to set up new cloud environments using proven best practices in security and compliance and to build applications using software development toolkits for popular languages, such as Python.

During the training Experis delivers four employability workshops to help support participants with their job search. Pre and post course mentoring support is provided by Sage.

After the four weeks of training, graduates of the programme are connected with AWS customers & partners with the aim of securing work placements of 3-months (or longer), or full-time opportunities.

Goal/Outcome: 192 learners have participated so far of which 60% secured an IT placement. 78% of learners stayed with the company where they gained practical experience.

Country: UK

Website: https://aws-restart.com/
Training taxonomy

ICT training can be classified by a variety of criteria, including the content of the curriculum, the duration, the way of teaching, and the accessibility and outcome of to the programme (e.g. certificate). During our assessment, we identified a number of taxonomies. The most promising training programmes use a combination of multiple methods that address different training needs such as cognitive and non-cognitive skills, experience, or certification.



Classroom

Traditional, instructor-led training in a classroom setting. Training usually leads to a certificate and can last for several months or years.



Online

Training includes but is not limited to massive open online courses (MOOCs). Courses are available on online platforms, are mostly free to join and may or may not have instructors. Assessments are some-times selfadministered or based on peer-to-peer feedback, while others offer the possibility to take a final exam and earn a certificate (fee-based).



Bootcamps

Intensive training programmes generally lasting from a few days to several months. Training can be full- or part-time depending on the programme and consists of lessons, individual and team projects, 1:1 tutoring and tests.



Workshops

These typically take one to three days. Training is on specialised topics and consists of presentations and interactive peer-to-peer sessions.



Experiential

A mix of technical and experiential learning including classroom-oriented learning and company placements. Both digital apprenticeships and, to a lesser degree, traineeships are designed around experiential learning.



Mentorships

Not a stand-alone training type and is integrated with other types. A trainee can choose or is appointed a mentor who is an experienced instructor or employee. The mentor is responsible for providing 1:1 guidance.



Classroom training refers to educational programmes mostly tied to a degree or certification, often hosted at universities or other collegiate institutions but also IT vendors. Those programmes tend to be more established than some in other categories.

Programmes that typically involve classroom instructions as the main driver of their education for a fixed period, ranging from a few weeks for certificates to multiple years for full bachelor's and master's degrees.

Educational degrees, from primary to tertiary, use classroom training and thus provide the foundation of most educational systems. However, traditional classroom training can be prone to stagnation in developing curricula and meeting the demands of current ICT job needs.

Advantages

- Recognised credentials: Traditional classroom education has proven endlessly to be used in many school forms and during most bachelor's, master's and doctoral degrees. These degrees are acknowledged as the most recognised go-to credentials in the job market.
- Transversal skills development: In the traditional classroom setting, skills other than ICT – transversal skills like writing, critical thinking and resource management – are often taught through learner engagement along the way.
- Local embeddedness: Classroom-based trainings allow a training institution to grow strong links with relevant local public and private stakeholders, thus facilitating access of learners to work placements and jobs.
- Public funding: In most countries, traditional classroom education – including formal education - is funded and thus provides the highest number of students entering the ICT job market.
- Learner engagement: Classroom training tends to be much more suitable for ensuring engagement of persons who lack self-efficacy, such as often found among NEET youth and the long-term unemployed.

Disadvantages

- Outdated and inflexible curricula: Universities and other traditional educational institutions fail or are lagging behind to adapt their curricula to the fast paced needs of ICT industry. Students end up missing the current requirement for the job market.
- Entry barriers: classroom style programmes, especially if offered free, tend to be more selective when choosing prospective participants. Stricter selection criteria have the risk of excluding those who may have the most to gain from such employability skills.
- Certification costs: Classroom training following a vendor-specified curriculum resulting in a certification tends to cost more, for both trainees and training providers. These programmes are often unable to reach lowincome groups like NEET youths unless exceptions are made.
- Accessibility: Training programmes which require the presence of the learner at the location of the training provider tend to be available most of all in the major urban centres of the country.

Examples

Web@académie

Target participants: 18-15 year old underprivileged high school dropouts, women

Financing mechanism: Public funding, corporate contributions, collaboration with enterprises

Description: Web@académie was founded by ZUPdeCO, a French charitable non-governmental organisation (NGO) with the mission to help students from disadvantaged backgrounds achieve academic success.

It features a 2-year training programme, of which the first 12 months are spend at an Epitech technology campus, followed by another 12 months in which classroom training alternates with periods of internships.

The training programme is divided into four semesters and follows a structure designed by Epitech, a private computer science college. The pedagogical approach is fully based on project-based learning, starting from the idea that the technology sector needs experts who not only have strong scientific and technical skills but also the ability to constantly learn about new technologies and concepts.

Goal/Outcome: Successful participants receive the Certificate of Integrator and Web Developer from Epitech. 96% of graduates are already in employment

Country: France

Website: https://webacademie.org/

Maharishi Institute

Target participants: Students without the financial means to access further education

Financing mechanism: Student fees

Description: The Maharishi Institute collaborates with a group of companies where students can gain skill-based certificates at the foundational level.

At the Institute's Academy, student can gain expertise in Microsoft curricula and certification through its e-learning platform.

The Invincible IT Programme offers students exit points with various levels of qualifications over a period of four to five years. These levels include specialisations in Microsoft, Cisco and SAP certifications, and further specialised technical training interventions such as coding, web development and data management.

Goal/Outcome: 15,000 learners completed various programmes and 93% of the graduates found employment. More than 5,500 graduates coming from disadvantaged communities are earning upwards of 230 million RSA in salaries. Hundreds of graduates have been employed in the banking sector; over 2,000 graduates work in the ICT sector as programmers and network engineers

Country: South Africa

Website: https://maharishiinstitute.org/



Online refers to training courses available on online platforms. These platforms range from massive open online courses (MOOCS) to provider-specific online teaching platforms to support other training styles such as classroom training. Courses vary from free and self-paced learning experiences to fee-based courses following a strict sequence of steps at set times.

Online trainings, such as MOOCs, can offer an easy and inexpensive entry and upgrade path into the ICT workforce. Most courses are free of charge, other are fee-based and require payment for certification. Many big ICT companies provide course material. Thus, the course content is geared towards the current needs in the sector. Nevertheless, online training requires high levels of self-efficacy, which many unemployed or other types of vulnerable target groups lack.

Some training programmes use an approach of online training combined with a second form, for example classroom training or mentorships. Some companies or training providers build their own infrastructure for this. In these programmes, students will have sessions where they are guided through the learning process and then continue their education or training on their own. However, these programmes might not only be more expensive for students but also the initial set-up costs are higher.

Advantages

- Accessibility: Most MOOCs can be accessed from home, and only require simple IT equipment and a good internet connection.
- Flexibility: Learning through online platforms can be more flexible as trainees can access courses and schedule tests based on their own availability and pace of learning. However, this may not be possible if the online training is offered at a training-site and is following a specific schedule.
- Certifications: Courses include but are not limited to content provided by IT vendors, such as Microsoft, IBM, Cisco, AWS, SAP and Oracle. Vendor-specific trainings follow a partnercentric approach in which companies create the curricula delivered by partners.
- Affordability: Most MOOCs are free of charge. However, vendor-specific online training that leads to certification can be costly.

Disadvantages

- **Connectivity:** Online programmes require good online access to the learning platform, which can be a challenge in some parts of a country. In addition, costs for internet provisions can act as barrier.
- Selectivity / prior experience: These programmes, especially if offered free, tend to be more selective when choosing prospective participants. Stricter selection criteria have the risk of excluding those who may have the most to gain from such employability skills.
- Self-efficacy: Since most online trainings are self-paced, they require a high level of self-efficacy from learners.
- High drop-out rate: MOOC completion rates are in single digits across all learners and fields
- Narrow focus: Vendor-specific online programmes tend to be not generic enough to educate on the underlying principles.
 Stakeholders in the sector report that employers increasingly want employees to cross-certify with multiple vendors.
- **Employability:** Online only trainings do not provide direct labour market access and are often not recognised well enough.

Examples

NetAcad for Refugees

Target participants: Refugees, interested students

Financing mechanism: Corporate contributions, collaboration agreements

Description: The NetAcad for Refugees was initiated by the Cisco Networking Academy Programme (CNAP) in 2016. It enables anybody interested, in this instance specifically refugees, to find online courses on the global Cisco Networking Academy platform.

Online courses are available in 16 different languages, including Arabic.They are free of charge and can be completed with an industry certification like CompTIA A+, CCENT, Linux Essentials, C++ Institute and others.

The online courses have also been embedded in qualification offers from NGO partner institutions, such as Asylplus and ReDI School of Digital Integration, Codedoor, CodingSchule and others. Cisco also provides internship offers for successful participants to gain work experience.

Goal/Outcome: Approximately 7,000 learners are currently subscribed, including 3,750 refugees, with a over 200% increase in learners from 2017 to 2018. 20% of learners moved forward to internships, 28% to study programmes, 18% to IT jobs and 8% to entrepreneurship.

Country: Germany

Website: https://www.netacad.com

Empleo Digital

Target participants: Unemployed youth and adults between 18 and 35 years, NEETs and youth at the risk of social excursion

Financing mechanism: Public and private contributions, in-kind donations, collaboration agreements

Description: With the support of the Fundación Telefónica, the programme supports young Spaniards through VET grants, internships and job placements. It provides ICT training on-site and online.

The on-site training offers five-month programmes in digital profiles such as cybersecurity, video game design, big data and data visualization, among others. The teaching methods consist of both traditional and blended learning approaches.

The online training consists of high-quality MOOCS lasting from four to eight weeks in digital profiles such as machine learning, social entrepreneurship, agile project management and digital competencies.

Goal/Outcome: 57,000 learners in online training (2016), and 800 on-site. 61% of learners were recruited into employment, 4% inspired to start own ventures and 4% chose further education pathways. In 2017, 283 companies were partners.

Country: Spain

Website: https://conectaempleoformacion.fundaciontelefonica.com/



Bootcamp refers to a variety of training programmes ranging from several days to months. It covers camps for absolute beginners, intermediate and advanced programmers. Most programmes though have a skill-intensive focus that covers specific areas of a programming language.

A variety of training providers use both, bootcamps and workshops as an inexpensive training method to reach a number of students. Bootcamps can last from a few days to a several months. They are rather skill or project focused and can aim at beginners, intermediate or advanced programmers. Bootcamps are usually complemented by smaller workshops focusing on specific areas or skills, e.g. transversal skills training.

In comparison to university degrees, bootcamps offer a more affordable, less restricted and up-to-date way of gaining experience in a chosen ICT field. Due to their short cycles, they are flexible in content structure and faster to adapt to new industry standards.

Advantages

- Affordability: Bootcamps are an affordable alternative to a four-year university degree, as they require less time to complete and tend to cost less.
- Flexibility: Compared to university programmes, bootcamps are more flexible in terms of curricula and can respond faster to changing market demands.
- Prior experience: Bootcamps are less selective than universities in terms of prior qualifications. Individuals who are interested and do not necessarily have an ICT background can enrol in training bootcamps.

Disadvantages

- **Certifications:** Bootcamps tend to not offer standardised certifications but rather follow a variety of teaching and training techniques.
- Employability: In terms of employability, bootcamp qualifications are typically not well known by employers, i.e. businesses tend to require more traditional technology qualifications or longer work experience in the ICT sector.
- Affordability: In some countries, bootcamp training is perceived as commercial. It is seldom free and state scholarships or similar funding mechanisms, do not cover bootcamp costs.
- Accessibility: It is not a widely adopted method of training, especially in smaller cities and towns.

Examples

Code4Jobs BBK Bootcamp

Target participants: Underprivileged, unemployed, everyone interested

Financing mechanism: Student fees, donations

Description: The BBK Bootcamp is a 12 week intensive training programme, reaching out to unemployed people in the region of Biscay (Basque Country).

It teaches .NET, the currently most demanded programming language in Basque country. The training does not only include technical skills but also develops transversal skills like communication, teamwork, project management.

The programme helps learners to prepare CVs and job interviews, publishes a portfolio on Github and brings them in contact with leading ICT companies.

Goal/Outcome: In two iterations, 40 studentes completed the programme of which more than 80% found employment within three months.

Country: Spain

Website: http://bbkbootcamp.com/

WebForce3

Target participants: Jobseekers, seniors who want to retain or gain employment in the digital sector

Financing mechanism: Student fees, collaborations, public funding

Description: WebForce3 is an intensive training programme in web development, providing fundamental knowledge for quickly finding a job. Their non-profit arm is called PassW.

The training lasts 3.5 months during which students absolve 490 hours of classroom education and about 15 days of group projects. Classroom lectures are delivered by ICT specialists whose day job is in web development. In addition, learners spend time with a dedicated online Learning Management System called WF3. WF3 offers auto-evaluation and a training space for every student, as well as access to a professional network to find job opportunities.

WebForce3 is accredited by the government to deliver three certifications, for Front-end developer, Back-end developer and Full-stack developer for web & mobile.

Goal/Outcome: Thus far, 1,800 learners have completed the training. 98% have completed the full training course and 95% have obtained certification. Within 3-6 month, 89% have found employment.

Country: France

Website: http://www.wf3.fr/



Workshop refers to short, intensive trainings focusing on a specific topic or skill. The training consists of presentations and interactive peer-to-peer sessions.

Workshops can be specified as mini bootcamps, usually lasting one to three days. Workshops are for a more experienced audience than bootcamps are, as they focus on specific issues, topics, or skills. They are less wide in scope but broader in terms of target audience.

Workshops are put to good use for continuing education to enhance existing skills and for career transitions, to quickly learn new skills in a related field. Many employers offer specific training leave and sometimes even provide budgets for workshop participation.

Advantages

- Flexibility: Due to their structure, workshops are flexible in terms of their content, and can easily be adjusted to new demands and industry standards.
- Affordability: Workshops are quick to set up, only last a few days and often require only one tutor or peer-to-peer teaching.
- Job integration: Next to online training, the most common way for continuing education and on-the-job training. Employers may pay for workshop participation

Disadvantages

- **Certifications:** Workshops tend to not offer standardized certifications but rather focus on a specific issue.
- Prior experience: Workshops are more selective than bootcamps in terms of prior qualifications as they focus on specific issues and skills and therefore require prior knowledge.
- Accessibility: Smaller cities and towns are left behind on this approach as most workshops take place in big cities at IT vendor sites or training facilities.

Examples

ReDi School

Target participants: Refugees and women from disadvantaged or immigrant backgrounds

Financing mechanism: Corporate funding and partnerships, foreseen model of training vouchers from the federal employment agency.

Description: ReDI offers three-month IT programmes consisting of workshops and corporate training projects, as well as summer courses. It also runs courses from Cisco's Networking Academy.

The idea of the School was sparked by a conversation which took place in 2015 at a refugee home in Berlin. Among the newcomers in the recent refugee wave in Germany, there were incredible IT-talents eager to learn, who were willing to contribute to Germany's society and help fill the shortage of IT workers.

Goal/Outcome: Almost 900 learners have completed the training (since 2016), with 62% continuing into paid jobs or internships. 6% of learners have started own ventures and 17% continued into further education at university. Currently (September 2018) 500 students are in training with a share of 40% women.

Country: Germany

Website: https://www.redi-school.org/

BBC Make it Digital

Target participants: Unemployed youth between 16-24 years and who have fewer than 2 A Levels

Financing mechanism: Public funding

Description: The programme aims to grow basic level digital skills and prepare trainees for employment or progression into apprenticeships. The BBC Academy works in partnership with training providers and job centres to deliver training and placements into internships and apprenticeships.

The curriculum is developed by the BBC Academy and involves major brands to help inspire trainees. The programme is an eight week long course, including workshops on social media and content creation, employability skills, budgeting, basic project management and team work.

The final stage of the traineeship is a three week structured work placement with a focus on companies who are likely to require basic-level digital skills.

Goal/Outcome: The programme attracts around 4,000 learners per year to participate nationwide, 70% of which secured an ICT-related job directly after completion.

Country: UK

Website: https://www.bbc.co.uk/makeitdigital



Experiential refers to trainings that use a combined approach of classroom teaching and company placements. The most prominent examples of experiential training are apprenticeships. This taxonomy offers a good balance of educational and practical experience.

Training on experiential training varies between a few weeks to several years. Training curricula are designed to reflect the demands of employers. Depending on country, they can be either very flexible or inflexible.

Advantages

- **Certification:** Depending on the programme, a trainee may or may not receive a certification. However, the number of hours worked are recognised as formal work experience.
- Employability: Internships and workplace learning programmes have high added value for trainees as they learn both technical skills and transversal skills, and get in touch with employers who may want to offer them a job after completion.
- Industry demand driven: As employers are involved in the training, such programmes are structured according to their demands and they benefit from the 'right' skills. This is a major success factor of experiential training programmes, especially those developed with the help of business-education partnerships.

Disadvantages

- **Prior experience:** Trainees have to be enrolled in a training programme to be placed into an internship. Few training programmes guarantee an internship for all participants, and places might be limited. Training programmes that offer compulsory work experience tend to be more selective in terms of prospective participants.
- Affordability: It is challenging for training providers to find employers who are willing to train and hire interns because of the resource burden on employers. Usually, experiential trainings are offered by well-reputed training programmes with a vast network of partners.

Examples

Simplon.co

Target participants: Unemployed job seekers, 30% of whom should be women, also NEET youth, refugees, seniors, people with disabilities

Financing mechanism: Public funding, corporate contributions, private donations

Description: The various educational programmes in the Simplon.co schools offer courses in coding and programming (e.g. web development and Java). Most courses last 6.5 months and can be finished with a certificate. Emphasis is also put on developing transversal skills like curiosity, creativity, selflearning, leadership and self-esteem.

The training programmes are designed as dual programmes: Participants spend part of their week in a work placement and the other part of the week in the classroom. In some training programmes, internships play an integral role.

Goal/Outcome: 2,056 learners completed the training until 2018. Currently 691 are in training. 77% of learners successfully completed the programme of which 78% were recruited after completion, 22% continued in further education, 16% inspired to start new ventures. Simplon.co has created 34 active schools in France, Belgium and Lebanon.

Country: France

Website: https://simplon.co/

Fast Track to IT (FIT)

Target participants: Long term unemployed, people with disabilities, migrants, senior citizens

Financing mechanism: Corporate contributions, project based public funding

Description: FIT works in close collaboration with IT industry partners and the Irish government to provide training courses and work placement services to the unemployed. FIT courses are tailored to the ICT sector and range from beginner to expert levels.

The programme consists of a 6-month college-based training and 18-month work-based learning. Teaching content is developed with ICT industry, and partners in education and training.

FIT also offers dual apprenticeship and industry-certificate courses.

Goal/Outcome: Thus far, 18,000 learners completed the programme with 72% proceeding into employment or further education.

Country: Ireland

Website: https://fit.ie/



Mentorship does not refer to a stand-alone training type, it is usually integrated with other taxonomies, especially experiential training. A trainee is appointed a mentor, i.e. an experienced instructor or employee. Mentors help guide and motivate students.

Mentorships are an integrated part of other taxonomies such as experiential, bootcamp or workshop, therefore duration ranges from a few days to several months. On the one hand, mentors provide a financial value to training programmes as they often work on a voluntary basis, on the other hand, students benefit from their individual guidance and motivation.

Advantages

- Affordability: Mentors often work on a voluntary basis.
- Motivation and support: Mentors often work based on intrinsic motivation to help students. Mentors often want help to overcome and remove obstacles they perceived themselves during their career.

Disadvantages

- Voluntariness: Since most mentors work on a voluntary basis, their impact highly depends on individual skills and motivation.
- Selectivity / prior experience: These programmes, especially if offered free, tend to be more selective when choosing prospective participants. Stricter selection criteria have the risk of excluding those who may have the most to gain from such employability skills.

Examples

IT for SHE

Target participants: Women

Financing mechanisms: Corporate contributions

Description: IT for SHE is a programme by the "Perspektywy" education foundation, an NGO led by personalities from Polish universities and other public figures. It aims to increase participation of women in the ICT workforce by providing support to female ICT students.

IT for SHE runs three main actions with a specific focus on mentoring girls: The mentoring programme for female ICT students focuses on finding and developing students' potential via a six-month partnership between a selected experienced ICT specialist and a student. It uses inspiration and counselling based on the mentor's knowledge, life and professional experience. About 40 mentors, all of which currently working as ICT specialist in companies across Poland, work as volunteers for the programme. Students are invited to apply to one of the mentors based on the latter's' profile posted on the web.

Goal/Outcome: Women in Tech Camp: The camp brings together about 130 female ICT students to discuss and study latest developments in advanced programming, participate in hackathons and meet top class mentors.

Volunteering programme: 50 volunteer female students from IT departments are sent to small towns to teach programming and tech knowledge at schools to youngsters.

Over 1,000 women participated at the Women in Tech Summit 2018.

Country: Poland

Website: http://www.itforshe.pl/en/

JOBLINGE goes MINT

Target participants: Unemployed young people aged between 16 and 25 years; young people from socio-economically disadvantaged background or those facing difficulties due to an immigrant background.

Financing mechanism: Public funding, donations, corporate contributions

Description: The programme aims to integrate young people at the risk of social excursion into the STEM sector. Through six-month training, participants can qualify for an internship or a job at one of the partner companies.

The programme uses interactive forms of learning, including specific sub-workshops on STEM and recruiting, focusing on introducing participants to work place environments.

Goal/Outcome: Since 2015, a total of 2,230 learners have participated in the STEM programme, 1,030 in 2018. 73% of the learners were placed into further (vocational) education and training or jobs, 1,120 internships were secured for learners. 60% of the participants are young people from a vulnerable background, more than 70% depend on social welfare, and 60% only have a lower secondary school diploma, including some with no normal education as well.

So far, 229 companies joined the programme as new STEM partners.

Country: Germany

Website: https://www.joblinge.de/

Summary chart of tech training taxonomy

Traditional Education and Training / Apprentic		raining / Apprenticeships	
Advantages:	Challenges:	Advantages:	Challenges:
 Recognised credentials 	Sometimes outdated curricula	 Building specific skills Exposure to target 	 Bad image, unattractive
Broad skills developmentDepending on	Significant time and financial investmentsConnection to job	groupsCloser to industry demands	 Employer burden Employer specific training
country: publicly funded	marketDifficult entry	 Easier entry Direct connection to job market 	Requires specific mindset of employers

Lifelong Learning		Industry-led Training	
 Advantages: Flexible, often online Improvement of existing skills 	 Challenges: Specific target groups Requires prior knowledge Question of funding, employer or employee 	 Advantages: Flexible, often online Improvement of existing skills Inexpensive for providers 	 Challenges: Specific target groups Requires prior knowledge Question of funding, employer or employee

	1. Sec.			
Career Transition	/ Conversion	Programmes	/ Lateral Er	trv

Advantages:

- Development of new skills
- Open to diverse population

Challenges:

- Funding
- Can require prior knowledge



Part 4 Policy

Developing the key priorities for inclusive ICT policies and addressing the issue of ICT training, job placement and sustainable labour market integration for a diverse tech workforce will require more and bold as well as coordinated and joint action. Governments in the countries under review have announced and launched different types of policy strategies to address these challenges. Many have only been launched recently (e.g. the UK Digital Strategy 2017 which aims at enabling a more diverse digital workforce and has starting in 2018 resulted in activities to establish new Digital Skills Partnerships (DSP) and local digital skills partnerships (LDSP)). Others have been announced for the near future (e.g. German government announcement of a new law on the immigration of skilled workers before the end of the year 2018).

Several of these policy strategies are associated to funding programmes (national as well as European ones) which offer more or less clear opportunities for funding specific activities in the area of inclusive ICT training for the creation of a more diverse workforce. These policy programmes set the policy framework (and nothing more) for things to happen. More detailed policy information can be found in the country briefs (Part 5).

France

Policy addressing gender equality in the digital workforce, diversity and inclusion in education, as well as structural reforms to the VET system are recent (2017).

Germany

In Germany, much of the policy addresses general labour, industry and work. A new digital strategy was introduced in 2016 together with a digitisation council (2018).

Ireland

Most of Ireland's strategies are running until 2020 to 2025 and address ICT skills, the further education and training system, as well as better integration for girls and women.

Poland

The Polish Government created a dedicated Ministry of Digitisation in 2015 focusing on the provision of digital literacy. Additional programmes also focus on ICT skills development.

South Africa

South Africa's focus lies on the development of ICT and broadband infrastructure while also focusing on the ICT user and specialist skills.

Spain

In recent years, Spain's strategies primarily faced youth unemployment. Since 2017, a new digital strategy was introduced to also focus on improving ICT skills of the Spanish workforce.

United Kingdom

Since 2017, UK has launched many new strategies and programmes to address the ICT specialist shortage, both on national and regional level.

Policy responses - key priorities for inclusive ICT skills policies

Policy developers need to bear in mind that "focusing on diversity and inclusion is crucial to overcome the fractures and inequalities of our age"²⁸. Moreover, "diversity is a crucial leverage for innovation".²⁹ Developing the key priorities for inclusive ICT policies and addressing the issue of ICT training, job placement and sustainable labour market integration for a diverse tech workforce will require more and bold as well as coordinated and joint action. This needs to be taken up by policy makers, education and training institutions and providers, businesses and industry, together with NGOs, trade unions, charities, foundations and – depending on the (national) context - further players active in this field.

A prerequisite for success is the existence of supportive framework conditions such as targeted and focussed policy strategies at national level but also at European level and an appropriate stakeholder eco-system, both, needed to build a diverse tech workforce at a much larger scale than at present. Governments in the countries under review have announced and launched different types of policy strategies to address these challenges (e.g. the red.es Strategy 2017-2020 but also different policies that aim to fight youth unemployment or the Digital Strategy 2025 in Germany). Some have only been launched recently (e.g. the UK Digital Strategy 2017 which aims at enabling a more diverse digital workforce and has, starting in 2018, resulted in activities to establish new Digital Skills Partnerships (DSP) and local digital skills partnerships (LDSP)). Others have released new laws (e.g. German government announcement of a new law on the immigration of skilled workers). In **France** policy is addressing gender equality in the digital workforce, diversity and inclusion in education, as well as structural reforms to the VET system. In **Germany**, much of the policy addresses the general labour market, industry and

work. A new digital strategy was introduced in 2016 together with a digitisation council (2018). Most of **Ireland's** strategies are running until 2020 to 2025 and address ICT skills, the further education and training system, as well as better integration for girls and women. In **Poland** the Government created a dedicated Ministry of Digitisation in 2015 focusing on the provision of digital literacy. Additional programmes also focus on ICT skills development. The focus in **South Africa** lies on the development of ICT and broadband infrastructure while also focusing on the ICT user and specialist skills. In recent years, **Spain's** strategies primarily faced youth unemployment. Since 2017, a new digital strategy was introduced to also focus on improving ICT skills of the Spanish workforce. Since 2017, the **UK** has launched many new strategies and programmes to address the ICT specialist shortage, both on national and regional level.

Several of these policy strategies are associated to funding programmes (national as well as European ones) which offer more or less clear opportunities for funding specific activities in the area of inclusive ICT training for the creation of a more diverse workforce. These policy programmes set the policy framework (and nothing more) for things to happen.

Addressing the challenges arising from the ambition for a more diverse tech workforce through related inclusive ICT programmes at a large scale will require action to be taken at different levels (European, national, regional, local) and in different areas (curricula / programme co-creation, operation quality labeling, certification etc.).

European Commission

The European Commission has started a number of activities in the area of ICT skills development and training and diversity. The most relevant and recent ones are described below.

Women in Digital: This activity launched by the European Commission at the Digital4Her conference in June 2018 includes a larger number of actions as part of a Commission strategy that will facilitate an increase in the participation of women in the digital sector. The actions will focus on three main areas: challenging stereotypes, promoting digital skills and education and advocating for more women entrepreneurs. Actions related to these focal points are to be implemented in the course of the next two years.³⁰

The Digital Skills and Jobs Coalition (DSJC): The Digital Skills and Jobs Coalition brings together Member States, companies, social partners, non-profit organisations and education providers, who take action to tackle the lack of digital and ICT skills in Europe. Actions range from training unemployed people, giving MOOCs for teachers, offering coding classes for children or cutting-edge training for ICT specialists. The Coalition also shares and promotes digital and ICT skills initiatives through the European Digital Skills Awards which can be replicated and scaled up across Europe. Each year the European Commission highlights excellent initiatives that help improve the digital skills of citizens, the labour force, ICT professionals, girls and women as well as in education through the European Digital Skills Awards. The Digital Opportunity traineeships scheme - which started in 2018 - is a pilot project giving students and recent graduates an opportunity to get hands-on training in digital fields such as cybersecurity, artificial intelligence, coding or digital marketing. Member States can support collaboration between the different actors in their country on developing digital skills by bringing them together in national coalitions. The Digital Skills and Jobs Coalition has established a <u>Governing Board</u> which provides strategic leadership and gives high-level advice to improve the functioning and the impact of the Coalition as well as monitoring its overall progress. The Governing Board advocates the views of the Coalition partners at European level, and acts as a link between pledgers, national Coalitions and social partners.³¹

Skills Agenda for Europe: On 10 June 2016 the European Commission adopted a new Skills Agenda for Europe. The agenda aims to make sure that people develop the skills necessary for the jobs of today and tomorrow. In the Skills Agenda for Europe the Commission asked all Member States to develop <u>national digital skills strategies</u> by mid-2017 and to set up <u>national coalitions</u> to support their implementation. To support the development of national strategies, a group composed of Member State experts has put together a menu of challenges to be addressed and potential actions that could form part of a digital skills strategy – the so-called "shared concept".³²

Part 5 Country Briefs

Concise country reports for all seven countries. These reports include the key composition of the workforce, a brief description and the baseline projection scenario of ICT workers demand and supply for each country's labour market until 2025.

The country reports continue highlight each country's diversity situation and the specific policies targeting it. A third focus is also on the identified initiatives that offer ICT skills training programmes for the target groups. The reports include an overview of the share of target groups and stakeholders involved in inclusive ICT training.

Country Brief: France

Table 3 Key figures at a glance – France	FR	Rank in EU28
ICT workforce	906,000	3
As % of domestic workforce	3.4%	16
% female	16.6%	12
Estimated annual replacement need	79,600	
Latest vacancy figures	39,600	
Vocational graduates	0	28
Tertiary graduates (only first degrees)	12,500	4
Projected jobs potential until 2025 (8 years)	725,000	
Of which expansion	476,000	
% of enterprises that employ ICT specialists	16%	24
% of enterprises providing training for ICT specialists	9%	20
% of ICT specialists with tertiary education	79%	4

Source: Eurostat (2015)

In France, the ICT specialist workforce accounts for 906,000 workers In absolute terms, this is the third largest headcount of ICT workforce in Europe, comprising 18% of Europe's ICT practitioners. A closer look at the data reveals that France has a slightly higher than average share of the highest skilled ICT workers than the European average. In relative terms, the share of ICT specialists in France's total domestic workforce puts the country at rank 16th in the EU28.

Jobs with the highest percentage growth rates are system administrators (+69% p.a.), information technology trainers (+53%), and software and application developers (+38%). These jobs typically require high level skills and academic education. Other growing ICT jobs in France also include some that do not usually require an academic education³³, such as ICT user support technicians (+17%). Across all jobs, 68% of companies indicate difficulties finding candidates that fit their requirements for ICT specialists.³⁴





Source: empirica (2017)

Diversity

France faces considerable challenges in tackling youth unemployment. The rate of youth unemployment is 24.6%, almost 6 percentage points (p.p.) higher than the EU average. Large numbers of young people (11.9%) are neither in education nor in employment and training (NEET), often a result of bad performance in secondary school. Socio-economic background is one of the main determinants of the likelihood of finding quality employment. This is conflated with the difficulties of the labour market to integrate non-natives born outside of the EU: the gap between the employment rate of non-natives and persons born in the country is significantly larger than the EU average.

In terms of gender equality, France can boast of one of the smallest employment gender gaps in Europe outside of the Nordic countries (6.7 p.p.). Unfortunately, this is not reflected in a high share of women working in digital occupations. While the overall female share in the workforce is 48%, in digital sector jobs it is 27%, and even worse when considering ICT specialists with only 16%.^{35,36} The number of women in the ICT workforce is threatening to remain low, not only because few women are graduates from subjects relevant for these sectors (10.8%) but also for another reason: The turnover for women in the ICT workforce is high. The 2017 Gender Scan study showed that graduates of STEM (Science, Technology, Engineering, and Mathematics) display the highest turnover in Europe: 40% of women graduates leave the STEM workforce after only 10 to 15 years of professional life.³⁷

Policy

In an effort to clarify the country's digital policy, the Government has adopted, in February 2013, a **Roadmap on Digital Policy**³⁸ defining three pillars: (1) Opening opportunities for the youth, (2) Reinforcing the competitiveness of firms and (3) Promoting values. Some of the measures taken under the first and third pillar target development of e-skills and ICT training programmes to support diverse populations to enter the labour market:

- In 2013, the Ministry of Higher Education and Research launched the "France Université Numérique³⁹" (FUN). FUN is a platform through which MOOCs from a large number of French universities and other established education providers have been made accessible.
- The "jobs for the future"⁴⁰ programme, designed to provide training to young persons with low or no qualification, has been complemented by tailored schemes to train for specific digital jobs, such as web developer, archivist or digitalisation operator.
- Measures to promote digital literacy have also includes several ICT training programmes which issue certificates, such as C2i, to low- qualified and unemployed people. The aims are to boost job search strategies and to develop continuing education in the digital sector.

One of the outcomes of the Roadmap on Digital Policy was the **Grande École du Numérique**, a multistakeholder partnership launched by the Ministry of Labour and Employment. A new digital strategy (**"For a Digital Republic**") was adopted by the French National Assembly in January 2016. It is based on an open call for participation to anybody interested in the area, launched by the French Digital Council (CNNum) in October 2014. The action plan includes measures for the support of diverse populations to enter the labour market.

Gender equality in the digital workforce has been addressed be the inter-ministerial **Sector Plan for Diversity in the Digital Professions**⁴¹ (2017). It appeals to women during the vocational orientation phase, aims to raise awareness among employers for the business case for diversity and encourages them to train and recruit more women.

The government's **education policy** has seen a number of attempts at reform that are of special relevance for diversity and inclusiveness, also of ICT training. The latest round of reforms has addressed upper secondary and tertiary education in a mutually complementary manner.

The 2017 **Law on Equality and Citizenship** takes important steps towards recognition of skills obtained outside of formal education.

An ambitious **VET reform** was launched in 2017, the impact of which will become visible over the coming years. The reform includes an overhaul of the **apprenticeship** system, giving employers (in co-operation with unions) full control over the definition of qualifications and the design of training measures.

Inclusive ICT training

Out of 29 identified initiatives that offer ICT skills training programmes for the target groups, 21 were deemed relevant to the issue of inclusive ICT training. These programmes were specifically targeted towards disadvantaged socio-economic groups such as persons at risk of long-term unemployment and youths not in employment or education and training (NEET). Another frequent focus was on women. Figures 5 and 6 show a further breakdown of these programmes in terms of target groups addressed and stakeholders involved in inclusive ICT training in France. The stakeholders involved in inclusive ICT training are predominantly training providers, and industry (IT and other).



Figure 20 Share of target groups in inclusive ICT training in France, % of programmes surveyed



Figure 21 Share of stakeholders in inclusive ICT training in France, % of programmes surveyed

Source: diversITy Survey, empirica (2017)

Source: diversITy Survey, empirica (2017)

Country Brief: Germany

Table 4 Key figures at a glance – Germany	DE	Rank in EU 28
ICT workforce	1.5 M	2
As % of domestic workforce	3.6%	11
% female	16.3%	14
Estimated annual replacement need	54,100	
Latest vacancy figures	72,200	
Vocational graduates	12,900	3
Tertiary graduates (only first degrees)	15,800	2
Projected jobs potential until 2025 (8 years)	828,000	
Of which expansion	395,000	
% of enterprises that employ ICT specialists	22%	14
% of enterprises providing training for ICT specialists	12	12
% of ICT specialists with tertiary education	49	27

Source: Eurostat (2015)

In Germany, the ICT specialist workforce accounts for 1.5 million workers, or 3.6 percent of the workforce. In absolute terms, this is the second largest headcount of ICT workforce in Europe, accounting for 18 percent of Europe's ICT specialists. In relative terms Germany ranks 11th among the other EU members.

For the past years, software developers, database designers and administrators, and systems administrators had the highest number of reported vacancies. Vacancies with an increasing trend include ICT user support technicians, and ICT installers, servicers and systems administrators. The highest amount of vacant ICT jobs can be found among high skilled positions, requiring academic degrees. At the same time, the fastest growing occupations are in the mid and low-level skill positions, requiring VET education, apprenticeships or ICT training.



Source: empirica (2017)

Diversity

While Germany shines in long-term unemployment rates (1.7%), NEET share (6.7%) share of youth unemployment (7.1%) and employment rate of older workers (68.8%), its gender employment rate gap, non-native employment rate gap and disability employment gap are less impressive (7.6; 10.6; and 20.6 p.p.).

Especially migrants and refugees face challenges in Germany: An increase in the employment gap between foreign- and native-born Germans between 2005 and 2016 is noticeable.⁴² Foreign-born youth are also over-represented in NEET rates, with a native-born NEET share at around 5% and foreign-born share at 16%. Educational differences are imminent.⁴³ Figures on labour market participation show a 5.5% unemployment rate for natives compared to 34.8% unemployment rate among those with migration background.⁴⁴

Women are underrepresented in STEM fields in education. They are underrepresented in dual vocational training and additionally concentrated in fewer technical occupations.⁴⁵ While predominantly men choose training programmes for ICT specialists, less than 8% of women do so. In computer science fields alone, the share of women graduates is 14.5 percent. Compared to that, the overall female share of graduates in science, mathematics and computing is 38.3 percent in Germany.

Policy

General policies include those on industry and labour, **Industry 4.0⁴⁶** and **Work 4.0⁴⁷**, highlighting the challenges of rapid digitalisation in industry and the integration of low-skilled workers, immigrants, and people with disabilities into the respective industry 4.0 workforce.

In August 2018 the German government established a new **digitisation council** ('Digitalisierungsrat') as a strategic advisory board for the government to advice on this topic.

In 2016, the **Digital Strategy 2025** was introduced. It addresses the development of digital infrastructure, fostering innovation and trade, and support to digital transformation for German businesses. The strategy's education proposal aims at changes to the educational system, a better integration of ICT elements, and a better connectivity to the labour market for graduates.

The integration of refugees into training and jobs has been a priority issue for the German government. Here, Germany cooperates with the ESF, e.g. the **ESF-BAMF 'German for Professional Purposes'** programme targets language training and skill building for immigrants in Mathematics and ICT.

One example of a federal-level programme targeting vocation education for migrants and refugees is **Coordination Center for Training and Migration** *(Koordinierungsstelle Ausbildung und Migration, KAUSA)*. The programme promotes and supports dual training in companies for persons with a migrant background and cooperates with a network of participating institutions and employers. Next to this, many states (Länder) launched their own programmes to tackle refugee employment.

The initiative **Women in STEM Occupations** (*Frauen in MINT-Berufen*) was launched by the Ministry of Economy, Labour and Housing of Baden-Württemberg (Ministerium für Wirtschaft, Arbeit und Wohnungsbau) in 2010. The programme promoted careers in STEM for women with the support of a network of partners in private enterprises, education and training institutions and employment agencies.

Various programmes promoting women workers in STEM fields are supported by the Ministry of Education and Training; one example is the programme **Come, make STEM** (*Komm, mach MINT*), *a* nationwide networking initiative that inspires girls and women in STEM programs and careers.

Other national programmes include:

- The Girls' Day initative48 launched by the Ministry of Education and Research, German Trade Union Confederation (Deutscher Gewerkschaftsbund) and the Initiative D21. For one day, girls can gain insights into the everyday life of the companies or universities and test their skills practically.
- Cliché Free (Klischeefrei)49 was launched by the Ministry of Education and Research and the Ministry (Bundesministerium für Familie, Senioren, Frauen und Jugend). The aim is to help young people choose jobs or studies without being influenced by gender roles.
- CyberMentor50: This is an initiative by the University of Regensburg and the Friedrich-Alexander University of Erlangen-Nuremberg. Up to 800 girls in grades 5 to 12 are supported by a personal mentor for one year.

Inclusive ICT Training

Out of 66 identified initiatives that offer ICT skills training programmes for the target groups, 38 were deemed relevant to the issue of inclusive ICT training. Figure 8 and 9 show a further breakdown of these programmes in terms of target groups addressed and stakeholders involved. Inclusive ICT training in Germany focuses primarily on refugees and women. The main stakeholders involved are non-profit organisations, public sector entities and IT vendors.





Source: diversITy Survey, empirica (2017)



Figure 24 Share of stakeholders in inclusive ICT training in Germany, % of total programmes surveyed

Source: diversITy Survey, empirica (2017)

Country Brief: Ireland

Table 5 Key figures at a glance – Ireland	IE	Rank in EU 28
ICT workforce	79,900	18
As % of domestic workforce	4.1%	9
% female	18.9%	7
Estimated annual replacement need	2,600	
Latest vacancy figures	5,000	
Vocational graduates	0	
Tertiary graduates (only first degrees)	3,000	
Projected jobs potential until 2025 (8 years)	30,800	
Of which expansion	9,300	
% of enterprises that employ ICT specialists	35%	1
% of enterprises providing training for ICT specialists	13%	6
% of ICT specialists with tertiary education	82%	1

Source: Eurostat (2015)

The Irish ICT workforce accounts for about 80,000 workers, or 4.1% of the total workforce – which is above the European average. In absolute terms, Ireland ranks 18th among the EU members, while relatively it ranks 9th.

Since 2011, the number of ICT workers has slightly increased in the country, with most of the growth coming from the categories "ICT operations" and "user support technicians". These job types usually require low to mid level skills, typically gained by VET education, apprenticeships or ICT training. According to the latest available data, the ICT sector has the highest vacancy rate of all sectors in Ireland⁵¹. 35% of all difficult to fill vacancies in October 2016 were in the ICT sector, primarily for professional roles, requiring academic degrees, in software development, followed by engineers, systems/solutions architects; business intelligence; tech support and sales; and digital commerce managers.

At the same time, a FIT investigation found that 21% of current vacancies require skills at entry level, 37% at competent level, and 42% at expert level⁵².





Source: empirica (2017)

Diversity

Although Ireland's labour market has recovered well from the latest recession, several groups still face serious challenges in finding employment. Long-term unemployment still affects more than 10,000 persons aged below 25, a figure that has been particularly slow to decline.⁵³ Youth unemployment stands at 16.8%, somewhat better than the EU average (18.7%). However, the share of young people not in employment, education or training (NEET) is well above EU average (13% vs. 11.6%).

While the recent inflow of high-skilled migrants from within and outside of the EU has boosted the share of nonnatives in the workforce to 5.3 %, which is still low, the country finds it even harder than most other EU countries to provide people with disabilities with employment (31.1 p.p. employment gap). In the ICT sector, foreign-born workers from outside of the EU make up 9.6% of the workforce.⁵⁴

Ireland's gender gap in employment is 10.7%, roughly the same than the EU average but particularly the digital workforce suffers from structural under-representation of women. According to data from the national statistical institute CSO, only 31% of those working in Ireland's ICT industries were women in 2016, against a figure of 46% across all sectors.⁵⁵ Only 21% of all third-level ICT graduates were women in 2016, against 52% across all fields of study. Next to this, retaining women in the ICT workforce poses another problem, as 41% leave the sector after 10 years of experience.⁵⁶

Policy

Most of Ireland's policy approach is based on the Action Plan for Jobs, launched in 2012, a major government initiative for job creation. The recent editions of the action plan have also put stronger focus on inclusiveness and equality. One current focus is on reskilling and upskilling jobseekers for ICT jobs and on offering ICT training for the long term unemployed.

In 2015-2016, eight **Regional Action Plans for Jobs** have been launched to accommodate for the need to coordinate and design policy action in the employment domain on local and regional level. A new **Regional Enterprise Development Fund** has been set up to support the development and implementation of collaborative and innovative projects, many of which have a focus on persons at risk of exclusion from quality employment. In this regard, a key component of the Action Plan for Jobs is Ireland's National Skills **Strategy 2025**, which is implemented by the Department of Education and Skills. Its objectives include a specific focus on active inclusion to support the participation of underrepresented groups in education and training and the labour market.

Another approach was launched in 2015, the **Enterprise 2025** strategy, highlighting the importance of training in relevant skills, especially for the unemployed, and the ICT sector.

The **ICT Action Plan** from 2012 featured key targets including doubling the number of ICT graduates from undergraduate programmes until 2018. It was updated in 2014 as the **ICT Skills Action Plan 2014-2018**, featuring a target to domestically produce 74% of the forecast industry demand for high-level ICT skills.

The **Further Education and Training Strategy 2014-2019** features a strong emphasis on the FET system's capability to produce the skills demanded by the economy, as well as active inclusion and quality provision.

The FET Strategy's Strategic Objective of implementing a new apprenticeship system was further specified in the 2016 Action Plan to Expand Apprenticeship and Traineeship in Ireland 2016-2020. Two ICT apprenticeships were newly developed in response to industry demand for software development skills.

The **National Strategy for Women and Girls 2017-2020** by the Department of Justice and Equality aims at better integration of girls and women into STEM education and employment.

The National Disability Inclusion Strategy 2017-2021 and the Comprehensive Employment Strategy for People with Disabilities 201-2024 tackle the inclusion and employment of people with disabilities. One of the objectives is to empower people with disabilities to enrol in third level education. Others aim to build skills, capacity, and independence; provide bridges and supports into work; make work pay; promote job retention and re-entry to work; provide co-ordinate and seamless support; and engage employers. The strategy does explicitly refer to STEM-related jobs.

Immigrants, in particular those from non-EU countries, are the subject of the **Migrant Integration Strategy** (2017-2020), to ensure that needs in relation to skills acquisition and labour market activation are addressed.

Inclusive ICT Training

Out of 92 identified initiatives that offer ICT skills training programmes for the target groups, 63 were deemed relevant to the issue of inclusive ICT training. The main target group for these programmes was unemployed job seekers. However, this also includes underrepresented groups such as women and disadvantaged socio-economic groups such as NEETs. Figures 11 and 12 show a further breakdown of these programmes in terms of target groups addressed and stakeholders involved in inclusive ICT training in Ireland. The main stakeholders involved in inclusive ICT training are the government, training providers, and IT vendors.



Figure 26 Ireland - Share of target groups in inclusive ICT training in Ireland, % of programmes surveyed

Source: Source: diversITy Survey, empirica (2017)



Figure 27 Share of stakeholders in inclusive ICT training in Ireland, % of total programmes surveyed

Source: Source: diversITy Survey, empirica (2017)

Country Brief: Poland

Table 6 Key figures at a glance – Poland	PL	Rank in EU 28
ICT workforce	424,000	6
As % of domestic workforce	2.6%	24
% female	13.5%	22
Estimated annual replacement need	10,600	
Latest vacancy figures	40,000 - 50,000	
Vocational graduates	20,400	2
Tertiary graduates (only first degrees)	11,800	5
Projected jobs potential until 2025 (8 years)	246,000	
Of which expansion	161,000	
% of enterprises that employ ICT specialists	12%	27
% of enterprises providing training for ICT specialists	5%	25
% of ICT specialists with tertiary education	70%	8

Source: Eurostat (2015)

The Polish ICT workforce accounts for about 424,000 workers, or 2.6% of the total workforce. In absolute terms, this is the sixth largest headcount of ICT workers in Europe and the largest in Eastern Europe. Between 2011 and 2015, the number of ICT workers has grown significantly, with most of the growth coming from software developers & analysts and applications programmers.

The strongest growth rates can be found among ICT occupations that require an academic degree, such as telecommunications engineer (+28% p.a.), software and applications developer and analyst (+24%), and system analysts (+21%). At the same time, 70% of polish ICT specialists hold an academic degree and Poland is the only country that is producing a greater supply than demand in ICT workers. Large numbers of ICT graduates leave Poland every year for countries in which pay levels are higher, such as Germany, the UK and the USA



Figure 28 Baseline projection scenario for Poland's ICT labour market from 2017 – 2025

Source: empirica (2017)

Diversity

Poland's swift economic recovery after the latest recession has led to figures comparable to EU average concerning the rates of youth unemployment (17.7%), long-term unemployment (2.2%) and NEETs (10.5%) comparable to EU average.

Since Poland has one of the lowest shares of non-native inhabitants born outside of the EU in all of Europe (1.1%), the employment gap between natives and people born abroad (1.5%) is negligible and of little relevance due. In contrast, the country's disability employment gap is huge (30%), putting Poland at rank 21 among EU28 countries.

Poland's gender employment rate gap is at 12.9%, higher than the EU28 average (10.5%), which puts the country at rank 22 among the EU28. In addition, the share of women in Poland's ICT workforce is relatively small with 13.5%, against an average of 16.1% in the EU28.

Policy

The main strategic document guiding government policy in Poland is the **Responsible Development Strategy by 2020** (including outlook for 2030) from 2017. The Strategy provides for the introduction of changes in the system of education, and in vocational education and training and higher education in particular. It addresses the challenges of youth unemployment and persons outside of both education and the labour market.

Actions to support the employment of young NEET as well as the long-term unemployed are also part of the **2017/2018 National Reform Programme (NRP)**, which includes implementation of the EU's **Youth Guarantee** programme.

In December 2016, the Ministry of National Education introduced structural reform influencing the structure, length and progression routes within the education and training system (Law on School Education). One of its main aims is promoting employers' co-operation with schools, especially to organise practical training in real working conditions. Changes to the VET system and curricula are in the process of adoption.

The Polish Government created a dedicated **Ministry** of Digitisation⁵⁷ in 2015. It aims to develop a highquality ICT infrastructure by particularly focusing on the development of e-services in public administration and the provision of digital literacy among students at school. Social inclusion is also on the ministry's agenda. In July 2013, Poland became the first EU Member State to launch a **Broad Agreement for Digital Skills**.⁵⁸, a national response to the European Commission's Grand Coalition for Digital Jobs⁵⁹. The Polish Government invites major national stakeholders in eskills to join the Agreement. One of the first signatories has been the Polish Information Processing Society (PIPS), the association of ICT professionals. Polish universities, associations and major ICT companies including UPC Poland, Microsoft and Cisco Systems have joined as well.⁶⁰

The Government also planned to appoint an ICT Sectoral Skills Council by 2016 but this has not yet materialised. $^{\rm 61}$

National programmes covering inclusive ICT training programmes in Poland are mainly organised in the context of the so-called **Operational Programmes (OPs)** for using European Structural Funds. Two national Ops are relevant: **OP Knowledge, Education and Development** aiming to improve quality and efficiency of the higher education system. Target groups include NEETs and people with disabilities. **OP Digital Poland** focuses explicitly on ICT specialist skills, also related to social inclusion.

The **National Programme for Equal Treatment** (*Krajowy Program na Rzecz Równego Traktowania*) was approved in 2013 and ran for three years. It covered access to all types of education and training. As such it has provided the basis for a range of activities about women's access to work-related ICT training and related career paths.

Inclusive ICT Training

Out of 47 identified initiatives that offer ICT skills training programmes for the target groups, 29 were deemed relevant to the issue of inclusive ICT training. These programmes were specifically targeted towards disadvantaged socio-economic groups such as persons at risk of long-term unemployment NEETs. Another frequent focus was on women. Figures 14 and 15 show a further breakdown of these programmes in terms of target groups addressed and stakeholders involved in inclusive ICT training in Poland. The main stakeholder involved in inclusive ICT training providers and IT vendors play an important role as well.



Figure 29 Share of target groups in inclusive ICT training in Poland, % of programmes surveyed

Figure 30 Share of stakeholders in inclusive ICT training in Poland, % of programmes surveyed



Source diversITy Survey, empirica (2017)

Source diversITy Survey, empirica (2017)

Country Brief: South Africa

Table 7 Key figures at a glance – South Africa	SA
ICT sector workforce	250,000
ICT sector workforce as % of domestic workforce (formal, non-agricultural)	2.2%
% non-white (ICT sector)	65%
% female (ICT sector)	~40%
Latest vacancy figure (ICT sector)	7,200
Vocational graduates per year	n.a.
Tertiary graduates per year (only first degrees)	5,300
% of enterprises that employ ICT specialists	n.a.
% of enterprises providing training for ICT specialists	n.a.
% of ICT sector workforce with tertiary education	17%

Source: Own compilation based on Adelzadeh (2017), MICT SETA (2017) and WEF (2017)

South Africa's ICT sector employs about 250,000 persons, which translates into about 2.2% of the country's total labour force – roughly the same share as the average for the EU and China but significantly higher than in the other BRICS countries India, Russia and Brazil.

IT job vacancies have increased by 38% from 2016 to2017 with technical and specialist IT professionals in the highest demand, followed by other professionals with experience in systems and languages Developers, programmers and specialised software subject matter experts continue to be highly sought after.⁶² Therefore, the most demanded jobs require high skill levels and high educational qualifications.

Based on the results of a comprehensive skills forecasting study⁶³, the number of employees in the MICT sector will increase from 323,000 in 2015 to 381,000—454,000 in 2025, depending on the economic and political development overall. Under the assumption that the share of ICT within the Media, Information and Communication Technologies (MICT) sectors will remain at today's level of 77%, this means that the ICT sector will employ between 290,000 and 350,000 workers in 2025, up from 250,000 in 2015. However, these numbers do not reflect the potential shortage of ICT workers.



Figure 31 Baseline projection scenario for South Africa's ICT labour market from 2017 – 2025

Diversity

South Africa's labour market currently suffers from very high rates of unemployment (26.7%), especially youth unemployment (53.3%). The total number of young people neither in employment nor in education and training (NEET) in the age group 15 to 24 years alone was 3.2 million in 2017, resulting in a rate of 31.2%. ⁶⁴

Disaggregation by population groups shows that Black Africans face considerably more problems in finding employment; the gap between employment rates of the White and non-White working age population is over 21 percentage points. Such disparities are also present within the ICT workforce: only 43% of South Africa's MICT workforce is Black/Africans⁶⁵, against a share of 80% in the economically active population.⁶⁶

South Africa's gender employment rate gap is at 11.4%, significantly below the OECD average of 15.4%. ⁶⁷,, which is generally considered a great achievement. Yet in the ICT workforce, the share of women can only be guessed: The data presented in the 2016 MICT SETA report suggests that 40% of the MICT sector employees are female, however, there are doubts to what extent they are representative for the entire sector workforce.

In university education, computer and information sciences is the field of study with the lowest share of women after military sciences and engineering: enrolment and completion rates are between 20% and 30% lower for female than for male students.

Policy

An overarching strategic guide for skills development is provided by a set of **National Skills Development Strategies (NSDSs)**. The NSDSs are five-year policy plans devised by the DHET to guide the development of sector-specific training frameworks with clear, numerical success indicators⁶⁸. The current framework falls under the NSDS III (2011-2016), which was recently extended up to the year 2020.

In order to address the insufficient capacity and lack of integration of the country's vocational education and training system, the 2013 White Paper on Post School Education & Training envisaged increased enrolment in public TVET colleges, from $\pm 800'000$ currently to 2.5 million, by 2030.⁶⁹

A National Plan for Post-School Education and Training (NP-PSET) is currently being under preparation to follow up the White Paper, to overhaul occupational programmes and qualifications.

The **Employment Equity Act** (1998) has resulted in what is today known as B-BBEE (**Broad-Based Black Economic Empowerment**). Under the B-BBEE, all medium-sized and large South African companies must report on a Scorecard to what extent they follow codes of conduct defined for Blacks' (including African, Coloured (mixed race) and Indians) participation in ownership; management control; skills development; enterprise and supplier development; and socioeconomic development. The **Preferential Procurement Act** demands that all companies in South Africa that deal with the government or parastatals must comply with B-BBEE as certified by their Scorecard. In return, these companies require their suppliers to be empowered to improve their rating at government. Thus broad-based empowerment is driven down the supply chain.

The government outlined concrete measures for addressing ICT skills shortages in two **National e-Skills Plans of Action (NeSPA) in 2010 and 2012**. The plan includes a number of priorities regarding ICT specialist training to be accomplished in years until 2018:

Development, coordination and provision of ICT specialist training in the public sector is the delegated to the E-Skills Institute, the National Electronic Media Institute of South Africa (NEMISA) and the Institute for Satellite and Software Applications. In February 2014, these institutions were merged to form the iKamva National e-Skills Institute (iNeSI).

South Africa Connect, the National Broadband Policy launched in 2013, includes actions to boost acquisition of ICT skills in the form of both "supply side skills" (i.e. ICT specialist skills) and "demand side skills" (i.e. ICT user skills).

The **National ICT Policy White Paper** from September 2016 represents a further development of the policy framework for South Africa's "transformation into an inclusive and innovative digital and knowledge society". Although most of it is concerned with ICT infrastructure and services, the need for policy intervention in the skills development area is mentioned as well.

Inclusive ICT Training

Out of 51 identified initiatives that offer ICT skills training programmes for the target groups, 38 were deemed relevant to the issue of inclusive ICT training. These programmes were specifically targeted towards Blacks, which includes African, Coloured (mixed race) and Indians

disadvantaged socio-economic groups such as persons at risk of long-term unemployment and youths not in employment or education and training (NEET). Another frequent focus was on women. Figures 17 and 18 show a further breakdown of these programmes in terms of target groups addressed and stakeholders involved in inclusive ICT training in France. The stakeholders involved in inclusive ICT training are predominantly training providers, and industry (IT and other).

Figure 32 Inclusive ICT e-Skills and ICT training programmes in South Africa: Main target groups



Source: Own data collection (2017)

Figure 33 Inclusive ICT e-Skills and ICT training programmes in South Africa: Main stakeholders



Source: Own data collection (2017)

Country Brief: Spain

Table 8 Key figures at a glance – Spain	ES	Rank in EU 28
ICT workforce	546,000	5
As % of domestic workforce	3.1%	17
% female	17.4%	10
Estimated annual replacement need	14,000	
Latest vacancy figures	4,700	
Vocational graduates	10,700	4
Tertiary graduates (only first degrees)	14,100	3
Projected jobs potential until 2025 (8 years)	229,000	
Of which expansion	117,000	
% of enterprises that employ ICT specialists	25%	7
% of enterprises providing training for ICT specialists	13%	6
% of ICT specialists with tertiary education	79%	3

Source: Eurostat (2015)

In Spain, the ICT specialist workforce accounts for 546,000 workers, or 3.1 percent of the workforce. In absolute terms, this is the fifth largest headcount of ICT workforce in Europe, accounting for 7 percent of Europe's ICT specialists. As a share of the domestic workforce, Spain's ICT workforce ranks 17th among all EU countries.

Spain's digital economy has grown rapidly in recent years but employers struggle to find talent with the required skills to fill ICT positions. In 2017, there were 32,300 registered unemployed ICT specialists while the official vacancy number was 4,700⁷⁰. Based on our own survey of Spanish employers and reports from recruitment firms, job vacancies for ICT specialists are one of the most difficult to fill. In Spain, most require academic degrees to enter the ICT labour market. However, mid and low skill levels dominate the Spanish ICT workforce composition, displaying discrepancies between hiring requirements and actual job prerequisites.

The only ICT professional group experiencing a steady growth rate in job numbers is telecommunication and broadcasting technician (+5.4% p.a.), surprisingly a group that usually does not require an academic education.



Figure 34 Baseline projection scenario for Spain's ICT labour market from 2017 – 2025

Source: empirica (2017)

Diversity

Spain's long-term unemployment rate at 9.5% is more than double the EU average. Almost one in two unemployed persons (46%) has been out of work for at least 12 months. In terms of youth unemployment (44.4% vs. 18.7% EU28) and young people not in employment, education or training (14.6% vs. 11.6% EU28), Spain ranks at the bottom of EU28 countries (27th and 22th rank). These trends are particularly harmful if they affect low-educated youth as they can have negative long-term consequences by reducing future employment and earnings potential for affected youth.⁷¹

Minorities in Spain, i.e. non-natives born outside the EU, make up for the 10th largest immigrant population in the EU, the employment rate gap here is 4.1%, better than the EU28 average of 8.3%. and significantly better than other EU countries with large amounts of non-EU immigrant communities, such as France and Germany.

Spain's gender employment rate gap is the same as the EU average (10.5%) and has decreased by almost half over the last ten years. However, this decrease is not due to growth in the employment of women but rather a sharp fall in the employment rate of men. The share of women in the ICT workforce is around 19% and therefore 26%. lower than the share of women in the total workforce.⁷²

Policy

The most recent set of policy actions is the **Digital Agenda for Spain**⁷³ (2013). Among nine broad actions outlined by the Digital Agenda, the two most relevant are the promotion of digital inclusion and digital literacy in Spain. Its strategies focused on the inclusion of the most socially deprived groups through cooperation with non-profit organisations and private enterprises.

Since 2017, an updated version of the Digital Agenda with revised targets has been prepared under the new policy action, **Digital Strategy for an Intelligent Spain**. The main areas under consideration by the Spanish government are improving ICT skills of the Spanish workforce; STEM training and measures to increase the quantity and quality of ICT specialist skills; and, improvements in the education system to promote these competences.

The **Operational Program for Social Inclusion and Social Economy** (*Programa Operativo de Inclusión Social y de la Economía Social, POISES*)⁷⁴ was launched by the Ministry of Employment and Social Security in 2014 to fight unemployment, especially within diverse groups.

The Strategy for Entrepreneurship and Youth

Employment (Estrategia de Emprendimiento y Empleo Joven 2013-2016)⁷⁵ was a working plan with recommendations and incentives to reduce youth unemployment.

The Youth Employment Operational Program

(*Programa Operativo de Empleo Juvenil, POEJ*)⁷⁶ is being run from 2014 to 2020 and will mainly contribute to the implementation of the EU Youth Guarantee initiative.

The modernisation of Spain's system for vocational education and training (VET) is a key ingredient given the country's much discussed shortcomings in the area. In 2015, a major reform was launched The **National Catalogue** of professional qualifications was updated and new qualifications were added, including a Basic Professional Degree in ICT.

Some autonomous communities have introduced policy action complementing those at the national level:

- The Barcelona Digital City, 2017-2020 (Barcelona Ciutat Digital)77 is an inclusive and missionoriented technology and innovation strategy of digitization
- The Plan de Inclusión Dixital de Galicia was launched in 2015 and is part of the Digital Agenda of Galicia 2020 (Axenda Dixital de Galicia 2020)78, It is structured into three major strategic axes: digital literacy, digital training and digital and participative social innovation.
- The Basque EIT Coalition 79 was launched by the government of Euskadi (Basque Country) in 2013. The plan is aligned with the European Commission's Grand Coalition for Digital Jobs. The Basque EIT Coalition plans to create a model and platform of evaluation, certification and recognition of digital competence
Inclusive ICT Training

Out of 115 identified initiatives that offer ICT skills training programmes for the target groups, 62 were deemed relevant to the issue of inclusive ICT training. These programmes were specifically targeted towards people in long term unemployment, followed by women and then disadvantaged socio-economic groups. Figures 20 and 21 show a further breakdown of these programmes in terms of target groups addressed and stakeholders involved in inclusive ICT training in Spain. The main stakeholders involved in inclusive ICT training are non-profit and public sector institutions.



Figure 35 Share of target groups in inclusive ICT training in Spain, % of programs surveyed



Figure 36 Share of stakeholders in inclusive ICT training in Spain, % of total programs surveyed

Source: diversITy Survey, empirica (2017)

Source: diversITy Survey, empirica (2017)

Country Brief: United Kingdom

Table 9 Key figures at a glance – UK	UK	Rank in EU 28
ICT workforce	1.6 M	1
As % of domestic workforce	5.1%	3
% female	16.2%	15
Estimated annual replacement need	62,400	
Latest vacancy figures	163,000	
Vocational graduates	50,800	1
Tertiary graduates (only first degrees)	19,400	1
Projected jobs potential until 2025 (8 years)	1.15 M	
Of which expansion	651,000	
% of enterprises that employ ICT specialists	23%	13
% of enterprises providing training for ICT specialists	10%	14
% of ICT specialists with tertiary education	64%	12

Source: Eurostat (2015)

In UK, the ICT specialist workforce accounts for 1.6 million workers, or 5.1 percent of the workforce. In absolute terms, this is the largest headcount of ICT workforce in Europe, accounting for almost 20 percent of Europe's ICT specialists. In relative terms, only two other EU member states sport an ICT workforce larger than in the UK.

Of the very core category of ICT professionals in Europe, i.e. software, database and network professionals, more than one in four (26%) work in the UK. The UK's ICT workforce is especially prominent in the finance and professional services sectors, reflecting the overall importance for the UK's economy at large. The largest relative growth can be found for the occupations IT and telecommunications director (+12% p.a.), project and programme manager (+9%), and graphics designer (+9%). In absolute terms, the largest growth in terms of number of jobs added can be attributed to programmers and software development professionals. ICT jobs in the UK more than ever require academic degrees, indicating discrepancies between job requirements and educational attainment.



Figure 37 Baseline projection scenario for UK's ICT labour market from 2017 – 2025

Source: empirica (2017)

Diversity

The number of NEETs, for the UK is only slightly better than the EU28 average (10.9% vs.11.6%). On this indicator, the UK ranks 16th among the 28 EU member states while youth unemployment in general is at 13% (8th). The share of non-natives born outside of the EU in both total population and in employment⁸⁰ is at 8.3%. The UK has the 12th largest share of such non-natives in the EU. In comparison to natives, the employment rate is 6%. lower. 17% of ICT specialists are of non-white ethnicity (BME) – the same rate as for the entire BME working age population.⁸¹ The UK's disability employment gap is one of the largest in the EU. Only 8% of ICT specialists are disabled, compared with 23% of the general working age.⁸²

The UK gender employment rate gap is at 9.5%, somewhat below the EU average of 10.5%. In the ICT workforce, the share of women is only 16.2%⁸³. Of that, the highest shares of women are found in the occupational groups 'Graphic designers', 'Assemblers of electrical and electronic products' (both 35%) – against a meagre 14% for programmers/software developers. For Scotland there is evidence that the majority of women with ICT and other STEM subject qualifications do not end up in related areas: 73% of female STEM graduates are lost from STEM occupations, compared to only 48% of males.⁸⁴ In the 2015/16 season, women made up 52% of apprenticeships, but only 18% of apprenticeships in ICT.⁸⁵ Minority groups as well as women are strongly underrepresented in senior roles.⁸⁶

Policy

The **Digital Strategy 2017** formulates UK's digital policy, targeting the skills gap and fostering digital inclusion. The strategy prioritises public-private partnerships with both the industry and the NGO sector. It outlines government action in particular for digital skills to be fully embedded in education; boosting lifelong learning to up-skill people across their working lives; reforming the technical education system to help develop a range of specialist digital skills to fill specific digital jobs; and strengthening cyber security skills.

Launched in 2017, the **Tech Talent Charter** means to promote a more diverse digital workforce by presenting employers of ICT specialists with suggestions for effective actions and principles to adopt and embed into their organisations.

In 2017, the **Digital Skills Partnership** was established to bring together public, private and charity sector organisations to boost skills for a world-leading, inclusive digital economy. For coordination of actions at local level, **Local Digital Skills Partnerships (LDSPs)** were launched in 2018 to increase collaboration between businesses, NGOs, and public sector organisations. The first LDSP was launched in June 2018 by the Lancashire Enterprise Partnership.

In its 2015 **Conservative Manifesto**, the government pledged to halve the disability gap by the year 2020, which the government understands as that over a million disabled people will be helped to move into or maintain work.

By 2013, the government started to ask for groups of employers ('trailblazers') to collaboratively develop new apprenticeships, apprenticeship standards and assessment approaches. The objective is to ensure that apprenticeships meet real-life labour demand. Included are a number of so-called **digital apprenticeships** standards.

An **Apprenticeship Levy** was introduced in 2017 as a means to fund expansion of apprenticeships. The Levy is a payroll tax on large employers, with funds raised ring-fenced in a digital account and only available to be spend on apprenticeships (somewhat different arrangements apply in Scotland and Wales). In early 2018, a new, employer-led **Digital Apprenticeship Quality Board** was established in order to assess and promote the quality of the apprenticeship system.⁸⁷

In Scotland, the **Equalities Action Plan For Modern Apprenticeships in Scotland** was launched in 2015 and updated in 2017. It represents an action plan for mainstreaming inclusiveness and diversity across all elements of the apprenticeship system. The plan's objectives are monitored, and a strong emphasis is placed on the Plan's promotion to the wider public.

The key role of **College-based technical and professional education** (TPE) is acknowledged in the government's **Post-16 Skills Plan for England** (2016) as well as in the **Industrial Strategy Green Paper** (2017). A new TPE Strategy was launched with the aim to identify new broad technical vocational routes. One of the is called "Digital" and will be designed to lead towards occupation as programmer, software developer, network administrator, web designer or IT technician.⁸⁸

Inclusive ICT Training

Out of 57 identified initiatives that offer ICT skills training programmes for the target groups, 29 were deemed relevant to the issue of inclusive ICT training. These programmes were specifically targeted towards disadvantaged groups, such as NEETs and women. Another main focus was on long term unemployment. Figures 23 and 24 show a further breakdown of these programmes in terms of target groups addressed and stakeholders involved in inclusive ICT training in the UK. The most involved stakeholders in inclusive ICT training are IT vendors and training providers.





Source: diversITy Survey, empirica (2017)



Figure 39: Share of stakeholders in inclusive ICT training in the UK, % of total programmes surveyed

Source: diversITy Survey, empirica (2017)

Part 6 Recommendations: The Future of Diverse ICT Training

This report identified a number of challenges for the various stakeholders, based on experiences gained from the assessment of a large number of training programmes in the seven countries. These challenges are not country specific but rather offer a broad overview of existing issues within inclusive ICT training throughout the several markets, school systems and training approaches. Each challenge and the issues it addresses are then met by some recommendations. These recommendations are the essence of this report; they are based on country assessments, desk research, interviews, and discussions in workshops.

Improving diversity in the ICT workforce and inclusive ICT trainings

Based on the challenges, issues and recommendations, the future of diversity and inclusive training in ICT requires key actions to be implemented in the future. These actions involve all stakeholders and require a systematic approach to education, to the labour market and to company values.

• Skills Gap and Hiring Process

The key to more diversity in ICT is not only an overhaul of the educational systems. Many of the existing issues in the demand and supply of ICT labour are based on a skills gap of cognitive vs. non-cognitive skills and issues of skills matching. As laid out, existing degrees in the educational systems teach cognitive skills but lack non-cognitive skills. There is no simple solution. While the educational side of things needs to alter their curricula and adopt more transversal skills and include work placement, companies need to better understand the job market and their own job requirements. Using this approach, companies can attract and encourage different target groups that might have fewer technical skills but are highly motivated to learn them. Companies need to overhaul their hiring processes. We found a widening discrepancy between job descriptions and actual job requirements. The assessment of job requirements also feeds into the development of a "skills profile".

• System of New Credentials

A system of new credentials should be developed to better support the educational systems. A "skills profile" can achieve this, but so could smaller elements as well. Such a set of new credentials could contain elements like certification, portfolios and standardised curricula. Many but not all experts from inclusive ICT training programmes see certification as advantageous and beneficial for the graduates from these programmes. This holds true for programmes awarding well recognised certificates (often from IT vendors) or those from training providers with a good reputation. They see this as an asset and fast track into the labour market. Others argue and warn that these types of certificates cannot and should not replace formal education degrees. Formal degrees are seen as superior, specifically since vendor- based certificates were originally intended as an add on and only used and trained in further education contexts. That is where they see the place and strength of these. In general, the value of certification is undisputed. However, many inclusive ICT training programmes face the problem of lack of recognition of skills and competences trained since they do not offer a recognised certificate awarded to programme participants. A way out of this dilemma could be the use of alternative certification methods including certification in form of badging (e.g. OpenBadge) which allows for certifying even small and micro courses and training 'bits'. However, the situation in this market is complex and confusing. A number of technology companies have started with these types of workforce credentialing which students can earn. These started, but are no longer limited to participants of MOOCs but include many different types of trainings of varying duration. In the Policy Brief we have recommended the European Commission and / or national governments analysing the market of alternative certification methods, thereby taking care of national peculiarities in each Member State with the view of helping (inclusive) training providers in offering certified courses to their clientele more easily and thereby increasing the employment chances for them. The results should be made available as a 'guide to alternative certification' to training providers inside and outside the formal education and training systems in European countries and regions. Practitioners from inclusive ICT training courses may want to start lobbying for this towards their national governments.

• Flexibility in Education

The traditional education route is still seen as the most trusted pathway into ICT labour, the majority of the ICT workforce consists of workers with a university degree background. Yet, industry complains about (a) the lack of up-to-date specific programming skills and (b) the lack of transversal skills. The underlying issue is the lack of work placements and the fast developing ICT landscape. In order to meet these demands, a new flexibility in the traditional education would be required, i.e. more work placements for students and a higher flexibility in designing university curricula. Nevertheless, also other educational routes such as apprenticeships, and vocational education and training are often based on long lasting curricula as well.

• New digital degrees, VET and apprenticeships

Based on a better understanding of industry demand and "skills profiles", new digital degrees can be developed, specifically non-tertiary degrees such as vocational education and training and apprenticeships. This approach could deliver a practically oriented workforce within a comparatively short amount of time. These types of degrees can be specifically attractive for the target group of NEETs or youth at the risk of social exclusion. However, not only the development of such degrees is key to the shortage of ICT workers. Currently, in many of the assessed countries, VET and apprenticeships are rather unattractive. A concentrated marketing campaign can address the lack of awareness. Yet, only industry can boost the attractiveness of such degrees, by allowing better career options and a better permeability into higher paid positions for existing workers.

• Creating a Hub

One way of engaging stakeholders is by forming a system for effective communication toward collaboration, ensuring that programmes meet actual need, and expand, replicate, and share best practices. An example is the Tech Talent Charter,⁸⁹ which is a commitment by organisations to a set of undertakings that aim to deliver greater diversity in the tech workforce of the UK, one that better reflects the make-up of the population. Signatories of the charter make a number of pledges in relation to their approach to recruitment and retention.

• Realise the Value of Diversity

More companies, especially SMEs, need to realise the value of a diverse workforce: Many studies have shown that diverse teams outperform others^{90,91}, generate more money⁹² and uncover more angles⁹³. Diversity is not restricted to the inclusion of women but also older, younger, and otherwise different (minorities, NEETs, different field of study) colleagues. Policymakers together with industry need to make an effort to create and support programmes with the goal of including students from all underrepresented target groups.

• Tax-based instruments

In countries where tax-based mechanisms and instruments for incentivising and funding (further) training activities exist, these can offer opportunities also of financial support and funding for inclusive ICT training programmes. A typical example for such an instrument is the Apprenticeship Levy introduced in the UK in 2017 as an incentive to further training in companies, mainly large companies but also SMEs. It was originally implemented as a means to fund expansion of apprenticeships. The Levy is a payroll tax on large employers, with funds raised ring-fenced in a digital account and only available to be spend on apprenticeships. It also is an instrument with the potential to open up avenues for SME training activities including admittance of apprentices from underrepresented groups if government agrees to use unspent money for these purposes. The UK government has already signalled openness for supporting such types of activities. Providers of inclusive ICT training programmes in the UK could have good chances of funding support and 'push at an open door' if they manage to locally team up with other relevant stakeholders from industry and local agencies, develop appropriate proposals for funding support and submit these as part of Local Digital Skills Partnerships (LDSP) currently (December 2018) being launched. Their objective is to increase collaboration between businesses, NGOs, and public sector organisations to help address the local digital skills needs in more targeted and innovative ways. It is recommended to thoroughly check for similar types of instruments as potential funding opportunity for inclusive ICT training programmes also in other countries and start lobbying towards government to open these also for inclusive ICT training activities for the creation of a more diverse workforce which has been stated unanimously as a policy goal throughout the EU Member States and beyond.

• Institutionalizing Data Collection

An institutionalised data collection whether on country or European level would help to better identify the existing and future supply and demand trends in ICT. Such regular audits would deliver skills shortages and their relationship to skills produced and directly feed into the educational and organisational system, e.g. based on a "skills profile".

- ICT vendor certificates are important for young people and adults who want to transition into the ICT sector. For career transitioning youth and adults, employers considered ICT vendor certificates to be relevant for most technological job profiles. However, for most employers such certificates are only relevant if obtained from reputable national or international training institutions.
- For individuals who do not have an academic degree and who dropped out of school or college, ICT training programmes should ideally introduce options of studying ICT-related subjects. Evidence from our survey shows that most such programmes are targeted specifically to young learners. For younger cohorts, training programmes like these emphasise the importance of opening pathways to explore future possibilities in ICT education.
- Job applicants with well-developed transversal skills are better positioned to be recruited by employers. These transversal skills range from effective communication and coordination, problem-solving, negotiation, teamwork and collaboration, and decision making. Employers indicated that graduates and trainees with no prior work experience tend to lack such skills. The prevailing perception among employers is that higher education institutions in Spain do not sufficiently address the need for experiential or practical learning.
- According to employers, ICT skills training should also address the development of behavioural and mind-set skills. This approach helps to prepare trainees for actual situations encountered at work. One of the main reasons experiential trainings are successful is because they address a need employers feel is not being met by traditional educational institutions.
- Mixed or integrated approaches to training are the most desirable for both trainees and employers, particularly those in an experiential learning setting. However, only well-structured programmes with significant support from sponsors and businesses can provide this type of integrated training.
- Business support is especially relevant for designing curricula of training programmes for both technical and soft skill-sets because employer-driven programmes respond better to market demands for ICT and work-relevant skills.
- Substantial long-term success can be achieved by integrability / connectivity to the local educational system. Training programmes should achieve certifications that allow their learners to enter the traditional educational system.

Educational system

Торіс	Career guidance, school system
lssue	 Lack of awareness of academic and specifically non-academic ICT education and training pathways Very limited knowledge about careers in ICT among young girls and women but also among their parents Guidance counselling at schools in general suffers from problems of quality, specifically also with respect to ICT careers Prejudices toward ICT careers and opportunities exist, especially toward lower education pathways High drop-out rates in STEM subjects especially by girls already at early stages
Affected Stakeholders	Industry, Policy
Recommendations	 Education and training institutions together with industry need to increase the offer and supply of interdisciplinary IT related education Actions should target all stakeholders involved in career guidance and counselling networks Industry and educational institutions should foster their collaboration to better inform about ICT pathways It is necessary to step up online promotion of ICT pathways With improvements in the ICT education, e.g. apprenticeships, VET and training programmes, all stakeholders should actively fight prejudices against ICT careers At upper secondary level, students must be better prepared. The introduction of new, compulsory "scientific and digital humanities" courses appears necessary. At tertiary level, access to and conditions for success at higher education should be reformed in order to make them more inclusive and less dependent on parental background. One goal is to enable stronger individualisation of pathways.

Alterations to the school system and specifically the career guidance can help tackle the ICT worker shortage. One of the existing issues is the lack of available academic and non-academic education pathways, including apprenticeships and vocational education and training. Many young people do not know about specific opportunities and pathways. Educational policy should address these issues by reforming the career guidance system and notably change curricula to be more open to ICT, e.g. by adding compulsory scientific and digital humanities courses.

However, schools cannot tackle this challenge by themselves; a joint approach between industry and educational institutions is necessary. In cooperation with school and career counselling, the ICT Industry should actively promote pathways and jobs at schools

Policy as well as education and training stakeholders and industry may want to investigate whether increasing the offer and supply of interdisciplinary IT related education and training programmes at all levels (e.g. higher education, VET, further education) could help to increase participation of women in the ICT and STEM sector. Such offers have shown to be attractive to women. This is confirmed by the high shares of women in studies such as bio informatics, media informatics and health informatics in Germany which range from 36%, 40% to 44% respectively.

Торіс	Promote non-academic pathways, apprenticeships and vocational and educational training
lssue	 Apprenticeship-based training suffers from a severe image problem, which has a negative effect also on the appeal of modern-type apprenticeships such as those in digital occupations Many vacancies could be filled with less qualified personnel by HR departments tend to demand excessively high qualifications Paths of digital VET and apprenticeships are either missing or do not fulfil hiring criteria Very low permeability into better paid positions exists for employees with apprenticeship background EU companies do not invest sufficient resources in training current and future employees, compared to companies in other parts of the world.⁹⁴
Affected Stakeholders	Practitioners, Industry, Policy
Recommendations	 Key influencers such as parents, teachers, as well as the wider public need to be convinced that apprenticeships in the digital domain present a high-quality option towards a career in ICT HR / recruitment departments need to rethink hiring criteria and develop more appropriate job profiles All stakeholders need to co-develop new paths of digital VET and apprenticeships to fulfil job requirement and industry standards. This can be highly attractive to and suitable for diverse target groups, especially for NEETs and minorities Companies must provide a better permeability into higher positions for employers with an apprenticeship background to make the apprenticeships pathway more appealing A high profile, multi-channel marketing campaign is needed to display the potential and benefits of the apprenticeship system A strong collaboration between ICT vendors and vocational schools is desirable within the right policy setting. Pre-defined curricula in multiple languages developed between ICT vendors and schools are rather flexible and can be seen as an attractive option for ICT training in VET contexts (see cooperation of the Cisco Networking Academy programme with more than 500 vocational schools in Germany) An apprenticeship levy as implemented in the UK most recently or similar may result in higher employer investment into the apprenticeship system in countries where this is not yet well developed

The fact that tertiary education is the most dominant form of education in the ICT sector does not suffice and help overcome the existing shortage of ICT workers. To improve this situation, either more students need to graduate with a degree in any ICT occupation, or other forms of education need to fill the shortage of ICT workers. Vocational education and training as well as apprenticeships can provide such skilled labour. However, currently neither employers, nor potential employees in many countries perceive VET and apprenticeships very well. Therefore, it is necessary to meet some prerequisites: (1) New paths of digital VET and apprenticeships need to be developed which requires industry, policy and training providers to work hand in hand; curricula must be developed with an industry friendly flexibility in mind. (2) Digital paths of VET and apprenticeships need to become more attractive to prospective students by raising awareness in schools, and specifically the career guidance system and promoting better career prospects with a better permeability of skilled workers with such a background. (3) Linking inclusive ICT training programmes to and establishment of some sort of permeability between inclusive ICT training programmes and the national formal education and training systems may help to even further increase the chances of labour market entry and job sustainability even at times of crisis.

Торіс	Connectivity to job market
lssue	 Many students with a bachelor's or master's degree still face difficulties in entering the job market as the connection between school / university and ICT industry is too weak Target groups often lack necessary transversal skills and work experience. Recruitment favours learners with well-developed transversal skills, specifically transversal skills such as creativity and communication linked to digital skills.
Affected Stakeholders	Industry, Policy, Practitioners
Recommendations	 Universities and other forms of training need to better emphasise transversal skills development Work placements should become an integral part of any training Training programmes always need to include transversal skills teaching in their approach

While career guidance is a first help to find prospective ways into ICT labour, the connectivity to the job market for those who have made the decision needs to follow. Many ICT students still face difficulties entering the job market. The underlying issue is a disconnection between universities or other educational institutions and industry through underdeveloped transversal skills. In order to tackle this issue, a concerted effort by industry and educational institutions is necessary, this includes a restructuring of course content to better match the skills needed but even more so it includes work placements. Educational institutions, training providers and other programmes cannot reach this target without coordinated efforts from ICT industry.

The lack of transversal skills is often linked to the lack of actual job experience. Therefore, it is important to improve the provision of work placements and mentorships. Collaborative approaches can help overcome this challenge: SMEs, or industry in general, need to work closely with training providers and educational institutions to provide such work placements. Policy is required to deliver a framework for financial and organisational support.

Торіс	Permeability of inclusive ICT programmes towards the formal education system
Issue	 Currently, the permeability from inclusive ICT trainings into the traditional educational system (e.g. VET), is rare Graduates from traditional educational pathways still have better acknowledged degrees and a higher job security
Affected Stakeholders	Industry, Policy
Recommendations	 Industry associations together with policymakers should develop official examination standards and tests that allow graduates from inclusive ICT trainings the opportunity to enter state-recognised traditional education

Permeability of inclusive ICT trainings into the formal VET, although seen as important, still is an exception since options to achieve this are rare. One way offered in Germany is for the candidates to take part in an "external examination" at the Chamber of Industry and Commerce. Admission is subject to conditions. A candidate is admitted to the final examination if proof can be furnished that he or she has worked in the occupation in which the examination is to be taken for at least one and a half times the time prescribed as the training period. Such an approach could help to develop this path as a solution option towards state-recognised training in the formal education system. However, where this opportunity already exists, very limited use has been made of this option. The reasons for this have not yet been dealt with in a structured manner. It is recommended to investigate and analyse these, share the results and experiences to see whether there is an interest in pursuing such an approach in other countries and then decide whether and how this approach could best be re-designed and implemented.

Industry

Торіс	Open up industry-driven training programmes for people at risk of social exclusion
lssue	 Learners from this target group are typically not able to afford such programmes Training is usually not structured to fit this target group
Affected Stakeholders	Practitioners, Industry
Recommendations	 Commercial training providers will require some kind of financial arrangement to cover the participation fee as learners are typically not able to afford them In addition, teaching methods, content and support structures need to be adapted to take account of the needs of, for example, young at-risk people New funding models need to be developed in co-operation between commercial providers and NGOs operating in the social and education domains

While industry-driven training programmes are usually run by commercial training providers and quite expensive to access, there should exist a chance to open up this approach to include people at risk of social exclusion. To achieve this, commercial training providers need to adapt their teaching methods and content. This requires new financial models to accommodate this change and subsidies to learners. The benefit of industry-driven trainings is the well-known demands of content structure and the proximity between training providers and industry. This provides an opportunity to strengthen diversity in ICT, if such trainings are able to include such underrepresented groups.

Торіс	Change recruiting and hiring practice, need for better recognition of skills matching
lssue	 The language used in vacancy descriptions discourages women and people with a lower but fitting qualification from applying for a vacancy Many vacancies could be filled with less qualified personnel but recruiters tend to demand rather high levels of skills for open positions Employers tend to assume that an academic degree is required even for entry-level ICT positions. This limits the practical value of alternative training pathways, which are typically more suitable for persons from a disadvantaged socio-economic background. Lack of collaboration between industry and VET education and training and apprenticeship schemes
Affected Stakeholders	Industry
Recommendations	 A strong collaboration between industry and VET schools is needed Companies actively need to overhaul their recruiting system. The use of online assessments of the actual job qualifications and of related software tools may help to correct exaggerated skills demands A change in attitudes among recruiters is needed. As some experts have observed, "recruiters must be convinced to step outside the institutional framework of diplomas and trainings, and agree to employ individuals whose paths in life have provided them with personal skills that would be useful to businesses."⁹⁵

Today, recruitment and hiring is one of the biggest challenges of industry. Specifically in the ICT field employers when posting vacancies formulate exaggerated skills requirements, while workers with degrees other than a university degree in ICT could already fill many of the existing vacancies.

However, many employers still tend to assume that an academic degree is required even for entry-level ICT positions. This limits the practical value of alternative training pathways, which are typically more suitable for persons from a disadvantaged socio-economic background. Assessments of actual the actual skills and competences of a candidate and mapping these to a "skills profile" would help to identify the level of matching between both. This would probably reveal that inclusive ICT training graduates sufficiently reflect and fit employer demand. It would also help training providers and other educational educations adapt their curricula to such a "skills profile" to help further increase the placement rate.

As an interesting side issue statistics reveal that industry year by year manages to recruit more ICT workers than graduates from relevant subjects leaving university or vocational education and training. While in the year 2015 the number of such graduates in Europe amounted to 205,000, the ICT workforce increased by 426,000. This demonstrates that "lateral entries", i.e. labour market entrances of people without degree in ICT from formal education systems of more than 200,000 individuals occurred.⁹⁶ This may also open up a further avenue and pathway into employment for the diversITy target groups if properly promoted to industry actors for them to recognise the potential of these future ICT workers.

Skills

Торіс	Transversal skills gap in addition to ICT skills gap
lssue	 Employers demand transversal skills ranging from effective communication and coordination to problem solving, negotiation, teamwork and collaboration. Graduates and trainees with no prior work experience tend to lack these transversal skills. Many academic graduates also lack practical skills like effective negotiation and decision-making. The numbers of work placements available for the diverse target groups are insufficient. However, these are important, specifically for learning transversal skills and the potential employer to get to know the candidate or intern.
Affected Stakeholders	Practitioners, Industry, Policy
Recommendations	 The ICT sector should adopt a central "skills profile" approach that ensures skills training sufficiently reflects employer demand. This also encourages employers to take part in creating and revising skills profiles A responsive ICT framework with active monitoring of such existing and new ICT skills profiles should be set up Adequate and flexible programmes, apprenticeship degrees or vocational routes to meet the criteria of the "skills profiles" and the current ICT labour demand should be developed For training providers, smaller sessions within larger training modules should specialise on such skills: interview simulations, workshops on communication, team building exercises Training programmes must train behavioural and mind-set skills by using different exercises that simulate the work environment and prepare trainees for actual work-related situations Universities must overhaul their curricula and integrate skills training Experiential training programmes have proven successful in this regard

Consensus exists within the interviewed experts that an imminent skills gap exists in the ICT labour market. This gap is often described as a skill vs. mindset gap. While graduates mostly fulfil the technical skills, they lack the transversal skills like effective negotiation and decision-making. The OECD Skills for Jobs database confirms that the skills shortage is specifically significant in areas like judgment and decision making, social perceptiveness, coordination, or negotiation.^{97,98} To make it easier for educational institutions and training providers, the ICT sector should develop a "skills profile" that reflects the employer demand. Based on this profile, curricula can be adopted and updated. This requires a level of flexibility in education that is non-existent today.

Торіс	Improve evaluation, skills demand statistics, skills assessment and profiling
lssue	 Many countries lack regular ICT skills audits as a way to better recognise skills shortages, employer demand and hiring requirements If they exist, they often lack comparability There is a lack of serious evaluation of learning interventions. Little is known about their impact in terms of employment and career building ICT skills assessment tools – although several of these exist – are hardly used for skills assessment and profiling of candidates to allow for an allocation to best suitable training programmes In order to make them universally applicable throughout Europe these tools should be based and use skills and competence frameworks agreed on at European level and ideally following a European standard
Affected Stakeholders	Policy
Recommendations	 Up-to-date insight into skills demand and shortages and their relationship to skills produced by the education and training system are required for stakeholders in inclusive ICT training to take the best possible decisions. For instance, training providers need the best information they can get about current and expected future demand for skills Such data could be provided in the form of ICT skills audits and independent organisations should be funded by governments or European institutions to conduct these on a regular basis Moreover, tools for an assessment of ICT and other skills – currently hardly used – should be more widely promoted and put to use since they could help to collect data to inform and guide training decisions that can benefit both the learners and future employers. These should follow a European standard and be based on a European skills and competence framework to make them universally applicable.

The European e-Competence Framework (e-CF) is recommended for use. In 2016, the e-CF became a European standard and was published officially as the European Norm EN 16234-1.⁹⁹ The e-CF provides a reference of 40 competences as applied at the Information and Communication Technology (ICT) workplace, using a common language for competences, skills, knowledge and proficiency levels that can be understood across Europe. It is associated to 30 European ICT Professional Role Profiles built on the e-CF. These provide a generic set of typical roles performed by ICT Professionals in any organisation, covering the full ICT business processes and would be helpful in developing "skills profiles" for inclusive ICT training activities. ICT Skills assessment tools also already exist in the market. They follow slightly different approaches but can all provide the necessary results for profiling candidates and mapping their skills to "skills profiles". A selection of such tools following the e-CF European standard includes the e-CF Profiling Tool (CEN ICT Skills Workshop), the e-Competences Quality tool (EXIN, Netherlands & empirica, Germany) and the e-Competence Benchmark (CEPIS) to name just a few.¹⁰⁰

Promotion

Торіс	Promotion of ICT careers to women to drastically increase the share of women in ICT jobs
lssue	 Deep-seated misconceptions about women's suitability for tech jobs Lack of role models Lack of incentives The question of reconciling family life and working life remains a barrier to employment of women in the digital domain
Affected Stakeholders	Practitioners, Industry, Policy
Recommendations	 Modes of training need to be adapted to the need of woman learners for flexibility and support, making extensive use of ICT (e.g. eLearning) for this purpose The power and creativity of existing communities of engaged workers should be leveraged, e.g. the experience of successful, volunteer-driven initiatives, like coding clubs addressed specifically at young women Female mentors, especially in ICT, can encourage girls to choose education pathways and careers in technology through shared experiences, advice and networking Female students and employees in the sector should be mobilised for ICT promotion because they are best able to convince their peers Government and policymakers should develop better strategies at early school stages to engage women into ICT education and careers. Initiatives for the integration of women into ICT fields remain broad and unaccompanied by strategies aimed at raising awareness at early schooling New partnerships are to be established for joint activities to advance women in ICT fields. One example is the United Nations' 'International Girls in ICT fields. Important stakeholders can assist in adapting such campaigns to the national and local level

One of the underrepresented groups in ICT is women, thus the challenge is to promote respective careers to them. While the overall number of women in ICT jobs is already low, the number of female university ICT graduates is even lower. In order to promote ICT to women, it is necessary to overcome the underlying deep-seated misconceptions about women's suitability for tech jobs. To achieve this goal, it is necessary to develop better strategies for early schooling to engage women in ICT education, government initiatives should aim at raising awareness. Simultaneously, the mentorship model has proven effective to encourage girls. Therefore, it is necessary, that teachers and schools, training programmes and providers emphasise mentorships for girls and women in STEM or ICT, develop appropriate role models and publicly promote these. One possible way is by offering interdisciplinary IT or STEM related subjects and training programmes. Such offers have shown to be attractive to women. This is confirmed by the high shares of women in studies such as bio informatics, media informatics, or health informatics.

Торіс	Mentorships and role models / mentorship networks
Issue	Lack of mentorships in training programmes and work placementsLack of female mentors
Affected Stakeholders	Practitioners, Industry, Policy
Recommendations	 Female mentors should be an integral part of any inclusive ICT training programme. Especially in ICT, mentors can encourage girls but also members from the other target groups to choose education pathways and careers in technology through shared experiences, advice and networking The power and creativity of existing communities of engaged workers should be leveraged, e.g. the experience of successful, volunteer-driven initiatives, like coding clubs addressed specifically at young women Well-functioning mentorship using role models to which the target groups can relate should be implemented Innovative mentorship models should be developed for an increasing use of mentorship, such as cross-organisational and cross-regional mentor networks, possibly operating online only Mentorships should become an integral part of inclusive ICT training programmes An (online) mentorship network should be established to foster the use of mentorships

Mentoring is crucial for the success of inclusive ICT training programmes. The good practice showcases (GPS) make intensive use of these and offer this service either throughout the duration of a training course of even up to three years after course completion. It is one of the most critical success factors. Mentoring programmes are important offers for students and trainees during their education, specifically for women and people from minority groups. Mentors can play an important role as role models who help question traditional gender roles; they can demonstrate career opportunities for groups currently underrepresented in the ICT workforce; and they can provide practical, tried-and-tested ways how to address obstacles in day-to-day training. Moreover, mentors provide network contacts, which can make all the difference once the time has come to apply for a job. Many mentorship programmes make use of seasoned employees who volunteer for the role based on an intrinsic interest in advancing progress in the diversity area.

The small number of people from many under-represented groups in the workplace means that finding mentors in-house – for example, successful employees with a disability – can pose a challenge. For this purpose, innovative models such as cross-organisational and cross-regional mentor networks, possibly operating online only, could be established for which employers apply. This would require inclusive training providers to cooperate. Incentives through government funding could foster their establishment.

Торіс	Role of media
Issue	 Media can play an important role in reaching and impacting parents and children but also other target groups to convince them of the opportunities of ICT careers through education and training etc.
Affected Stakeholders	Industry, Policy, Practitioners
Recommendations	 Governments should team up with (public) radio and TV channels, develop and launch attractive formats to be broadcasted widely or run other types of initiatives starting at young age and directly addressing children from disadvantaged group.

An interesting example is the BBC micro:bit initiative – which is part of the BBC 'Make it Digital programme'. This can be seen as an activity initiated by media to enable and inspire children to participate in the digital world, with particular focus on girls and those from disadvantaged groups. It is using micro:bit (an open source hardware ARM-based embedded system designed by the BBC for use in computer education) as an easy and effective learning tool for digital skills and creativity. micro:bit was designed to encourage children to get actively involved in writing software for computers and building new things. Founded in September 2016 it has already reached more than one million young people throughout Britain. https://microbit.org/.

Conclusion

While the demand for skilled ICT workers at all levels is increasing rapidly, consensus exists that action is needed to overcome the existing and continuously rising skills shortage and gap, which can be observed in all European countries and globally. Low-skilled school leavers, school dropouts, workers with outdated skills as well as individuals with diverse backgrounds but also women as a large untapped resource, all provide enormous potential to alter and help close the skills gap. Inclusive training programmes, such as the ones assessed for this report, can help. Such training programmes are an important (sometimes the last) step of educational journeys. However, at present these are "too little and too few". They need to become larger in scale and sustainable in operation.

Often a systematic overhaul of existing programmes is needed to prepare individuals from the diverse target groups for the ICT track and career. Moreover, there is a need to better integrate ICT skills training in existing educational streams and at the same time, due to fast paced developments in ICT industry, education and training need to become more flexible and up-to-date. Here, inclusive ICT training programmes have an advantage compared to formal education and training.

Today there is an agreement among experts that "on complex tasks, diverse teams will overtake teams of talented but similar individuals by a sizeable margin (...) (and that) diverse groups outperform homogeneous groups on various occasions".¹⁰¹ "Focusing on diversity and inclusion is crucial to overcome the fractures and inequalities of our age". Moreover, "diversity is a crucial leverage for innovation". "The capacity to leverage diversity requires bold and visionary leadership - at the level of organisations, cities, and nations".¹⁰²

In the course of this report, we have identified quite a number of inclusive ICT training programmes, many of which developed interesting approaches and promising concepts. However, over the past year at lot has changed already, and some of the programmes identified already ran out of funding and struggle to continue offering their programmes. Thus, next to accessibility, sustainability should be a top priority in designing inclusive ICT training.

One of the root causes for the lack of inclusion is entry barriers to ICT training and jobs. To improve inclusion, training programmes need to ensure access for participants, including financial, technical and geographical support. Additionally, recruitment processes need to include collaboration with local enterprises. Enterprises should participate in the selection of trainees and provide work placements, in exchange for privileged access to graduates after completion of the programme.

Furthermore, the key to sustainability lies within strong collaboration of industry, policy and providers, to establish the necessary structures. These structures are of financial, bureaucratic and practical nature. The most important aspects of training are mentorship and practical experience. It is necessary to develop long lasting concepts of up-to-date curricula, work placement integration and financial incentives and structures through governments which can help create the necessary eco-system of actors needed and provide the necessary framework conditions and a sufficient (financial) basis for operation. Furthermore, it is of the utmost importance to raise the awareness of diversity, and already at an early age promote career pathways such as vocational education and training and apprenticeships to children and their parents. In the cases where individuals have dropped out of the formal education system, more and larger-scale inclusive ICT training programmes need to be developed with the support from governments and industry addressed to these target groups and to make a difference and create real impact. At the same time, permeability to formal education and training could help opening up further opportunities at a later stage and help secure jobs even more specifically in times of crisis.

While the demand of ICT jobs is already high and even growing, the potential for an inclusive workforce to enter the ICT labour market exists. This provides ample opportunities for new inclusive training programmes. With the identified training taxonomies and pathways in mind, and the right solutions to challenges, the momentum for new inclusive training programmes and a diverse ICT workforce is even higher.

The present project has revealed that practitioners active in this field should consider – amongst others – some key points for the creation of a good inclusive ICT training programme. These require a team of actors to

- be set up with the right partners, specifically from industry as (potential) future employers,
- teach "soft" skills in addition to technical ICT skills,
- design and update programmes together with industry,
- strongly consider linking to vocational education and training (VET) to make best use of a promising pathway to employment with the chance for their students to obtain a universally recognised formal degree,
- closely cooperate with employment agencies and obtain necessary accreditations to be able to secure long-term funding,
- implement well-functioning mentorship using role models,
- decide on whether and how certification can add value,
- make use of tax-based or other types of government instruments for incentivising and funding training activities in general and specifically inclusive ICT training programmes and where appropriate

• lobby for these based on comparable (successful) cases in other countries.

Policies should – amongst others –

- seek to set up supportive framework conditions together with an appropriate stakeholder eco-system,
- increase permeability of inclusive ICT trainings into the formal VET,
- make available a 'guide to alternative certification' to training providers throughout Europe,
- shorten the review cycles of occupation standards and adapt quicker to changes and
- add a new flexibility in applying apprenticeship standards,
- set up cross-organisational and cross-regional mentor networks,
- investigate whether and how tax-based funding can operate as incentive to further training in companies and specifically for diverse groups of individuals,
- establish local level initiatives and partnerships which in some countries have proven to be successful, and
- demonstrate good practice of inclusive ICT training programmes in their countries and at European level.

Appendix

List of supporters

Fiona Aldridge Learning and Work Institute

Christina Allmeroth CompTIA

Priska Altorfer wikima4 AG and member of the European Taskforce for Women in IT for The Council of European Professional Informatics Societies (CEPIS)

María Alvarez de Linera ISDI

Beatriz Ardid PeopleMatters

Jose Manuel Azorin-Albiñana Asociación Seniors Vidafone

Liz Bacon Abertay University

Marta Balius Generation Spain

Begoña Baños Fundación Altius

Natalie Barkei Bitkom e.V.

Helena Bayo -

Vivianne Bendermacher Techionista

Wilfried Berlin Airbus

Antonio Bermejo Zeta Gestión

Isidre Bermúdez Ferran Fundacíon Esplai

Carlos Bertran Fundación Generation Spain Farid Bidardel CodeDoor

Alexander Böhne BDA - Bundesvereinigung der Deutschen Arbeitgeberverbände

Antoine Bonenkamp PEOPLECERT

Viktor Bos Amsterdam Economic Board

Adriana Botelho KeepCoding

Anna Bramska Ministry of Digital Affairs

Olivier Brechard WebForce3

Laura Bujanda RED.ES

Laurentiu Bunescu ALL DIGITAL

Ángela Caballero González LA RUECA ASOCIACIÓN

Cristina Camerlingo Campo Carrefour

Lucia Candeira Federación Mujeres Jóvenes

Trinidad Cano Castillo La Rueca Asociación

Robbie Carroll Amazon Web Services

Juan David Casasbuenas Nesta

Cecilia Castaño Collado Universidad Complutense de Madrid Laura Castela Fundación Telefónica

Jessica Cecil BBC Make it Digital

Mary Cleary Irish Computer Society

Ekaterina Clifford ALL DIGITAL

Ian Clifford ALL DIGITAL

Blanca Cobo Vodafone Spain

Emilio Cortes Paton Bt España

Max Costick Amazon Web Services

Marisa Cotera Agencia Para El Empleo -Ayuntamiento De Madrid

Margaret Cox ICE Group

Olivier Crouzet Ecolé 42

Gloria Cuadrado Carrefour

Miriam Darias Fundación Santa Maria La Real

Thierry David Ministry of Economy & Finances -General directorate for enterprises

Roger De Keersmaecker

Cristina de la Cuesta Marina Fundación Telefónica David De San Benito Cisco

Sjoerd de Vries University of Twente

Alejandro Debenedet Itwnet International

Claire Donaldson Department for Digital, Culture, Media and Skills

Andriana Doncic Department for Digital, Culture, Media and Sport

Mary Lisa Durban Orange Foundation

Polina Dvinskihh Estonian Ministry of Econimic Affairs and Communications

Irene Ek Swedish Agency for Growth Policy Analysis

Nacho Escobar

Eva Fabry European Centre for Women and Technology - ECWT

Fiona Fanning Certiport, a Pearson VUE Business

Paola Fantini EIT Manufacturing

Arantza Fernandez Fundacion Secretariado Gitano

Luis Fernandez Sanz Universidad de Alcalá

Bárbara Ferrer GMV

Joel Ferrer Puig Fundación Esplai. Ciudadanía Comprometida

Harald Fisch MINT Zukunft schaffen

Anders Flodstrom EIT Digital

Loïc Forgeois Orange **Debbie Forster** Tech Talent Charter

Julie Foulon MolenGeek

Maria Jose Fraile Martinez Meta4

Fátima Gallo ISDI

Marta Garcia- Valenzuela Talengo

Samia Ghozlane Grande Ecole du Numérique

Fay Giannarou Ministry Of Administrative Reconstruction-Greece

Avi Gillis Department for Digital, Culture, Media & Sport

David Giron Codam

Krzysztof Glomb Institute of Innovative Technologies EMAG

Wolfgang Gollub Arbeitgeberverband Gesamtmetall

María González Fundación Balia

Anna Greenhalgh Business in the Community Ireland

Dominique Gross Diagram SL

Jean-Marc Guiol Total Global HR Services / Opérations RH

Jean Guo Konexio

Erika Gutmane CEPIS

Monika Hackel Bundesinstitut für Berufsbildung (BIBB) Anneke Hacquebard Ad hoc Group (Education and Certification) at CEN TC428

Dominik Häfner JOBLINGE gAG Frankfurt RheinMain

Peter Hagedoorn OCÉ

Philipp Haines JOBLINGE

Adrian Head Huawei Technologies

Ellen Helsper London School of Economics and Political Science

Natalia Hernández Rojo Globomedia

Jonas Hettwer Joblinge gAG Berlin

Patrick Hijlkema EOH

Tiffiny Humphries Maharishi Institute

Māra Jākobsone LIKTA (Latvian Information and Communication Technology association)

Binta Jammeh Konexio

Heena Jethwa IBM

Carsten Johnson Cisco Systems

Hayley Josephs Browne Jacobson

Karolina Kaleta Joblinge

Soni Kanabar CSR Europe

Bhavna Karanmi Omnicom Media Group Claudine Kariger Ministry of State/Media and communications

Kim Keller German Federal Employment Agency

Gary J Kildare

Anne Kjaer Riechert ReDI School

Tobias Koeppel Cisco Systems - Cisco Networking Academy

Marianne Kolding

Katarzyna Koziol DIGITALEUREOPE

Jacek Królikowski Information Society Development Foundation

Jan Kundziołka Exempt From Theory - Social Wolves

Cecilia La lacono Simplon.co

Audrey Landon Social Builder

Rob Langford Kaspersky Lab

Bruno Lanvin INSEAD

Silvia Lavado Anguera Universidad Europea

Markus Lecke Deutsche Telekom

Katja Legisa Digital Leadership Institute

Maria Lema Bartolome La Rueca Asociacion

Marcin Leszczylowski NESsT

Antonio Llorente La Rueca Asociacion **Cecilia Lo lacono** Simplon.co

Daniel Lopez Media Interactiva

Christian Lorenz DGfP - Deutsche Gesellschaft für Personalführung

India Lucas techUK

Robin Lundberg Kiron Open Higher Education gGmbH

MIruna Marin Cisco

Joanne Marke IBM

Jose Ignacio Marquez Bankia

Quentin Martens King Baudouin Foundation

Susan Martin Sue Martin Consulting

Miguel Angel Martín Sánchez Meta4 Spain S. A.

Lucía Martínez Generation Spain

Alba Martínez Generation Spain

Deborah McCann Department for Education

Klaus Melchers, GFN AG, Heidelberg

Laura Mendiguren BT España

Mónica Mezquita Fundae

Ivica Milicevic SOLAS

Aida Millán AMETIC

Victor Molero

Alejandra Montoro Vodafone

Azahara Morales Durán Securitas Direct

Gemma Moratalla Arribas Carrefour

Stanley Mugisha University Of Genoa

Jana Kathinka Müller DIHK

Ralph Müller-Eiselt Bertelsmann Stiftung

Paulina Munoz ReDI School

Gerry Murphy VMware

Beatriz Nava Pérez Fundación Accenture

Rebeca Navarro Vodafone Atienza

Valentin Negoita APDETIC Romania

Emily Nelson Ballymun Job Centre

Ana Cristina Neves Fundação para a Ciência e a Tecnologia (Portuguese Foundation for Science and Technology)

Benjamin Nguyen ReDi School of Digital Integration

Jennifer Nicolay JOBLINGE gAG FrankfurtRheinMain

Ruben Nieuwenhuis TechConnect

Jonathan Novotny ode for Change

Jack Orlik Nesta

Rachel Orr GSK Marta Ortiz Ginestal La Rueca Asociación

Agnieszka Orzechowska Educational Research Institute

Wolfgang Percy Ott Cisco Systems

Johanna Ottolinger Salesforce

Gareth Owen Association of Chartered Certified Accountants

Dimosthenis Papakonstantinou CRETHIDEV

Andrea Parola European e-Skills Association

Holger Pelz Niedersächsisches Kultusministerium

Laura Penin Anton K2 Partnering Solutions

Chris Pennell IDc

Raúl Pérez Fundación Secretariado Gitano

Carlota Perez Aguilar Entrepreneur

Elena Perez Berjon Banco Santander

Roos Peters Codam Coding College

Maggie Philbin TeenTech, BCS Women

Armonia Pierantozzi Simplon.co

Rebecca Plant Microsoft

Fabrizio Porrino acilityLive

Joanna Pruszynska Witkowska CodersTrust Polska

Camille Radosta Social Builder Tommi Raivio CSR Europe

Poul Erik Rasmussen euro.digital

Ingo Rauhut VDI e.V.

Alvaro Retorillo Foundation Santa Maria la Real

Andre Richier European Commission

Alexander Riedl uropean Commission, DG CONNECT, Digital Economy and Skills unit

Victor Rodrigo Raya Red.es

Irene Rodriguez Fundación Secretariado Gitano

Javier Rodriguez Zapatero

Manuel Roque Twice Consulting

Malin Rosqvist RISE SICS

Beatriz Ruiz de Llano Fundación Balia

Ramón Ruiz Pozuelo La Rueca Asocación

George Ryan FIT CLG

Malgorzata Ryniak Volvo Group IT

Marta Sánchez Fernández Securitas Direct

Laura Sánchez García Federación Mujeres Jóvenes

Dr. Afsar Sattari German Association of Women Engineers

Stefanie Sausele RKW Kompetenzzentrum Lily Scheuerpflug Kiron Open Higher Education

Christiane Schubert JOBLINGE gAG FrankfurtRheinMain

Patricia Serrano Lopez Fuenlabrada City Hall

Aoife Sheehy Fastrack into Technology

Avi Snir Elevation

Helin Sööt Estonian Ministry of Econimic Affairs and Communications

Anna Stépanoff Wild Code School

Carmen Stephan CodeDoor

Lilia Stoyanov Transformify Ltd.

Silvia Carla Strada Politecnico di Milano

Małgorzata Szyszko Education Foundation Perspektywy

Mara Tanelli Politecnco di Milano

Ana Tejero Rodríguez Fuenlabrada City Hall

Daniel Terán

Guillaume Thureau Factoría F5

Stephen Timms Parliament

Tamas Tompa Codecool

Alejandro Javier Tosina González red.es

Austeja Trinkunaite CEPIS

Clara Ubeda Fundación Altius **Eva Vaca** Cáritas Madrid - vicaría II **Rodrigo Zardoya** Fundacion Dedalo

Maria Valdes de la Colina Mead Johnson Nutrition - Head of Human Resources

Altheo Valentini Fondazione Patrizio Paoletti

Freddy Van den Wyngaert EuroCIO

Niels van der Linden Capgemini Invent

Trijntje Van Dijk IT Professionalism Consultation

Tamira Van Roeyen Techionista

Jose Varela Ferrio UGT

Ismini Vasileiou University of Plymouth

Maite Villalba Universidad Europea de Madrid

Blanca Villamía Fundación Orange

Kirsten Vollmer Federal Institute of Vocational Education and Training

Fredrik von Essen IT&Telekomföretagen

Fiona von Prónay JOBLINGE Dachorganisation

Sjoerd de Vries University of Twente

Caitriona Whelan NALA

Anna Wohlfarth SNV Stiftung Neue Verantwortung

Nenja Wolbers Stiftung Digitale Chancen

Carla Zaldua code4jobs

Maria Zambudio Ibeas Fundación Codespa

ICT workforce compositions

Figure 40 ICT workforce compositions



Figures 37 and 38 illustrate the composition of the ICT workforce in each of the six assessed European countries, Germany, Spain, Ireland, France, Poland and United Kingdom. In five of the six countries, the biggest share of ICT workers falls into the category of core ICT practitioners at the professional level with the exception of Spain. Here, the biggest share of workers falls into the category of core ICT practitioners at the associate/technician level. The second highest share of this group can be found in Ireland. Germany and UK have the highest shares of management, architecture and analysis workers, followed by France and Ireland. In all countries, the share of other ICT practitioners at professional level is the lowest.



Figure 41 ICT workforce compositions continued

Endnotes

1 McKinsey (2018) Delivering Through Diversity. Retrieved from:

https://www.mckinsey.com/~/media/McKinsey/B usiness%20Functions/Organization/Our%20Insight s/Delivering%20through%20diversity/Deliveringthrough-diversity_full-report.ashx

- 2 Eurostat data, for South Africa OECD data and Department of Higher Education and Training (2018) 'Fact Sheet on NEETs'. Pretoria.Department of Higher Education and Training.
- 3 Eurostat data, for South Africa see Adelzadeh, A. (2017) 'Modelling Future Demand and Supply of Skills in South Africa. Technical Report: 10 Year Skill Demand and Supply Forecast', Report prepared for the Department of Higher Education and Training, Pretoria.
- 4 Women in Digital: https://ec.europa.eu/digitalsingle-market/en/women-ict
- 5 Pledgers are Coalition members who submitted one (or more) pledge(s). A pledge is a concrete commitment to carry out an action to reduce the digital skills gap in Europe, addressing one of the identified challenges/actions mentioned in the Members Charter.
- 6 The Digital Skills and Jobs Coalition (DSJC): https://ec.europa.eu/digital-singlemarket/en/digital-skills-jobs-coalition
- 7 Skills Agenda for Europe: https://ec.europa.eu/social/main.jsp?catId=1223
- 8 McKinsey (2018) Delivering Through Diversity. Retrieved from:

https://www.mckinsey.com/~/media/McKinsey/B usiness%20Functions/Organization/Our%20Insight s/Delivering%20through%20diversity/Deliveringthrough-diversity_full-report.ashx

9 Phillips, K. W., Liljenquist, K. A., & Neale, M. A.
(2009). Is the Pain Worth the Gain? The Advantages and Liabilities of Agreeing With Socially Distinct Newcomers. Personality and Social Psychology Bulletin, 35(3), 336–350.

- 10 https://www.creditsuisse.com/corporate/en/media/news/articles/me dia-releases/2012/07/en/42035.html
- 11 https://www.sciencedaily.com/releases/ 2006/04/060410162259.htm

- 12 Lehohla, P. (2005) "Prevalence of disability in South Africa', Census 2001 Report, Statistics South Africa.
- 13 Eurostat: Women in Science and Technology (10/02/2018)
- 14 MICT SETA (2018) 'Sector Skills Plan 2019 to 2024', Final version. Retrieved from: http://www.mict.org.za
- 15 Hüsing, T., Korte, W., Dashja, E.: e-Skills in Europe -Trends and Forecasts for the European ICT Professional and Digital Leadership Labour Markets (2015-2020). empirica, 2017
- 16 House of Commons, Science and Technology Committee (2016). Digital skills crisis – Second Report of Session 2016–17. Report, together with formal minutes relating to the report. Retrieved from:

https://www.parliament.uk/business/committees/ committees-a-z/commons-select/science-andtechnology-committee/inquiries/parliament-2015/digital-skills-inquiry-15-16/

- 17 Delamaide, D. (2018, August 3). German economy faces shortages as growth tests limits.
 Handelsblatt Global. Retrieved from https://global.handelsblatt.com/companies/germa n-economy-faces-shortages-as-economy-reachescapacity-limits-895822
- 18 Bundesministerium des Innern, für Bau und Heimat: https://www.bmi.bund.de/SharedDocs/pressemitt eilungen/DE/2016/09/asylsuchende-2015.html
- 19 OECD. (2015). Connecting with Emigrants. Retrieved from https://www.oecdilibrary.org/content/publication/9789264239845en

20 Microsoft and KRC Research (2017). How role models are changing the face of STEM in Europe. Retrieved from https://news.microsoft.com/uploads/prod/sites/9 3/2018/04/How-role-models-are-changing-theface-of-STEM-in-Europe.pdf

- 21 Ibid.
- 22 WISE: From classroom to boardroom the STEM pipeline:

https://www.wisecampaign.org.uk/statistics/fromclassroom-to-boardroom-the-stem-pipeline/

- 23 See Tech Partnership (2017b), Half of women actively discouraged from tech careers, QA study finds.
- 24 See Royal Society of Edinburgh (2012), Tapping all our Talents. Women in science, technology, engineering and mathematics: a strategy for Scotland.
- 25 See National Learning and Work Institute (2017), Three million apprenticeships – Building ladders of opportunity.
- 26 Mooney (2018), ICT and business skills in high demand.
- 27 Górniak (2015) 'The Hidden Human Capital'. Data collection for this study was through online surveys, group interviews with representatives of government, employers and training institutions, and in-depth interviews with representatives of central and regional administration, academia, employer organizations, etc.
- 28 Alain Dehaze, Adecco Group Chief Executive Officer: 2018 Global Talent Competitiveness Index: Talent Diversity and Competitiveness will fuel the future of work.
- 29 Peter Zemsky, Deputy Dean and Dean of Innovation of INSEAD: https://www.insead.edu/news/2018-gtci-talentdiversity-competitiveness-fuel-future-of-work
- 30 Women in Digital: https://ec.europa.eu/digitalsingle-market/en/women-ict
- 31 The Digital Skills and Jobs Coalition (DSJC): https://ec.europa.eu/digital-singlemarket/en/digital-skills-jobs-coalition
- 32 Skills Agenda for Europe: https://ec.europa.eu/social/main.jsp?catId=1223
- 33 For skill levels, see International Labour Office (2012) 'International Standard Classification of Occupations', pp. 12-15.
- 34 Cedefop (2016). France: Mismatch priority occupations. Online article, Skills Panorama. Retrieved from: https://skillspanorama.cedefop.europa.eu/en/anal ytical_highlights/france-mismatch-priorityoccupations
- 35 Ministère de l'Éducation nationale, de l'Enseignement supérieur et de la Recherche, Ministère des Familles, de l'Enfance et des Droits des femmes, Secrétariat d'Etat chargé du numérique, and Ministère de l'Economie et des Finances (2017). Plan sectoriel mixité dans les métiers du numérique. Retrieved from:

https://www.economie.gouv.fr/files/files/PDF/pla n_mixite_numerique_vf.pdf

- 36 Eurostat data for 2015.
- 37 Grande École du Numérique (2017). Mixité dans le high-tech: participez à l'enquête Gender Scan 2017! Online article, Grande École du Numérique. Retrieved from: www.grandeecolenumerique.fr/gender-scan-

2017/ 38 Office of the Prime Minister, France (2013).

Séminaire gouvernemental sur le numérique: Feuille de route du Gouvernement. Retrieved from:

https://www.economie.gouv.fr/files/seminairenumerique-axe.pdf

- 39 Ministère de l'Enseignement supérieur et de la Recherche (2013). France Université Numérique: Le numérique au service d'une Université en mouvement. Retrieved from: https://cache.media.enseignementsuprecherche.gouv.fr/file/France_universite_numeriq ue/83/6/DPGF_SC1_BAT_272836.pdf
- 40 The "emplois d'avenir" are jobs sponsored by the Government (75% of the minimum wage) in the non-business sector to give under-qualified or unqualified youth the opportunity to get their first job or acquire skills to get better jobs. They are full-time jobs with long-term contracts or shortterm ones from one to three years
- 41 Ministère de l'Éducation nationale, de l'Enseignement supérieur et de la Recherche, Ministère des Familles, de l'Enfance et des Droits des femmes, Secrétariat d'Etat chargé du numérique, and Ministère de l'Economie et des Finances (2017). Plan sectoriel mixité dans les métiers du numérique. Retrieved from: https://www.economie.gouv.fr/files/files/PDF/pla n_mixite_numerique_vf.pdf
- 42 Federal Statistical Office (DESTATIS). (2017). Integrationsindikatoren 2005-2016: Menschen mit Migrationshintergrund haben weiterhin Nachteile. Wiesbaden, Germany. Retrieved from https://www.destatis.de/DE/PresseService/Presse /Pressemitteilungen/2017/11/PD17_413_12521.h tml
- 43 Ibid.
- 44 Bundesagentur für Arbeit: Der Arbeitsmarkt im März 2018 (29.3.2018, Presseinfo Nr. 10)
- 45 Ministry of Education and Research. (2017). Report on Vocation Education and Training 2017. Germany. Retrieved from

https://www.bmbf.de/en/informationmaterial.php

- 46 https://www.bmbf.de/de/zukunftsprojektindustrie-4-0-848.html
- 47 https://www.arbeitenviernull.de/
- 48 https://www.girls-day.de/
- 49 https://www.klischee-frei.de/
- 50 https://www.cybermentor.de/
- 51 McNaboe, J. et al. (2017). Vacancy Overview 2016. Dublin: Further Education and Training Authority (SOLAS).
- 52 https://fit.ie/
- 53 National Youth Council of Ireland (2017). CSO Live Register: Youth Council reaction to latest figures.
 Press release, 7 December.
 http://www.youth.ie/nyci/CSO-Live-Register-Youth-Council-reaction-latest-figures-1
- 54 McNaboe, J. et al. (2017). Vacancy Overview 2016. Dublin: Further Education and Training Authority (SOLAS).)
- 55 Central Statistics Office (CSO)(2016). Women and Men in Ireland 2016. Dublin: CSO. http://www.cso.ie/en/releasesandpublications/ep /p-wamii/womenandmeninireland2016/
- 56 Tech Central (2017). Women Reboot programme goes national. Press release, 5 September 2017. http://www.techcentral.ie/women-reboot/.
- 57 https://mc.gov.pl/
- 58 http://umiejetnoscicyfrowe.pl/
- 59 https://ec.europa.eu/digital-singlemarket/en/digital-skills-jobs-coalition
- 60 Dashja et al. (2015) 'e-Leadership Skills for Small and Medium Sized Enterprises', p. 6.
- 61 Cedefop (2016). Poland: Mismatch priority occupations. Skills Panorama. Online article, 10/2016. Retrieved from: http://skillspanorama.cedefop.europa.eu/en/analy tical_highlights/poland-mismatch-priorityoccupations
- 62 Moyo, A. (2017) 'SA sees spike in IT job vacancies', ITWeb, retrieved from: https://www.itweb.co.za/content/XlwrKxv3Dmk7 mg1o
- 63 Adelzadeh, A. (2017) 'Modelling Future Demand and Supply of Skills in South Africa. Technical Report: 10 Year Skill Demand and Supply Forecast', Report prepared for the Department of Higher Education and Training, Pretoria.

64 Department of Higher Education and Training (2018) 'Fact Sheet on NEETs'. Pretoria. Department of Higher Education and Training. Retrieved from:

http://www.dhet.gov.za/Planning%20Monitoring% 20and%20Evaluation%20Coordination/WED%20Fa ct%20sheet%20on%20NEETs_Final_Version_29%2 0Aug%202018.pdf

- 65 MICT SETA (2017) 'Sector Skills Plan 2018 to 2023', Final version. Retrieved from: http://www.mict.org.za
- 66 Statistics South Africa (2018) 'Quarterly Labour Force Survey' Quarter 1:2018, Statistical release P0211, Retrieved from: http://www.statssa.gov.za/publications/P0211/P0 2111stQuarter2018.pdf
- 67 OECD (2019) 'Gender gaps in employment rates', OECD Employment Database. Retrieved from: http://www.oecd.org/employment/emp/onlineoe cdemploymentdatabase.htm
- 68 Department of Higher Education and Training, Republic of South Africa (2011) 'National Skills Development Strategy III'. Retrieved from: www.dhet.gov.za/SitePages/SkillsDevelopmentNe w.aspx
- 69 Department of Higher Education and Training, Republic of South Africa (2013) 'White Paper on Post School Education & Training: Building and Expanded, Effective and Integrated Post-School System'
- 70 El Servicio Público de Empleo Estatal (SEPE).
 (2017). Empléate: Ofertas de empleo y bolsa de trabajo. Retrieved from https://www.empleate.gob.es/
- 71 Carcillo, S., Fernández, R., Königs, S., & Minea, A. (2015). NEET Youth in the Aftermath of the Crisis: Challenges and Policies. OECD Social, Employment and Migration Working Papers. (164).
- 72 Martínez, J. P., & Bustamante, J.M.D. (2016). El Empleo y las Cualificaciones Profesionales en la Industria de las TIC.
- 73 Ministry of Energy, Tourism and Digital Agenda, Government of Spain. (2013). Digital Agenda for Spain 2013-2015. Retrieved from http://www.agendadigital.gob.es/digitalagenda/Paginas/digital-agenda-spain.aspx.
- 74 Ministry of Employment and Social Security, Government of Spain. (2014). Youth Employment Operational Program. Retrieved from http://www.seat.mpr.gob.es/portal/areas/politica _local/coop_econom_local_estado_fondos_europ

eos/fondos_europeos/2014-2020_FSE/fse_poej.html

- 75 Ministry of Employment and Social Security, Government of Spain. (2013). Strategy for Entrepreneurship and Youth Employment. Retrieved from http://www.empleo.gob.es/es/garantiajuvenil/info rmate.html
- 76 Ministry of Employment and Social Security, Government of Spain. (2014). Youth Employment Operational Program. Retrieved from http://www.seat.mpr.gob.es/portal/areas/politica _local/coop_econom_local_estado_fondos_europ eos/fondos_europeos/2014-2020_FSE/fse_poej.html
- 77 City of Barcelona. (2017). Barcelona Digital City. Retrieved from http://ajuntament.barcelona.cat/digital/en
- 78 Government of Galicia. (2015a). Digital Agenda of Galicia 2020. Retrieved from https://amtega.xunta.gal/es/agenda-digital-degalicia
- 79 Basque Government. (2013). Grand Coalition -Pledge of Basque EIT Coalition. Retrieved from https://ec.europa.eu/digital-singlemarket/en/grand-coalition-pledge-basque-eitcoalition
- 80 Not to be confused with the BME population, many of which are born in the UK. No comparable data is available for the BAME population.
- 81 BCS (2017). Diversity in IT 2017 Shaping Our Future Together. Swindon: BCS. Retrieved from: http://www.bcs.org/category/19217?src=hs4
- 82 Ibid.
- 83 Derived from Eurostat data for 2015. The Tech Partnership figure for both 2015 and 2016 is 17%, see The Tech Partnership & BCS (2016), Women in IT Scorecard 2016.
- 84 Royal Society of Edinburgh, The (2012). Tapping all our Talents. Women in science, technology, engineering and mathematics: a strategy for Scotland. Edinburgh: The Royal Society of Edinburgh
- 85 National Learning and Work Institute (2017). Three million apprenticeships – Building ladders of opportunity. Leicester: Learning and Work Institute
- 86 House of Commons, Science and Technology Committee (2016). Digital skills crisis – Second Report of Session 2016–17. Report, together with formal minutes relating to the report. Retrieved

from:

https://www.parliament.uk/business/committees/ committees-a-z/commons-select/science-andtechnology-committee/inquiries/parliament-2015/digital-skills-inquiry-15-16/

- 87 National Learning and Work Institute (2017). Three million apprenticeships – Building ladders of opportunity. Leicester: Learning and Work Institute
- 88 Gathercole, E. (2017). Making sense of the plans for T-Levels. Online article. FE Week Reporter, 6 March. Retrieved from: https://feweek.co.uk/2017/03/06/making-senseof-the-plans-for-t-levels/
- 89 https://techtalentcharter.co.uk/
- 90 https://www.mckinsey.com/businessfunctions/organization/our-insights/is-there-apayoff-from-top-team-diversity
- 91 Phillips, K. W., Liljenquist, K. A., & Neale, M. A.
 (2009). Is the Pain Worth the Gain? The Advantages and Liabilities of Agreeing With Socially Distinct Newcomers. Personality and Social Psychology Bulletin, 35(3), 336–350.
- 92 https://www.creditsuisse.com/corporate/en/media/news/articles/me dia-releases/2012/07/en/42035.html
- 93 https://www.sciencedaily.com/releases/2006/04/ 060410162259.htm
- 94 Dromey, J. and McNeil, C. (2017). Skills 2030 Why the adult skills system is failing to build an economy that works for everyone. London: Institute for Public Policy Research.
- 95 Conseil National du Numérique (CCNum)(2013). Citizens of a Digital Society – A New Inclusion Policy Based on Accessm, Digital Literacy, Support and Empowerment. Report submitted to the Minister Delegate with responsibility for Small and Medium-sized Enterprises, Innovation and the Digital Economy. Retrieved from: https://cnnumerique.fr/files/uploads/2014/01/Ra pport-inclusion-traduit-anglais_V2-1.pdf
- 96 empirica (2019): Supply and demand of ICT professional labour in Europe – status quo and foresight 2015 -2025. Working Paper (forthcoming)
- 97 OECD (2018). Skills For Jobs. Retrieved from: http://www.oecd.org/els/emp/Skills-for-jobsbrochure-2018.pdf
- 98 https://www.oecdskillsforjobsdatabase.org/

- 99 Common European framework for ICT Professionals in all industry sectors: http://www.ecompetences.eu/
- 100 European e-Competence Framework: Career and assessment tools: http://www.ecompetences.eu/de/career-andassessment-tools-3/
- 101 2018 Global Talent Competitiveness Index: Talent Diversity and Competitiveness will fuel the future of work: https://www.insead.edu/news/2018-gtcitalent-diversity-competitiveness-fuel-future-ofwork
- 102 empirica: Policy Brief: ICT Skills Training for Diversity December 2018