UNLOCKING A MORE DIVERSE WORKFORCE IN THE TECHNOLOGY SECTOR

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Abstract

The technology sector struggles with a diversity problem. As one of the industries facing the highest skills shortages, the technology sector can stand to benefit from a more diverse and inclusive approach to training, recruiting and retaining under-represented talent. Women, people of racial and ethnic minority backgrounds, youth and migrants all face unique barriers to entering and progressing in technical careers. This paper describes these barriers and proposes a range of actions that governments, civil society and businesses can take to build a more diverse technology sector. By addressing stereotypes, removing obstacles to training and building a more inclusive work culture, all stakeholders can work together to secure a more prosperous and productive technology workforce.

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Introduction

The technology sector struggles with a significant diversity and inclusion problem – women, people of racial and ethnic minority backgrounds, youth and migrants are all under-represented and face unique challenges in accessing jobs in the sector.[1] Differences in interests, abilities and aspirations widen with age, with a lack of role models particularly in childhood and adolescence discouraging many students from pursuing a career in technology. Barriers to training in adulthood affect some groups more than others and prevents workers from adequately preparing for current and future skill needs. Existing discrimination and bias, especially during recruitment, and a lack of career guidance and information about training options restricts career pathways and entry into the sector. Finally, unfavourable working conditions including a lack of flexibility and a harsh working culture affects progression, promotion and retention prospects for diverse workers.

Whilst progress has been made in recent years, greater action is required in order to secure a more inclusive and diverse workforce. Stakeholders need to work together to address a range of barriers and improve representation in technology and technical roles. Unlocking a more diverse workforce not only improves inclusivity and representation but can also help to alleviate labour shortages. By tapping into a more diverse workforce, employers can expand their talent pool and help to fill skills shortages, which are especially prominent in the technology sector (International Labour Organization, 2020[1]). By retaining a more diverse workers, employers can reap the financial gains, with gender and cultural diversity strongly associated with firm productivity (Criscuolo et al., 2021[2]). By prioritising skills and supporting a lifelong learning, businesses can attract and keep more diverse employees, and by addressing structural barriers in school and in adult training, governments and civil society can support a more inclusive technology future.

This paper presents an overview of the state of under-representation in the technology sector, with a particular focus on European and American data, and from a gender, race and ethnicity, age and migrant status perspective. It identifies the barriers to full representation and proposes a range of approaches to address these barriers. The evidence gathered suggests that, with the support of governments, employers, trade unions and training providers, the technology sector can achieve a more diverse and inclusive workforce.

[1] Reference to 'the technology sector' in this report is done so to denote the Science, Technology, Engineering and Mathematics (STEM) industry, the Information and Communications Technology (ICT) industry, and technical roles in other industries.

Key policy messages

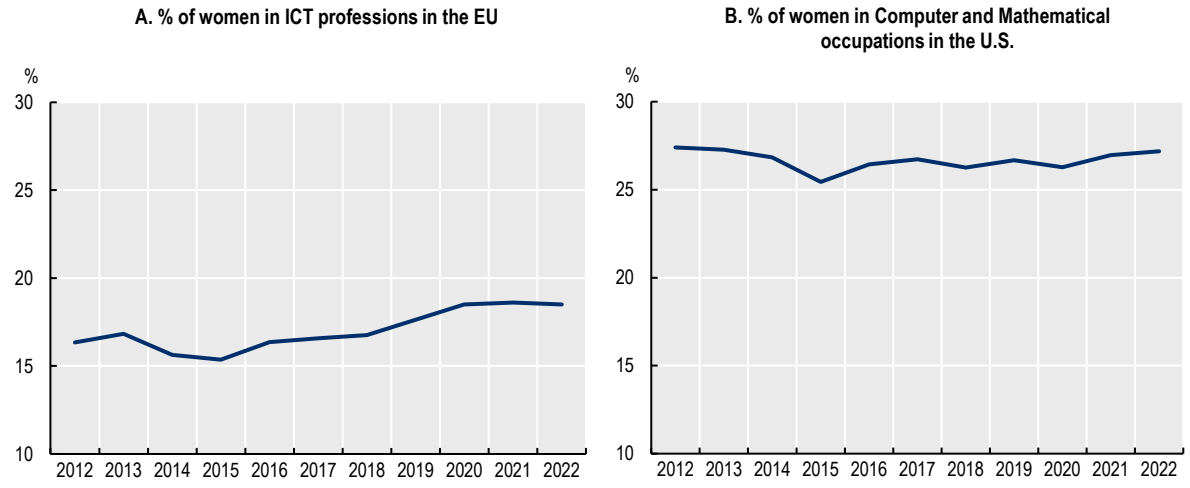
- Governments should work with schools to develop unbiased teaching materials and foster less discriminatory teaching practices to address stereotypes about technology careers that are formed at an early age.
- All stakeholders – schools, public employment services, governments, the non-profit sector, social partners and employers – should actively promote successful role models for women and minorities in the technology sector, and provide greater access to training and career information related to professions in technology.
- Governments and education and training providers should co-operate to address the numerous obstacles to adult participation in learning opportunities, for example by fostering the adoption of more flexible learning content or expanding funding options to make training more accessible.
- Education and training providers should consider making learning programmes shorter and more modular, and expand delivery options to increase accessibility and encourage participation amongst a wider group of adult learners. The non-profit sector can support the work of training providers by offering targeted, 'bootcamp' style programmes for diverse learners.
- Employers and social partners should encourage workers to engage with external training opportunities and deliver more on-the-job training, providing funding support where possible.
- Businesses should broaden pathways for recruitment into the technology sector by applying skills-based approaches and implementing targeted recruitment initiatives in order to attract and hire more diverse talent.
- Employers can collaborate with learning institutions in the development and delivery of training programmes, and can engage with skills-first methods by partnering with providers to offer post-training work placements.
- Businesses and social partners can promote improved transparency in working conditions by increasing data collection efforts regarding diversity and performance metrics. Senior leadership should make active and clear commitments to improving diversity and inclusion.
- Businesses and social partners should put in place a range of inclusive workplace practices to address unconscious bias, fight overt discrimination and support the progression and retention of women and minorities in technology professions. This can include but is not limited to mandating diversity on recruitment panels, delivering unconscious bias training, and providing mentors.
- All stakeholders should understand their local diversity issues and can consider developing targeted awareness campaigns to reach out to underserved communities to highlight the benefits of working in the technology sector.

Under-representation in technology

Women

In both the European Union and the United States, women are less likely to work in fields related to technology. In Europe, only 18% of ICT specialists are women in 2022 (Panel A of Figure 1). Similarly, in the United States men still make up 73% of computer and mathematical professions, leaving women to hold only 27% of these jobs (Panel B of Figure 1). Despite the difficulties in comparing across the two regions, little progress has been made over the past decade, with the proportion of women in these occupations increasing only slightly since 2012 in Europe and remaining stagnant in the United States.

Figure 1. Women still represent a small proportion of technology professionals



Note: Occupations in the two panels are not directly comparable.
Source: EU-LFS and CPS.

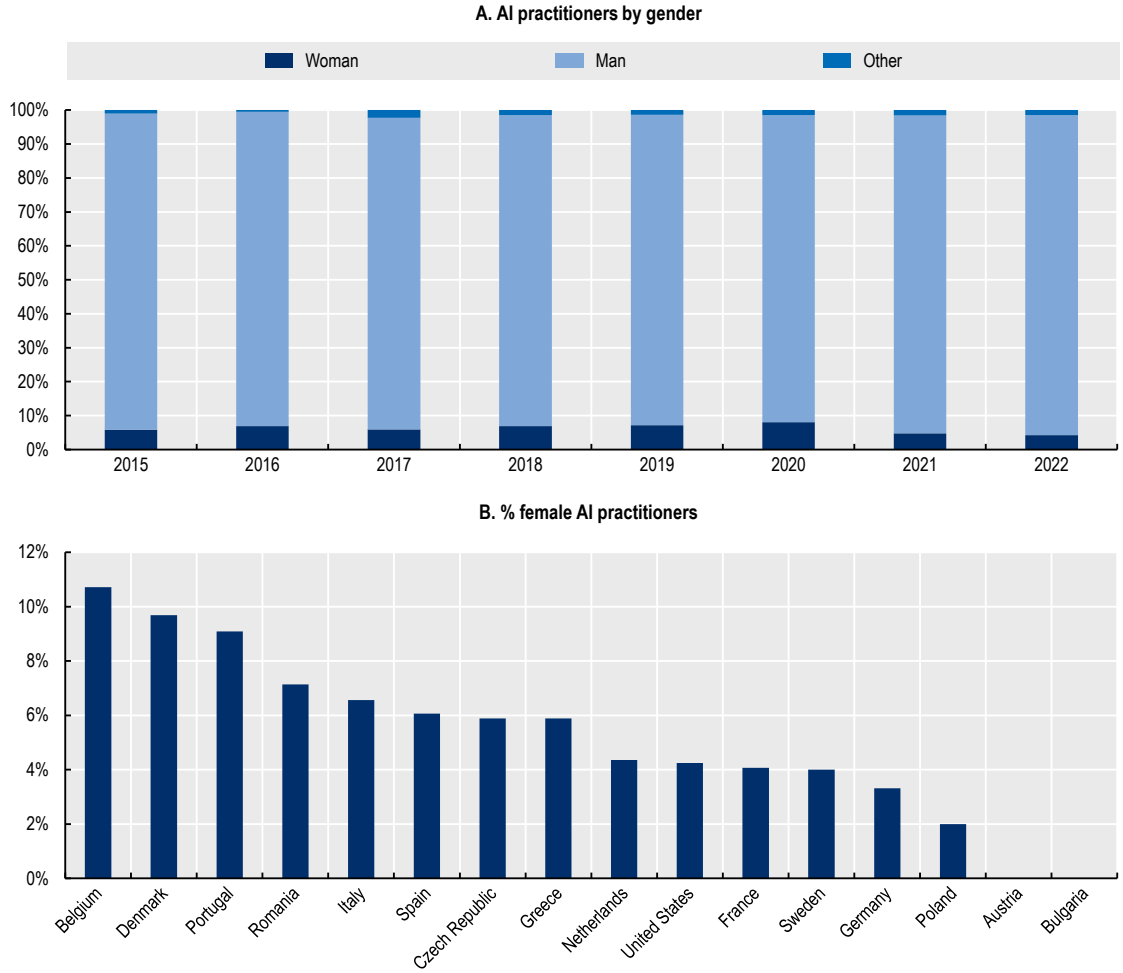
Despite this under-representation, some gains have been made over recent years amongst the broader STEM profession. In the United States, women have been entering the STEM workforce at a faster rate than men – between 2011 and 2021, the number of women in STEM increased by 31%, while the number of men grew by only 15% (National Center for Science and Engineering Statistics, 2023[3]). This data is encouraging as it shows that diversity within the STEM profession has been improving over the past decade, with more recent entrants into the profession being women. Nonetheless, greater improvements can still be made, particularly amongst specialised sub-fields of STEM.

Indeed, under-representation is especially pronounced in highly technical, frontier fields. Exploiting a longitudinal survey conducted on AI practitioners registered in the Stackoverflow platform, OECD.AI (2023[4]) finds that the proportion of women has remained relatively stable over the past decade, fluctuating

between 5% and 8% of data scientists and machine learning experts (Panel A of Figure 2). There are also large differences between countries – for example, in 2022, women represented around 10% of AI practitioners in Belgium and Denmark, compared to 4% in the United States and they were virtually not represented in countries such as Austria and Bulgaria (Panel B of Figure 2).

Under-representation in the labour market reflects under-representation in science-related tertiary education – the share of female STEM graduates is only 33% in the European Union and 34% in the United States (World Bank, 2020[5]).[2] Globally, female ICT graduates make up only 1.7% of all graduates, compared to 8.2% for men (World Economic Forum, 2022[6]). Furthermore, men are more than twice as likely than women to report that they have technology skills on their LinkedIn profile (World Economic Forum, 2020[7]).

Figure 2. Women are heavily under-represented among AI practitioners



Note: In line with the OECD.AI methodology, AI practitioners consist of respondents identifying themselves as either a 'data scientist' or a 'machine learning expert' in the annual Stackoverflow survey. More information on the methodology is available here: https://oecd.ai/en/stackoverflow-survey-data. Panel B refers to 2022.
Source: OECD elaborations based on OECD.AI (2023[4]).

[2] OECD calculations for the European Union based on data by country. Calculations take latest available year of data in the World Bank's Gender Data Portal. For most countries this is 2016 or 2017.

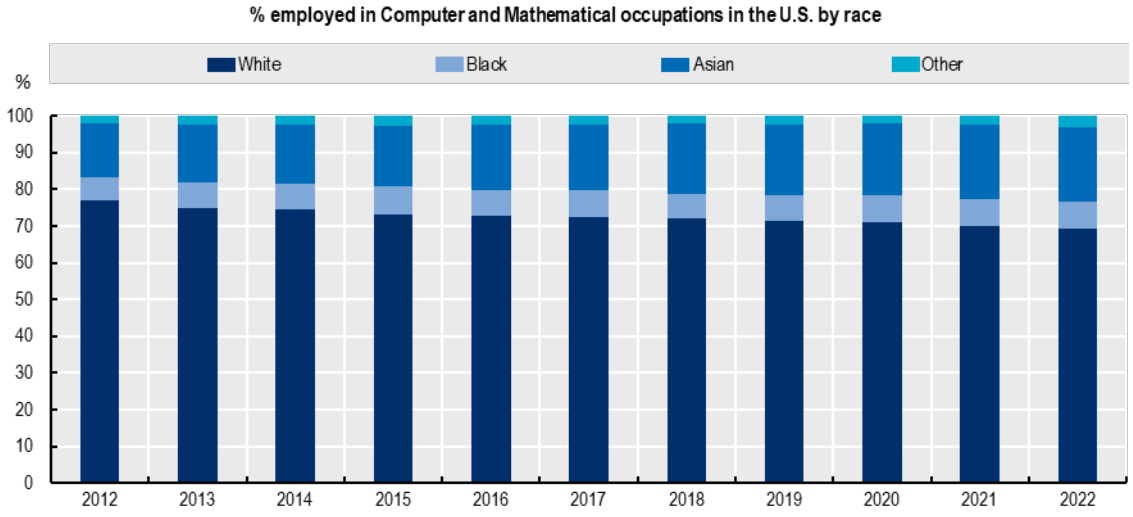
Racial and ethnic groups

Some racial and ethnic groups are particularly under-represented in technology and STEM fields. In the United States, only 9% of STEM jobs go to Black Americans and 8% go to Hispanic Americans (Pew Research Center, 2021[8]).[3] Under-representation is higher when gender, and race and/or ethnicity are compounded. Women of colour in the United States (Black, Latinx, and American Indian women) make up only 5% of the technology industry (Emsi Burning Glass, 2022[9]).

Black and Hispanic Americans are also under-represented amongst STEM college graduates. In 2018, Black Americans earned 7% and Hispanic Americans earned 12% of STEM bachelor's degrees. This is in comparison to white Americans who earned 62% of all STEM bachelor's degrees. Racial and ethnic under-representation is even worse amongst the pool of STEM masters and doctoral degrees. Interestingly, Black women vastly outnumber Black men in all STEM degrees, reflecting a general trend of Black women attaining higher levels of education than Black men in the United States (Pew Research Center, 2021[8]).

Specifically, amongst the computer and mathematical occupations in the United States, white Americans are still vastly over-represented. This is despite some progress over the last decade, with the proportion of white Americans working in this occupation decreasing from 77% to 69% from 2012 to 2020. This decrease is largely due to a rise in workers who identify as Asian (from 15% to 20% in the same timeframe), with minor increases in the shares of Black Americans and those of other minority backgrounds (Figure 3).

Figure 3. Racial diversity remains a challenge in the American technology sector



Source: CPS.

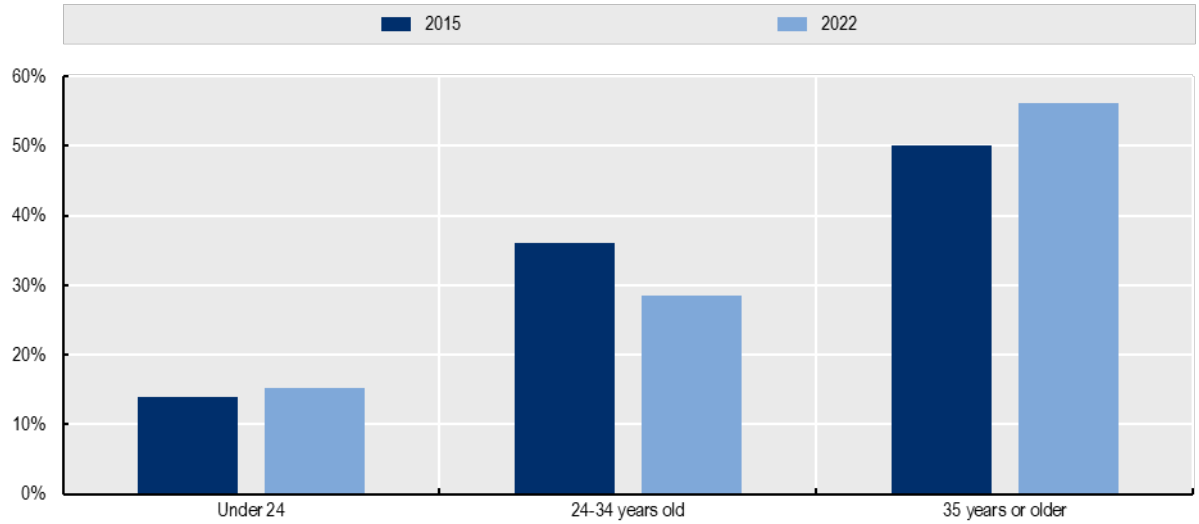
Youth, and those Not in Employment, Education or Training (NEET)

Young people are generally well-represented in technology roles. For instance, around one-third of ICT specialists in the European Union are aged 15-34 (Eurostat, 2023[10]). Furthermore, opportunities for youth in technology are growing with an employer survey finding that 86% of employers are hiring mostly at the entry-level for technology positions (Generation, 2023[11]). Whether the proportion of youth working in the

[3] These shares are lower than each group's respective share in the total workforce – Black Americans constitute 11% and Hispanic Americans constitute 17% of the total American workforce. Conversely, white Americans are over-represented in STEM roles, making up 67% of positions while only constituting 63% of the total workforce.

technology sector has increased or not over the last decade is still unclear, and heavily depends on the definitions and data under examination. For example, OECD.AI data suggest that, while young people represent a large share of AI practitioners, the proportion of 24-34 years old AI specialists has declined between 2015 and 2022 (Figure 4). On the other hand, according to the International Labour Organization (2022[12]) the share of young people working in digitally intense sectors more broadly is growing faster than the share for older workers.

Figure 4. Young people are well-represented among AI practitioners



Note: In line with the OECD.AI methodology, AI practitioners consist of respondents identifying themselves as either a 'data scientist' or a 'machine learning expert' in the annual Stackoverflow survey. More information on the methodology is available here: https://oecd.ai/en/stackoverflow-survey-data.
Source: OECD elaborations based on OECD.AI (2023[4]).

In the current context of high shortages, when the need to consider a broader range of profiles is high, young people who are currently Neither in Employment nor in Education or Training (NEET) represent a pool of untapped talent. However, NEET youth tend to lack the skills and qualifications required in the technology sector. Specific NEET groups may face additional barriers – women for example are more likely to be NEET, with 18.4% of 20–24-year-old women across the OECD NEET in 2021, compared to 15.2% of men (OECD, 2024[13]). Young workers who have had experience in automatable jobs are more likely to have NEET status (International Labour Organization, 2020[14]). These groups may thus feel less prepared for new jobs and tasks brought about by technological changes and may require extra support and second chance options to re-engage with education, training and the labour market.

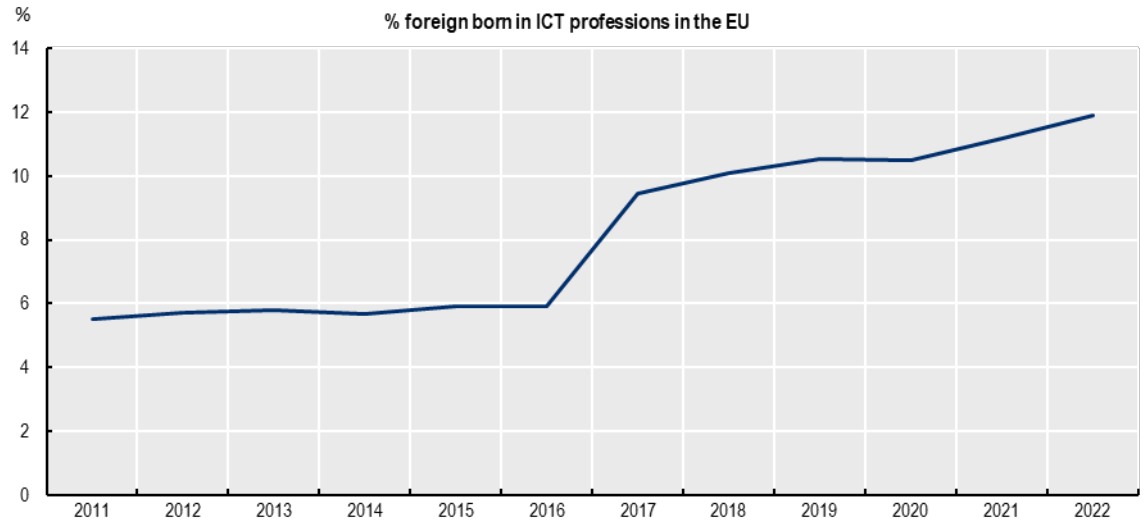
Migrants

Evidence on the representation of migrants in the technology sector is mixed. Some studies show that foreign-born adults tend to select into less skilled and lower paid roles, including in the technology sector. For instance, foreign-born workers in Europe are over-represented in jobs that provide services on digital platforms (Urzì Brancati, Pesole and Fernández-Macías, 2022[15]). These jobs are typically less attractive than other roles in the technology sector as they are temporary, lower paid and less skilled. However, there is also evidence that high-skilled migrants are over-represented in high-skilled occupations, especially in countries that facilitate cross-border mobility and migration of high-skilled workers. Foreign-born workers

in the United States hold more than half of the creative IT jobs located in metropolitan areas (where IT innovation clusters are located) (Otoiu and Titan, 2017[16]).

Nonetheless, data from the European Union Labour Force Survey shows that there have been significant improvements in the representation of migrants and foreign-born workers in the technology sector over the last decade. The share of non-native born workers – those that are not born in the same country they reside in at the time of the survey – in the ICT profession doubled between 2012 and 2022, from 6% to 12% (Figure 5). This suggests progress has been made though greater research is needed to understand the types of technology roles migrants enter into.

Figure 5. The representation of foreign-born ICT professionals in the EU has increased over the last decade



Source: EU-LFS.

Barriers to more diversity in the technology sector

Gender differences in interests, aptitudes and aspirations widen with age

At an early age, boys and girls tend to display similar interests and aptitudes in school. Data collected from 15-year-olds in the OECD's Programme for International Student Assessment show boys and girls perform similarly in science and mathematics tests, with girls even outperforming boys in some countries (OECD, 2018[17]; OECD, 2019[18]).[4] This suggests a pipeline issue: at some point, girls are discouraged from scientific careers. Furthermore, boys are generally over-represented at the top of the performance distribution in science and mathematics, suggesting that while on-average across the OECD girls perform better in these tests, there are fewer high-performers (OECD, 2019[18]). This reinforces the belief that girls need to perform extremely well in order to feel confident in their abilities.

Relatedly, girls tend to be more negative about their abilities in scientific domains which dampens their aspirations. Across OECD countries, only 1% of girls report that they want to work in ICT-related occupations, compared to 8% of boys, with the gender gap in terms of interest in these occupations widening over the past few years. Furthermore, the proportion of boys reporting that they expect to work as professionals who use science and engineering training is double that for girls. This is the case even for top-performing girls. Finally, gender differences in attitudes towards competition appear to be formed early, with girls less likely than boys to report positive attitudes towards competition and a greater fear of failure (OECD, 2019[18]).

Unlike differences by gender, differences in mathematics and science performance between native-born and foreign-born students are large from a young age. Across the OECD, students born in a country different from their test country perform worse in mathematics and science tests compared to native-born students. Students who primarily speak another language at home also perform substantially worse than native students (OECD, 2018[17]).

A lack of role models discourages some socio-demographic groups from choosing careers in technology

Growing up, young girls are more likely to see men in high-profile, leadership roles in technology, media and STEM fields. Specifically in the ICT sector – one of the highest venture capital funded sectors worldwide – only 2.7% of women start businesses, compared to 4.7% of men (Global Entrepreneurship

[4] Across OECD countries, girls slightly outperform boys in Finland, Iceland, Israel, Lithuania, Norway, Sweden in mathematics, and in Canada, Czech Republic, Denmark, Estonia, Finland, Germany, Greece, Iceland, Ireland, Israel, Latvia, Lithuania, Luxembourg, Netherlands, Slovak Republic, Slovenia, Sweden, Türkiye in science (OECD, 2018[17]).

Monitor, 2022[19]). As of 2022, only 24% of global technology leadership roles were held by women (World Economic Forum, 2022[6]).

A lack of exposure to successful and relatable role models has been shown to impact girls' subject choices, ultimately affecting their choice of career. Exposure to more female mathematics and science teachers in high school increases a girl's choice to enrol in and graduate from a STEM-related university degree (Bottia et al., 2015[20]). Women exposed to female STEM teachers in introductory college classes are more likely to complete a major in STEM (Carrell, Page and West, 2010[21]). Furthermore, a large-scale field experiment in France found that even one-hour of exposure to a female role model with a background in science increased the probability of Grade 12 girls enrolling in selective STEM programmes in higher education by 20% to 30% (Breda et al., 2020[22]). Results are largely due to an improvement in girls' aspirations for science-related careers, in-line with other evidence highlighting how exposure to female leaders in the public domain positively shapes girls' aspirations (Beaman et al., 2012[23]). Role model effects also appear to be the largest for female students who are strong in mathematics, suggesting high-achieving girls are more likely to see themselves succeeding in a STEM career (Bottia et al., 2015[20]; Breda et al., 2020[22]).

Role model effects tend to be a particular challenge in technical and male-dominated fields, which are also highly competitive. Some evidence indicates that women are more likely to enter competitive environments when they are exposed to strong female role models (Meier, Niessen-Ruenzi and Ruenzi, 2017[24]). Thus, exposure to successful women in competitive industries, and to women in management positions, may impact women's choices to choose high-pressure careers.

Moreover, girls of racial and ethnic minority backgrounds may be more susceptible to role model effects, given the lack of both gender and racially and ethnically diverse leaders in technology. Some evidence supports this finding that exposure to both Black and non-Black role models increased feelings of belonging and trust in STEM environments (Johnson et al., 2019[25]).

Barriers to training limit adults' digital upskilling capabilities

Across the OECD, women and men tend to display similar levels of basic digital skills. On average, 28% of women and 32% of men score high in problem solving in technology-rich environments in the OECD Survey of Adult Skills (PIAAC). However, men on average tend to have more advanced digital skills like coding (European Commission, 2018[26]). Among 16-24-year-olds in the European Union, 18% of men can write code in a programming language, while the rate for women is half this at 9% (OECD, 2023[27]). As adults, women are also less likely to develop their digital skills. In Europe, 18% of women undertook some form of training to improve their digital skills in 2018, less than men at 22% (European Institute for Gender Equality, 2021[28]).

Young people of both genders will require greater digital upskilling to prepare for the future of work. Post COVID-19, young people report a greater interest in technology careers (e.g., those related to cloud computing and internet of things), and a desire to undertake more technical training to prepare for a more technologically and digitally focused world (Tallo, 2020[29]). Whilst young people are generally optimistic about technology, almost half of people aged 18-24 fear their skills and knowledge won't be in demand in the future, and don't feel ready for the future world of work. Young women report feeling slightly less confident about their readiness in terms of skills than young men, while young people who are NEET are also slightly more negative about their future job prospects (World Skills and OECD, 2019[30]).

Upskilling will be essential to level these differences in digital skills. Whilst OECD data from the Survey of Adult Skills suggest that women and men participate equally in adult learning and education, women on average face different barriers to training relative to men. Internal OECD analysis finds that of those who wished to but did not participate in adult learning, women were significantly more likely than men to report

that a lack of time due to childcare or family responsibilities prevented them from participating. Men, conversely, were more likely to report they were too busy at work. As women are the primary caregivers in households in the United States and Europe, the provision of greater flexible learning options can improve women's participation in training (OECD, 2023[31]).

Discrimination at hiring and a lack of information restrict career pathways

Discrimination and bias continue to pervade recruitment and hiring processes in the technology and STEM field (Friedmann and Efrat-Treister, 2022[32]). This means women and candidates belonging to other under-represented groups are less likely to enter the technology sector, even when they have the skills. For those who do manage to enter the field, many begin in entry-level, non-technical positions. Women in ICT tend to concentrate in less well-paid occupations like project managers, rather than positions such as software development (International Labour Organization, 2018[33]).

To avoid discrimination at hiring, employers may want to use modern recruitment practices that focus more on skills rather than qualifications or experience. Indeed, particular groups, who are less likely to have formal qualifications, may be screened out of the candidate pool when employers rely on traditional recruitment practices. A greater use of skills-based hiring in the labour market can expand talent pools across several technology-related industries, and encourage the hiring of more women, young people, and racially and ethnically diverse workers (LinkedIn, 2023[34]). Whilst more progress is needed, some companies in the technology sector have already adapted their recruitment practices to be more inclusive, including through the use of anti-bias training, ensuring diversity of recruitment panels, reducing biased language in job ads, using blind resumes, and using skills-based assessments (Generation, 2023[11]).

Gender-biased career guidance and a general lack of information regarding technology careers also restricts women's choices regarding study and work. Evidence from six OECD countries suggests that women on average reach out to a career guidance advisor less than men (OECD, 2021[35]). Even when women access support, they may be confronted with gender-insensitive information. Guidance services may rely on their own stereotypes and biases when providing study and career advice, effectively discouraging certain groups from pursuing these careers. Only four in ten women feel encouraged to consider a job in technology or IT in the United States, with 44% never given any information or resources about technology careers (compared to 33% of men) (Wiley Edge, 2021[36]).

Furthermore, certain groups in society may simply have less information about careers in technology. One study shows that across 191 countries, women were less likely to be exposed to STEM-related advertisements on social media. Female Facebook users were less likely than male users to see ads for job opportunities and training in STEM fields (Lambrecht and Tucker, 2016[37]). As a result, women are less knowledgeable about and less aware of opportunities in technical fields, and may require greater support from guidance services.

Furthermore, given the fast-changing nature of work, young people need access to accurate information about study and career choices. Over 70% of young people aged 18-24 state that they would like more help finding a job while in school, and would welcome greater career guidance (World Skills and OECD, 2019[30]). In fact, 1 in 10 students in the United States don't receive any career guidance (World Skills and OECD, 2019[30]). This is worrying as many young people, particularly those with NEET status, are unable to identify which skills they need for future employment opportunities.

Unfavourable working conditions affect progression, promotion and retention

Unfavourable working conditions in demanding sectors like technology and STEM discourage women from choosing jobs in these sectors and prevent the women that do choose these careers from advancing into

management positions. Gender pay gaps in STEM fields are persistent – in 2019, women earned less than men in 69 of the 70 detailed STEM occupations as reported by the United States Census Bureau (United States Census Bureau, 2021[38]). Across the European Union, the gender pay gap among ICT professionals and technicians is 11% (European Institute for Gender Equality, 2019[39]).[5] Evidence from Spain suggests that the pay gap and the prevalence of discrimination widens as women advance higher up the pay scale in ICT professions, and in sectors that depend more on ICT (which by extension are more male-dominated) (Segovia-Pérez et al., 2019[40]). Sizeable pay gaps also exist along racial and ethnic lines, with Black Americans earning 78% and Hispanic Americans earning 83% of the earnings of white Americans in STEM fields (Pew Research Center, 2021[8]).

At a broader, structural labour market level, high childcare costs, a lack of adequate paid paternal leave and conservative gender roles create an unequal care burden which disproportionately impacts women's progression in almost every field (Kleven et al., 2019[41]). However, the competitive and demanding nature of careers in technology and STEM are an additional barrier for women. In certain industries like STEM, pay is often linked to working hours with monetary penalties attached to flexible working schedules (Goldin, 2014[42]).

Additionally, STEM workplace culture can be perceived as harsh, demanding and heavily male-dominated. Almost 70% of 18-28 year old technology workers in the United States have felt uncomfortable in a job because of their gender, ethnicity, socio-economic background or neurodevelopmental condition, and half had or wanted to leave a technology job because of how uncomfortable the company culture made them feel. Black and Hispanic workers in technology companies are the most likely to report that they did not feel welcomed by their colleagues and that they actively dislike their company's culture (Wiley Edge, 2021[36]).

Within the ICT and technology field, promotion pathways often differ by gender, with more women than men assigned to non-technical or non-managerial pathways. Issues with progression are often related to a significant retention issue, with women exiting these sectors at a higher rate than men. Women in technology professions are also promoted to senior management roles at a much slower rate than women in other industries – only 52 women are promoted to technology manager for every 100 men, versus 86 women for every 100 men for overall managerial roles (McKinsey, 2022[43]). Slower promotion rates discourage women and minorities from remaining in the technology sector, ultimately contributing to their attrition.

[5] The European Institute for Gender Equality adopts Eurostat's conventional definition of the gender pay gap as the gender gap in net monthly earnings.

Successful strategies to increase diversity

A holistic approach to increasing diversity in the technology sector is required to address the broad range of barriers described above. Relevant stakeholders, including governments, workers' representatives, training providers and civil society organisations, need to work together. Governments should improve teaching methods and promote role models in schools, improve the quality of career guidance and encourage greater participation in training to foster advanced digital skills in line with labour market needs. Businesses can promote change in their workplace practices to remove bias at hiring, actively address discriminatory workplace culture and improve the quality of the working environment to attract and retain more diverse talent. Case studies and practical examples included in this paper draw on desk research, on bilateral discussions with relevant stakeholders and on the results of the 2023 OECD Call for Innovations, which was launched in July 2023 to collect innovative experiences aimed at improving diversity in the technology sector.

How governments and civil society can support a more inclusive and resilient technology future

Addressing stereotypes and promoting inclusion in technology begins in school

Stereotypes of what a scientist or an IT specialist should look like are formed early, in school. To eradicate these stereotypes, policy makers can put in place a range of actions. Several OECD countries have recently implemented policies to encourage gender equality in school curricula and teaching materials. Sweden, for instance, revised its preschool curriculum in 2018 to explicitly address and challenge gender stereotypes that restrict children's development and choices (Brussino and McBrien, 2022[44]). In Chile, a pillar of the "National policy for gender equality in STEM" focuses on eliminating gender stereotypes in STEM education from an early age (OECD, 2023[45]).

Learning tools have been developed to help teachers eliminate gender bias from their teaching practices and promote gender equality through teaching. For example, training colleges in Korea are required to offer courses on gender equality in their learning programmes for prospective teachers. Other OECD countries have involved teachers specifically in encouraging more girls to study STEM subjects. For example, Luxembourg launched a training tool called "Gender4STEM Teaching Assistant" in 2019, which helps teachers assess and improve their gendered education practices. Depending on the teacher's profile, the tool recommends learning content to better manage gender diversity in the classroom (Gender4STEM, 2019[46]). In Australia, the Girls in STEM Toolkit and Future You have developed targeted resources to support teachers and parents to engage young women and girls in STEM learning and career pathways. Efforts are currently in place to better integrate this toolkit with other existing resources to support teachers (Department of Industry, 2024[47]).

Schools can also play a crucial role in broadening students' perspectives on diverse career opportunities, through better career guidance and information, regular career talks, and workplace visits. Initiating career

guidance at an early stage is essential to prevent the development of discriminatory stereotypes, as ideas about career trajectories form as early as in primary school (Archer, DeWitt and Wong, 2013[48]). To address this, schools in Denmark organise "girls' day" events for fifth-grade students, promoting professions where women are under-represented – notably STEM – and incorporating interactive activities with the active participation of firms (OECD, 2023[45]). School career guidance counsellors can work with public employment services to access relevant training and career information to then pass on to students. Civil society, in particular non-profit organisations, can support the work of governments by providing more targeted and local solutions to stereotyping (see Box 1). Higher education institutions can also work with high schools to expose younger students to college-life by diversifying entry pathways into formal education (see Box 2).

Box 1. Non-profit organisations can support the work of governments to tackle misinformation and gender stereotyping

Bioinformatika is a European non-profit organisation that provides free educational content and training programmes to youth in the field of bioinformatics – i.e. the storage, retrieval and analysis of biological data. Their initiative "Bioinforming the Youth" targets young people across Europe, particularly in the Western Balkans, and three-quarters of participants are young girls and women. The organisation aims to educate, empower and inspire young people to choose a career in science. The initiative was created in response to the growing need for greater promotion of science amongst youth. The organisation provides free and accessible online resources and offers training courses for high school and university students, where participants can gain hands-on experience in bioinformatics tools and techniques. In this way, Bioinformatika helps reduce misinformation and stereotypes about careers in science and provides a positive role model to young girls and women through the use of female professionals and trainers.

Box 2. Dual enrolment programmes connect high school students to community colleges

Community colleges in the United States have started to offer free dual enrolment programmes to high school students – particularly students from remote, low-income or vulnerable communities – allowing them to enrol into college-level courses while they complete high school. By expanding entry pathways into college and allowing students early exposure to college-life, these programmes help the youth more easily envisage a future where they go onto further training. Some colleges offer dual enrolment in technical fields relevant for the technology sector. For instance, MiraCosta in California offers a dual enrolment class for bio-manufacturing within a predominantly LatinX and underserved school district. Wake Tech, a technical community college in North Carolina, and Lorain County community college in Ohio are other examples of colleges that offer dual enrolment.

Governments can also promote examples of successful role models in science and technology by supporting the creation and development of new, female-founded technology start-ups (see Box 3). They can also consider developing broad-based, national media campaigns to boost awareness. For example, the Australian government recommends the creation of a national, measurable media campaign to build awareness of the breadth of STEM skills, types of jobs in STEM sectors and available pathways available in its recent Pathways to Diversity in STEM Review (Department of Industry, 2024[47]). Finally, governments may consider developing a national action plan or a set of guidelines for employers who hire STEM and/or technology workers. The Australian Government's aim to introduce a Workplace Action Framework guides

employers towards the positive workplace changes needed to secure a more diverse and equitable workplace (Department of Industry, 2024[47]). Importantly, these toolkits can be adopted by smaller and medium enterprises, ensuring that not only large firms reap the benefits of becoming more inclusive.

Box 3. Fostering a new generation of female role models by supporting female-founded technology businesses

In recognition of the severe under-representation of women in the technology industry and the limited venture capital funding offered to women-led companies, the European Commission is providing financial support to female-led technology start-ups. 50 beneficiaries were involved in a pilot of the scheme in 2021, with a full initiative launched since then. Alongside mentoring and coaching support, grants of EUR 75 000 are offered to early-stage deep-technology startups founded or co-founded by women in Europe. Grants help fund initial innovation, research and development processes and support the overall growth of companies. This type of funding model promotes female leadership in the deep-technology industry to build fairer, more inclusive technology innovations, while successful female leaders serve as role models for future generations of girls and women.

Removing obstacles to adult training helps foster skills for under-represented groups

According to data from the OECD Survey of Adult Skills (PIAAC), women are more likely to cite family responsibilities and high costs as barriers to participation in adult education and training. Making courses shorter and more flexible, opening up the possibility of online provision can help address time constraints. Governments and training providers – both in the public and private sector – can work to make adult learning provision more flexible with regards to when, where and how adults can learn. Covering the indirect costs of training can also help increase female participation (OECD, 2023[31]), particularly those who cumulate disadvantage and are also low-skilled or hold low-wage jobs.

To make adult learning provision more adapted to the needs of adults and address time constraints, provision needs to be more modular and course delivery methods should include online and asynchronous options. Short courses, such as those that award micro-credentials allow learners to address skills gaps in a timely and effective manner. Some of these courses provide learners with the option to learn at their own pace, or at least at a location and time that suits them, making them extremely useful for under-represented groups with significant time constraints (OECD, 2023[31]). Over the past several years, micro-credentials in the technology sector have grown significantly, with more providers offering short courses, many at an entry-level. Some examples can be found in Box 4.

Box 4. Delivering digital credentials to quickly prepare workers for a future in technology

Some large technology companies have developed a broad range of micro-credentials and certificates that provide adults with technology and digital skills. For instance, Google and Microsoft have an established online professional certificate programmes with courses offered in the ICT sector, many of which are suitable for beginners and for adults requiring a flexible learning schedule. Dell offers digital badges – i.e., a web-enabled version of a learner's credentials that can be shared online – after completion of the company's training programme. Finally, IBM's SkillsBuild programme allows learners

to earn free digital credentials from IBM and their partners, with many courses lasting only a few hours and offered in multiple languages.[6]

Education and training providers can establish targeted efforts to reduce barriers to training that are specifically faced by vulnerable groups. Community colleges in the United States for example have developed programmes that target underserved communities. These programmes offer students opportunities to earn an income while they train and work, helping to reduce financial barriers to training and thereby boosting participation amongst low-income groups (Box 5). Other efforts have been made to reduce other barriers to training – for example, by placing training in locations that are easily accessible by vulnerable communities, removing the cost of travelling to and from training centres.

Box 5. Removing barriers to training for vulnerable groups supports participation

Several community colleges in the United States have Learn and Earn programmes which allow students to work in a career field related to their study field while being paid. Employers who partner with these community colleges are required to pay students. Lorain County Community College has a Learn & Earn programme, which has been successful in increasing the number of women and under-represented minority students in the manufacturing and IT areas. In their micro-electronics programme, for example, which uses a paid work-based learning model, over 20% of participants come from under-represented backgrounds and 25% are women. Similarly, Wake Tech college offers paid apprenticeships and internships. Students gain professional experience and a business network without giving up a paid job. These type of Learn and Earn models are especially beneficial for vulnerable, low-income groups who need an income while they study, and would have potentially otherwise forgone study for paid work.

Alongside reducing financial barriers to training, new place-based learning models are being adopted in the United States to reduce time and geographical access barriers. These more innovative teaching approaches are designed for training providers to be more proximate to the communities they are designed to serve, ensuring all students regardless of background have access to training. For instance, the Broward College in Florida is a proponent of this approach. They place educators within underserved communities, for example in recreation centres and libraries, to ensure students are closer in proximity to teaching centres.

Short, bootcamp-style programmes have been an increasingly popular way to learn new technology skills in a short amount of time, making them particularly viable training options for time-constrained learners. In 2020, France, Spain, Belgium and Poland joined forces under the “GirlsInSTEM” project to organise bootcamps for girls to engage with the STEM field (OECD, 2023[45]). Community colleges in the United States also run accessible bootcamps, such as Montgomery College’s free, four-week bio-technology bootcamp. Some technology bootcamps specifically target women and other minorities, helping to boost digital and technology skills amongst under-represented groups. Moreover, mentoring, coaching and networking events are sometimes offered to learners who participate in these programmes. In this way, exposure to successful professionals in STEM and technology reinforces a positive role model effect for women and minorities. Box 6 provides examples of some non-profit organisations running technology bootcamps.

[6] More information on the mentioned programmes can be found at: https://www.coursera.org/professional-certificates; https://education.dell.com/content/emc/en-us/home/certification-overview/digital-badge.html; https://skillsbuild.org/students/digital-credentials (accessed 29/02/2024).

Box 6. Bootcamps help prepare women and other minorities for a future in the technology sector

It is increasingly popular for learners and jobseekers to attend short, bootcamp-style programmes, designed to boost their technical knowledge and skills, and prepare them for a role in the technology sector. Many of the organisations offering bootcamps target their services to girls and women, and other under-represented groups in technology. Laboratoria, for instance, offers technical bootcamps for women across Latin America. The programme prepares women who have no prior experience in technology with skills in web development or UX-design. Following the bootcamp, graduates are connected to quality jobs in the technology sector. In the United States, the non-profit organisation Black Girls Code specifically targets African American girls and women. By partnering with schools, local organisations and volunteers, the organisation offers in-person and virtual computer programming education girls and women of colour aged 7-25 years old. Other organisations such as PyLadies function more as a community, where women and others from under-represented backgrounds can join a like-minded global network interested in building their knowledge of technology careers. Pyladies hosts various informal networking and mentoring events to educate, inspire and encourage more women to participate in open-source coding. These events are especially appreciated by beginners requiring basic information (i.e., entry-level talent or career-switchers).

Governments can expand funding options and boost financial incentives to encourage greater participation in training. Making learning more affordable will especially help reduce barriers to training for low-skilled and low-income groups, individuals who also struggle to enter technology professions. In 2022, the European Union adopted a recommendation that Member States should consider establishing Individual Learning Accounts. These personal accounts provide adults with an individualised budget to spend on training and can include paid days of leave for learning purposes, making training a financially viable option for low earners (OECD, 2023[31]). Evidence from France's experience with its own Personal Training Account (*Compte Personnel de Formation*) shows that almost 80% of workers used their allotted budget to attend short training programmes (less than 100 hours) (Perez and Vourc'h, 2020[49]).

Governments can also enact policies to support adult learning by covering the indirect cost of training. One of the largest indirect costs for women is the cost related to childcare. Several OECD countries have schemes to cover the cost of childcare and other additional costs for adult learners. In Ireland, for example, under the Childcare Employment and Training Support scheme, adult learners can qualify for a subsidised childcare place. In Austria, the public employment service covers the costs of training, including the cost of learning materials, clothing, accommodation and a family allowance, for jobseekers and low-wage workers. Allowances for childcare are also common in training that targets single parents. Where possible, employers themselves can encourage their workers to engage in training and can financially support them by providing for example additional days of leave to be used for training or funding the cost of training directly.

Additionally, policy makers should consider the use of targeted schemes to boost participation amongst specific vulnerable groups. OECD countries use, to a varying extent, subsidies, vouchers and tax exemptions to incentivise training (OECD, 2022[50]). For instance, Lithuania's Competence Voucher system supports employers with a voucher for purchasing training services for their workers which can be used to develop skills relevant to priority technologies, equipment, hardware and software (Cedefop, 2018[51]; OECD, 2022[50]). Countries also provide free or low-cost digital skills training for especially vulnerable groups. The non-profit sector can further support the work of governments in reaching under-represented

groups by developing targeted training programmes – such as the one described in Box 7, designed to boost migrants' participation in technology training.

Box 7. Supporting technology training and digital upskilling of vulnerable groups

Various European governments support innovation and digitalisation in the economy through voucher schemes – these range from vouchers to micro, small and medium sized enterprises who make investments in specific software or machinery, to training vouchers designed to lower the cost of digital upskilling (European Commission, 2019[52]). For instance, Finland launched a training voucher in 2018 to strengthen basic digital skills of adults, and particularly targets the low-skilled, unemployed or those at risk of unemployment, pensioners, the elderly, job changers and immigrants (European Commission, 2019[52]). Estonia's DigiABC programme, which ran from 2017-2020, provided fully funded digital skills training for low-skilled workers in manufacturing (OECD, 2022[50]). Furthermore, the three-year Digital Skills for Integration and Active Citizenship project co-funded by the Erasmus+ programme of the European Union is an example of a cross-border programme which aimed to improve the digital skills of migrants, refugees, and asylum seekers (European Union, 2022[53]). Making basic digital skills training available to a wider population will support broader ICT knowledge and skills development and may help more diverse populations ultimately find entry-level work in the technology sector.

Based in Germany, Socialbee is an NGOs providing migrant and refugee integration services. Alongside a more holistic integration approach, Socialbee offers qualification programmes – including a dedicated technology programme – to newly arrived migrants and refugees. The non-profit organisation provides soft and hard skill training for 2 to 3 months to prepare learners for the German labour market ahead of their work placement, where they are placed with partner companies. The dedicated technology programme – called "Changemakers" – is delivered in cooperation with SAP. Participants receive soft skill training provided by Socialbee, and hard skill training relevant to the technology sector by SAP. In the end, participants can receive certification for completion of SAP modules, and gain practical work experience at SAP or at another partner company working in the technology sector. In this way, Socialbee creates equal opportunities for migrants and refugees while also supporting the technology sector to fill important roles. Socialbee follows migrants for 12 months after job placement, providing continued support where needed. More generally, holistic wrap-around services – including visa, legal and accommodation services, and language courses – help to successfully integrate migrants into their new community. Socialbee finds that 90% of participants are still in their job eight months after completing their programme.

How businesses can help build a more diverse technology sector

Expanding recruitment pathways to boost diversity

The private sector can help to create a more diverse technology workforce by making changes to its recruitment and hiring processes. Many applicants with diverse backgrounds already have the skills required to enter technology roles; however, traditional screening and assessment techniques, and the over-reliance on qualifications mean that many are not considered for jobs. Employers can boost the diversity of their talent pool by adopting skills-based approaches during recruitment, looking for candidates with the required skills regardless of how they have been acquired.

Additionally, businesses can engage directly with organisations that connect them with students and jobseekers from disadvantaged backgrounds. They can reach out to and partner with intermediary organisations which help connect the private sector with entry-level talent from diverse backgrounds.

Targeted recruitment drives are designed to train and hire under-represented groups and are a good way to engage interested individuals early on in their careers (see Box 8). Businesses can also engage directly with training providers, such as those that offer technical bootcamp training services. These programmes build hard skills and help prepare learners for a role in the technology sector (see Box 6). Ultimately, the earlier the private sector engages directly with learners in the technology space, the more likely they are to attract highly skilled candidates with diverse backgrounds.

Box 8. Building a more diverse technology talent pipeline through targeted training and recruitment drives

Break Through Tech's "Sprinternship" programme provides women and non-binary computer science college students in the United States with a paid micro-internship in the technology sector. The three-week internship is offered to first and second year students from large, public universities, many of whom are women from racial or ethnical minority backgrounds. Their dedicated computing and AI offerings include a project-based deliverable and industry immersion activities to help students gain a better understanding of the nature of a job in the technology sector while helping them to build relevant technical skills. Technology companies who participate in the programme gain meaningful exposure to a group of interns that often falls outside their traditional recruitment scope and are able to expand the diversity of their hiring pipeline. Many participants in the "Sprinternship" programme are offered paid summer internships, a key step on the way to a full-time job in the technology sector.

IBM's Pathways in Technology (P-TECH) programme is a public education model serving under-represented communities in 28 countries. In the United States, 40% of participants are young women and 90% are Hispanic or African American (IBM, 2020[54]). By integrating high school and college coursework, participants earn both a high school diploma and a cost-free, industry-recognised associate degree in six years. Graduates are first in-line for entry-level job openings at IBM. The programme expands pathways into technology jobs and makes a career in technology more accessible.

Leaders in the technology sector can also develop targeted outreach initiatives and media campaigns in the hope of attracting more diverse talent into the sector. Successful female technology leaders can promote careers in technology by engaging with younger generations as their mentors and coaches (see Box 9). Businesses can showcase the benefits of working in the technology sector and create greater awareness of careers in the sector by developing their own targeted awareness and media campaigns for underserved communities. The L'Oréal–UNESCO For Women in Science Program, for instance, promotes the representation of women in science globally. More specifically in Australia and New Zealand, L'Oréal-UNESCO Women in Science Fellowships were launched in 2007, with the initiative celebrating five women in science each year for their scientific excellence. The Fellowships programme supports women to continue their research with a $25 000 reward and provides media training and a platform to showcase their cutting-edge research, in an effort to inspire more girls and women to enter the scientific field (Department of Industry, 2024[47]).

Box 9. Mentor initiatives and media campaigns inspire the next generation

Female leaders in the technology sector can inspire a new generation of girls and women to enter technology-related fields by joining and participating in coaching and mentorship networks. FemTech Association Asia, founded in 2021, is the region's first and largest industry network for FemTech founders, professionals and investors. The association provides visibility to female-led businesses in women's health and technology. By becoming a member of the association, female professionals can

access community networking events, industry and region-specific thought leadership and advisory services. In this way, FemTech Association Asia helps make the global technology start-up pool in Asia more diverse.

Google for Startups Accelerator: Women Founders is a 10-week digital accelerator programme for women technology entrepreneurs across the United States and Canada. The programme is open to women who have launched a technology business and have acquired seed funding. The aim of the programme is to provide mentorship, technical project support and deep-dive workshops to help accelerate the growth of high-potential female-founded businesses in the technology sector.

FIRST Robotics (For Inspiration and Recognition of Science and Technology), a non-profit initiative based in the United States, works to inspire children to pursue STEM education and careers. FIRST Robotics has reached over 3.2 million students worldwide since its inception in 1989.[7] Its annual robotics competition engages high school students and provides them with hands-on learning.

Media campaigns can also be useful to spread broad awareness. Deloitte, for instance, has launched "Women in Cyber", an awareness campaign designed to entice more women into careers in cyber-professions.[8] The BNP Paribas Group has various initiatives spanning across France, Italy and Türkiye, and aims to reach its 37% women in IT target by the end of 2024 (compared to 32% in 2022).[9]

Building an inclusive work culture to attract and retain highly skilled candidates with diverse backgrounds

Firms can help to make a career in the technology sector more attractive by improving the working environment and making it more inclusive. Notably, they can promote greater pay transparency as a way to reduce the gender pay gap in technical roles. Across the board, 21 out of the 38 OECD countries (55%) mandate systematic, regular gender wage gap reporting by private sector firms (OECD, 2023[45]). Greater pay transparency increases competitiveness amongst firms by allowing employees to compare their own salary packages to firm benchmarks. Sharing information about average wages within firms can support underpaid workers to negotiate up their wage (OECD, 2023[45]; OECD, 2021[55]). Alongside transparency surrounding pay, firms can also disclose other gender and race disaggregated data (such as the percentage of diverse employees) in their annual reports, and more generally their diversity and inclusion goals. This can help firms, particularly larger, publicly listed firms, remain accountable for their diversity and inclusion targets. Big technology firms like Microsoft, Intel and Salesforce even tie the cash bonuses of their senior executives to performance on diversity metrics to ensure leaders are held directly accountable for attaining diversity goals (Payscale, 2019[56]; Unleash, 2022[57]).

Deliberate and transparent commitments by senior leadership help to build a more inclusive work culture and attract more diverse candidates. Salesforce, for instance, have instated a Chief Equality Officer role, in-charge of leading the company's global equality efforts. Apple, Google, Microsoft, and Meta also all have Chief Diversity Officers. A senior leadership role with an explicit focus on equality or diversity signals to potential employees that the firm is working towards building a more inclusive internal culture. Firms can also consider the use of non-compulsory targets or goals to signal their commitments to diversity. In the technology sector, Accenture, for example, publicly announced their goal to achieve a gender balanced

[7] See here: https://www.firstinspires.org/about/at-a-glance (accessed 22/02/2024).

[8] See here: https://www.deloitte.com/global/en/about/people/people-stories/deloitte-women-in-cyber.html (accessed 22/02/2024).

[9] See here: https://group.bnpparibas/en/news/bringing-women-closer-to-tech-our-challenge-for-equality-and-performance (accessed 22/02/2024).

workforce by 2025 (Accenture, 2017[58]). These public commitments, alongside regular and transparent reporting of performance metrics, as noted above, help keep firms accountable.

Businesses should consider implementing a range of other workplace practices to foster a more inclusive culture. Unconscious bias training, particularly for managers, can help to address underlying bias and can prove especially effective ahead of conducting any recruitment. Broader diversity and inclusion training modules can be offered to all staff. Firms can employ a zero-tolerance policy against harassment, discrimination, and abuse. To increase retention, early-tenure promotions can especially reward women and minorities in technical roles, further supporting their career progression in the technology profession. Businesses can also facilitate better retention and employee work-life balance by providing flexible work options by default, rather than through an opt-in model, to help reduce stigma and increase acceptance around taking-up flexible work.

Labels that reward employers who foster a diversity culture at work are becoming more common. A number of countries – like Australia, Spain and Portugal – give out annual business awards to reward leadership in the diversity space (OECD, 2020[59]). Specific to the technology sector, a diversity charter which certifies firms that have good gender equality practices has been shown to inspire more gender-equal practices in the IT profession, a similar practice to accrediting firms based on their diversity and inclusion success (see Box 10). This type of public certification or labelling process encourages more technology firms to make gradual improvements to their workplace culture in order to raise their visibility and attract better, more diverse talent.

Box 10. Public commitments to gender equality are a signal of a strong workplace culture

DiversIT Charter's certification process awards technology companies across Europe with a Bronze, Silver or Gold label based on their level of commitment to advancing gender equality in the ICT profession. Gold level certification is reserved for companies that have implemented several best practices and have made gender equality a top priority in their organisation for some time. Firms are assessed based on a framework and need to apply for re-certification every five years to keep their label. In this way, DiversIT Charter helps certified companies across Europe to attract like-minded, high-quality and diverse employees.

In Australia, Project F accredits organisations that have gender-equitable workplaces. Project F tracks the progress of accredited organisations and provides guidance, helping them to work towards higher levels of accreditation. Organisations accredited by Project F have seen increases in hiring, promotions, employee engagement and, in some cases, reduced attrition. Start-ups can also receive Gender Equity Toolkits to help them build equitable workplaces. Project F aims to address stereotypes unique to the technology sector that impact women's ability to remain and progress in technology jobs. Technology companies like Canva have received a Project F accreditation.[10]

[10] See here for more information: https://projectf.com.au/ (accessed 22/02/2024).

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