



The global digital skills gap

Current trends and future directions

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Published by the RAND Corporation, Santa Monica, Calif., and Cambridge, UK

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Preface

Rapid and widespread digitalisation has changed the nature of work, and digital skills are now regarded as essential for the modern workforce. Employees need digital skills to work with new technologies and to keep up to date with rapid technological advancements. While the demand for digital skills is high, supply is low. Workforces do not always have the skills needed to manage digital transformation, and businesses often struggle to find talent for digital roles. This digital skills 'gap' has become even more apparent during the COVID-19 pandemic. As digitalisation sped up to move many jobs online, the need for digital skills increased.

The overarching aim of the research was to carry out a scoping study to examine the evidence associated with various aspects of the current digital skills landscape, focusing primarily on the digital skills gap. We sought to better understand whether and why the digital skills gap is widening, as well as its implications for digital and social inequalities, and what various stakeholders are doing in response. To do this, we conducted an analysis of the key trends that are driving the digital skills gap at a global or macro level; and examined some of the practical steps that are being taken to address this challenge and potentially 'close' the digital skills gap. Through a focused and rapid assessment of recent literature, the research offers a snapshot view of key aspects of the digital skills landscape rather than a comprehensive and systematic evaluation of the evidence. Our findings highlight the importance and urgency of addressing the digital skills gap, not least to ensure that countries have the industries and businesses they need to keep pace with the rate and scale at which technological innovations are being developed and implemented. Furthermore, we highlight that digital and social inequalities – exacerbated by the global impact of the COVID-19 pandemic – affect opportunities to develop digital skills, and closing the skills gap could prevent the growth of social inequalities between those who have digital skills versus those who do not. The research will be of interest to policy makers, those in industry and academia, and more broadly to anyone – including the public – interested in technology and wider skills-related issues.

This research was prepared for Salesforce. RAND Europe had full editorial control and independence of the analyses performed and presented in this report, which has been peer-reviewed in accordance with RAND's quality assurance standards. This work informs the public good and should not be taken as a commercial endorsement of any product or service.

We were able to conduct this exciting research project because of the support and contributions of many individuals. First, we would like to thank the team at Salesforce for their advice and support over the course of the study, in particular, Jessica Kremer, Peter Gaylord, Dominique Penny-King, Izzy Fox, Fiona Williams, Ashish Patel and Connor Daly. We are also grateful to Ben Lovett, Antonia Adair, Katie Thomas and Sarah Lerman at Teneo, and Lynne Saylor, Catherine McShane and Erik Silfversten at RAND Europe for their helpful guidance throughout the project. We would like to thank Jessica Plumridge at RAND Europe for her contributions to the design of this report. Finally, we would like to thank our quality assurance reviewers at RAND Europe, Axelle Devaux, Harriet Teare and Camilla d'Angelo, for their helpful and constructive review of this report.

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Headline findings

What does the digital skills landscape look like?



Rapid and widespread digitalisation has changed the nature of work, making digital skills an essential attribute for the modern workforce



Along with digital skills, **soft skills are needed to facilitate workers' adaptation to changing work environments** and are increasingly valued by organisations



Employers are actively seeking employees with digital skills in order to adapt to an increasingly digitalised environment



The digital skills gap and its impact has come to the **forefront of discussions during the COVID-19 pandemic**



While the demand for digital skills is high, supply is low, and businesses often struggle to find talent for digital roles



On a global scale, it is becoming increasingly clear that the **digital skills gap comes at a cost**

What is driving the digital skills gap?



Digitalisation and the application of emerging technologies accelerate the demand for digital skills



Digital and social inequalities affect opportunities to develop digital skills



Traditional modes of education alone may not be keeping up with employers' needs for digital skills



The COVID-19 pandemic has amplified the urgency to create conditions which effectively leverage digital solutions for virtual work and commerce



Technological progress is **necessitating agile skill adaptation from workers** who need a range of new skills to adjust to the new marketplaces and work environments

How can organisations address the digital skills gap?



A common skills framework could be used to match talent with business skill demand



Skill-based hiring practices could help fill digital skills gaps within companies



Upskilling and reskilling initiatives can play a key role in building resilient workforces



Redistribution of labour and skills across businesses can create opportunities to address skill mismatches



Digitally inclusive initiatives and programmes can help develop digital skills



Industry experience opportunities can provide effective alternatives for building skills



Businesses can support workers by **adopting a lifelong learning approach**



Developing cross-cutting partnerships between different stakeholders can help tackle the skills gap



What does the digital skills landscape look like?

For businesses and industries, 2020 began with the convergence of accelerated digitalisation during the COVID-19 pandemic, disruptions to working environments, and growing calls for greater workforce inclusivity, equality and social justice.¹ **This brought about immense challenges but also created a moment of opportunity to reinvent what the workplace might look like and how to manage workforces in the future.** There have also been discussions of reducing post-pandemic unemployment, preparing workforces for the future of work, and finding digital solutions. Accordingly, digital skills have been underlined as key for the future of post-pandemic work.²⁻⁴ It has been highlighted that

building digital skills across society has the potential to open up opportunities for those who have been traditionally 'left behind', and allows businesses to unlock technologies to their full potential to deliver their vision, including fostering diversity, equity and inclusion.¹ However, developing digital skills across society in an inclusive way alongside other key skills (such as resilience, creative thinking, emotional intelligence etc.) is also important. There are important steps that companies can take to build up digital skills in the workforce and it is of key importance that personnel involved in this consider long-term skills demand, and take an inclusive, holistic approach to the issue.



What we mean by digital skills in the context of this study

We have used a relatively inclusive and holistic characterisation of digital skills. For this study we broadly used the UNESCO's definition of digital skills:⁵ the range of abilities required to use digital devices, communication applications and networks to access and manage information. Specifically, we consider digital skills as those that enable people to process and manage data, communicate and collaborate through digital means to create digital content; to stay safe and legal online; and to solve problems for effective and creative self-fulfilment in life, learning, work and social activities at large. This study focuses on the digital skills workers need to meet current demands for skills (specific 'in-demand' skillsets) but also those skill sets that will be needed to prepare for jobs of the future. While various terminologies have been used in the literature, for this study we broadly consider the digital skills 'gap' to result from the differential between the supply (from the education sector and within the workforce) and demand (from employers) for digital skills.

Rapid and widespread digitalisation has changed the nature of work, making digital skills an essential attribute for the modern workforce.

As technology is integrated in workplaces with increased digitalisation of supply chains and processes, employees need digital skills to work

alongside new technologies and future proof their careers. These skills span a broad spectrum and can encompass several categories, including: information and data literacy, processing, and management; communications and collaboration through digital means; digital content creation; security of information and communications technology (ICT); and use of hardware and ICT tools for problem solving and critical thinking.⁶⁻⁸ Digital skills can be applied at a basic level (e.g. turning on devices, opening emails, scrolling down a page, using word processing software) or involve more advanced tasks (e.g. developing and integrating emerging technologies such as artificial intelligence (AI), implementing and running cloud-based infrastructure, creating digital content, and developing and programming software).

Employers are actively seeking employees with digital skills in order to adapt to an increasingly digitalised environment. In EU countries, there is a shortage of digitally skilled talent in the labour market where 57% of enterprises find it difficult to fill ICT specialist roles (for larger enterprises, this figure stands at 64% and for small and medium-sized enterprises (SMEs), the figure is 56%).⁹ This trend is also observed in other parts of the world, from the United Kingdom, where over 75% of job openings request digital skills,⁹ to sub-Saharan Africa, where nearly 65% of job opportunities require a basic level of digital skills.¹⁰ A study has also shown that 69% of job postings in 2019 across New Zealand, Australia, Singapore, the United States and Canada were in digital occupations¹¹ and similar trends have been reported in Europe with 85% of all EU jobs requiring

69% of job postings in 2019 were in occupations requiring digital skills across New Zealand, Australia, Singapore, United States & Canada

Source: APEC. 2020. *APEC Closing the Digital Skills Gap Report: Trends and Insights; Perspectives on the Supply and Demand of Digital Skills and Degree of Digitalization.*

at least a basic digital skills level.¹² In Malaysia and China, there has been an increased demand for digital skills in the healthcare sector since mid-2019, whereas in Indonesia and Mexico, there has been an increase in digital skills requirements for the education and finance sector since mid-2018.¹¹



The demand for digital skills is outpacing the supply. On the one hand, there is an increasing need for a digitally competent workforce and a high demand for digital skills across all levels (ranging from basic to advanced). Such trends reflect the increasing level of adoption of digital tools by businesses, particularly in the context of COVID-19. For example, a global survey reported that over 80% of business leaders plan to accelerate digitalisation of work processes and provide more opportunities to work remotely.¹³ On the other hand, the supply of digital skills is not keeping pace with the increasing trends in demand: only 58% of citizens over 16 years old in Europe have been reported to have basic digital skills,⁹ and similar trends are found in other economies such as Brazil,¹⁴ China, Indonesia and Mexico.¹¹ This issue is further amplified by shortages in the number of graduates in ICT-related fields¹⁵ and, despite the engagement of younger generations with technologies at home or for social activities, there is a general lack of engagement of young people in digital skills training at school, in further education and in apprenticeships. With such shortages on the supply of digital talent, companies continue to report skills gaps in their workforce. For instance, 64% of large enterprises and 56% of SMEs have reported challenges in finding the right candidates for ICT vacancies.⁹

Box 1. Digital skills training definitions



Upskilling: focus on teaching employees additional skills to complement their pre-existing skills¹⁷



Reskilling: focus on teaching employees new skills (not necessarily connected to pre-existing skillset or knowledge)¹⁷

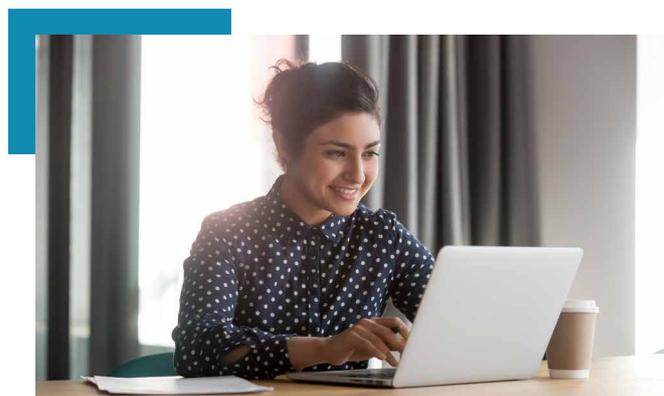
There is considerable debate on how to map out the gap between supply and demand. The discussion can be framed in terms of the shortage of labour needed to perform digital tasks; however, it can also be described in terms of the changing requirements of skills.^{12,16} Some argue that there is less of a 'skills gap' and more a 'skills mismatch' where the people with the skills needed by the labour market are not necessarily the ones who get hired.¹² In the EU in 2018, it was estimated that four in ten adults felt their skills were being underused, and that close to a third of tertiary education graduates were considered overqualified for their jobs.¹² Sectors which faced the most technological disruption were more likely to experience a skills mismatch, with workers in finance and ICT sectors under the most pressure to change and learn new skills in their jobs.¹² This is partly why those discussing the digital skills gap should not solely address how to 'recruit' (new) digital skills but also consider 'upskilling' and 'reskilling' existing employees. Managers who are building workforces that are resilient to digital transformation will need to consider what skills employees currently have, what skills they need now and in the future, and how skills and jobs can be reallocated to meet employers' demands.¹⁷

However, **a shortage or lack of a digital skill set can directly impact businesses.** A study by Capgemini showed that over half (54%) of surveyed companies with over 1,000 employees (across automotive, banking, consumer products, insurance, retail,

telecom and utilities sectors) agreed that shortage of digital talent led to a loss of competitive advantage and if the skills gap is not closed within the next three to five years, there will be negative impacts not only on product development, delivery and innovation, but also on customer experience and satisfaction.¹⁸ Digital skills shortages can create barriers for the adoption of new technologies across most sectors, as well as prevent companies from using new digital services to their full potential.¹³ This can lead to a loss in competitive advantage.¹⁸ A digital skills shortage can also lead to increased wage levels, which particularly affects SMEs and start-ups that potentially cannot afford to employ ICT specialists.¹⁵

On a global scale, the digital skills gap comes at a cost. For example, Accenture estimated that by 2028, G20 countries risk missing out on up to \$11.5 trillion of cumulative gross domestic product (GDP) growth if the digital skills gap was not addressed – this converts to losing approximately 1.1 percentage points of cumulative GDP growth (over the 14 countries measured).¹⁹ Growth risk can vary by the country's economy structure, industry, and how labour is distributed across roles.¹⁹ India's digital skills gap has the greatest GDP growth risk (an average of 2.3 percentage points every year), followed by South Africa and Mexico (1.8 percentage points of GDP annually), and China and Brazil (1.7 percentage points GDP annually).¹⁹ However, Canada and the United States have relatively low GDP growth risk (at 0.4 percentage points GDP annually), as do Australia, France, the United Kingdom and Germany (at 0.5 percentage points GDP annually).¹⁹

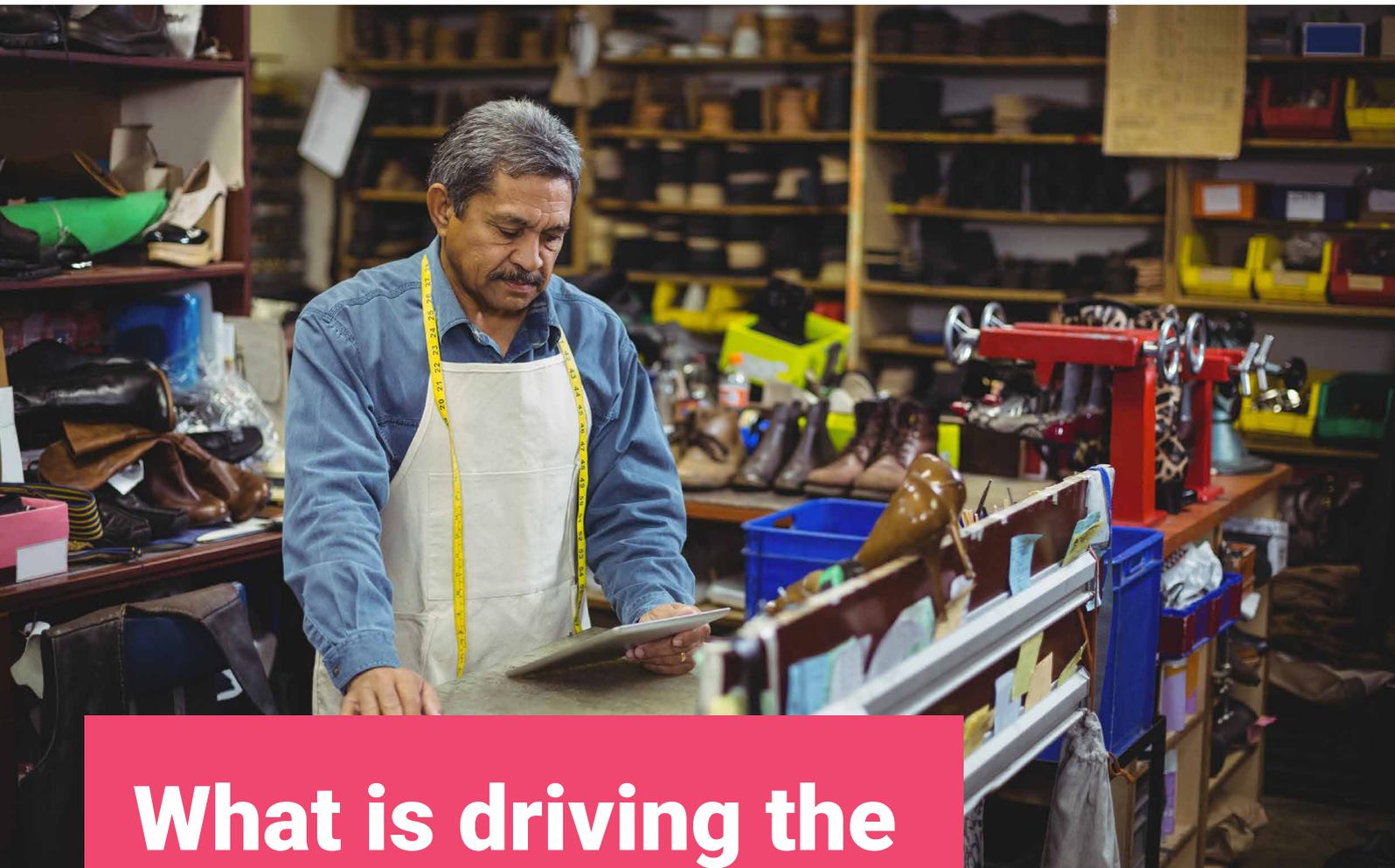
The digital skills gap and its impact has come to the forefront of discussion and debate during the COVID-19 pandemic. Since the pandemic began the use of digital technology is no longer optional for businesses to survive and thrive, as whole industries and companies have shifted their work online and digitalisation has sped up by an estimated three to four years.²⁰ In some contexts, 2020 was named 'the year of upskilling' as companies increasingly focus more on skill building, with basic digital skills and advanced IT skills and programming among the top ten skills companies prioritised.²¹ Individuals also recognised the gap in their skill sets and sought out online classes to gain credentials or advance professional skills, with a four-fold increase in the number of people taking online courses.^{13,22}



This report aims to contribute to the discussion and provide a global overview of some of the important drivers of the digital skills gap and examine what organisations and companies are doing to tackle this important issue.

It has been estimated that as much as \$11.5 trillion of cumulative GDP growth is at risk in G20 countries if the digital skills gap is not addressed

Source: Accenture. 2018. *It's Learning, Just Not as We Know It: How to Accelerate Skill Acquisition in the Age of Intelligent Technologies.*



What is driving the digital skills gap?

While the COVID-19 pandemic highlighted the increasing importance of the digital skills gap and sped up the digitalisation of services, there are underlying drivers which continue to widen the digital skills gap. Long-term changes to the economy and industries – through digitalisation – are driving demand for digital skills and the supply of ‘tech talent’ has not kept up pace with the demand for new and specialised digital skills. Potential digital talent is being overlooked because of educational and qualification barriers, and unequal access to digital infrastructure and skills limited by socio-economic status and the digital divide. This chapter provides an overview of these drivers and explains why they are impacting digital skills.

Digitalisation and the application of emerging technologies accelerate the demand for digital skills

The rise of digitalisation has shifted economies and changed skills demand. Globalisation has placed pressure on low-skilled jobs through overseas outsourcing;²³ whereas digitalisation has polarised the job market with decreasing demand for middle- and low-skilled workers.^{16,24} Despite significant technological progress, there was a slowdown in productivity in both advanced and emerging markets in recent years.²⁵ Some explanations for this include technologies not fully realising their expected impact and inadequate investment leading to misallocation

Box 2. Key drivers of the digital skills gap



Emerging technologies accelerate the demand for digital skills



Digital and social inequalities affect opportunities to develop digital skills



Traditional modes of education alone may not be keeping up with employers' needs for digital skills



The COVID-19 pandemic has amplified the urgency to create conditions which effectively leverage digital solutions for virtual work and commerce



Technological progress is necessitating agile skill adaptation from workers

of capital. Long-term deskilling, especially among younger workers, may also have been a factor.²⁵

The integration of new technologies places pressure on workers to keep up with changes in order to avoid job losses.

There are multiple forecasts regarding the impact of automation on job losses and job gains. For example, one study in 2020 estimated that as the capabilities of machines and algorithms will grow exponentially year on year, by 2025 the hours worked by machines will match human working hours.¹³ Another forecast, also in 2020, estimated that 14% of all jobs in OECD countries are at high risk of automation while 32% are at significant risk of automation.^{3,101} Furthermore, with the gig economy and non-standard work on the rise, workers are placed under increasing pressure to upskill or risk further wage stagnation.²⁴ Digital skills are more likely to be necessary for high-skilled positions (as they are equipped with the cognitive skills and technical knowledge to adapt to working with the new procedures technologies require), while medium-skilled positions require some digital skills to perform

tasks, and low-skilled workers may require infrequent (or no) use of digital skills (at even a basic level).¹⁶ The number of high-skilled occupations has risen, as has the share of low-skilled occupations, while the share of middle-skilled workers has declined.²⁸ Some services that will remain face to face or require socio-emotional skills and adaptabilities (housekeepers, hairdressers, etc.) are likely to grow, and these types of jobs can be completed by low-skilled workers.²⁸ Middle-skilled workers will have some skills that can be adapted and upskilled so they can transition into high-skilled occupations, but if they are unable to adapt, middle-skilled workers may increasingly have to compete for low-skilled jobs.²⁸

Box 3: Key fourth industrial revolution definitions



Fourth industrial revolution: a

generalised term used to describe the digitalisation of industries and how the development of new technologies (e.g. genetics, AI, robotics, nanotechnology, 3D printing and biotechnology) are integrated into society, providing both opportunities and challenges.²⁶



Digitalisation: the process of adopting ICT and new technologies across society and industry sectors.³



Automation risk: the likelihood that a job could be automated by existing technology in the near future.²⁷

Increased use of automation in workplaces has led to increased 'technological alarmism' with widespread concerns of mass job loss in the future. However, recent economic models suggest that 'jobs of tomorrow' could potentially fill employment gaps and lead to more employment.^{13,29} However, these economic models only hold true if workforces can keep up with the pace of change and complete tasks alongside new technologies (such as using new hardware, using software, creating and managing

algorithms, analysing big data, automating routine tasks and working remotely, as well as developing ethical ways of using technologies).³⁰ For example, middle-skilled workers continue to be most at risk of job losses partly because of the lack of efforts to reallocate their skills and tasks within job roles.²⁹



Box 4. Digital skills investment to offset job displacement

Investment in digital skills has the potential to offset job displacements caused by technological change. For example, in the United States, 1.37 million workers are projected to be displaced from their roles within the next ten years, but with an investment of \$4.7 billion, the US private sector could reskill up to 25% of workers who are expected to be displaced.³¹ If the government was to invest \$19.9 billion then 77% of workers expected to be displaced could be reskilled.³¹

Workers (especially low- and middle-skilled workers) need a range of new skills to adjust to the new marketplaces and work environments.¹²

Workforces need employees who have both the technical skills to work alongside new technologies and the soft skills to be able to collaborate and co-create in digitalised workplaces.³² Digital skills in demand can be broadly segmented into basic digital skills for accessing information online and using productivity tools, such as email and basic applications (e.g. spreadsheets), and advanced digital skills for programming, developing applications

and managing networks.^{9,27,33} Soft skills and certain types of cognitive skills are also needed to facilitate workers' adaptation to changing digital environments, such as information processing, self-direction, problem solving and communication.³³ Additionally, foundation skills (such as numeracy and literacy)³³ and digital competencies (a broad term which may include cognitive skills and attitudes towards the use of technology)¹⁶ are crucial to enable effective use of digital technologies.

Demand for new roles is also emerging across industries.¹³

The roles most likely to be displaced over the next few years include data entry clerks, administrative and executive secretaries, accounting and bookkeeping and payroll clerks, accountant and auditors, assembly and factory workers, and business services and administrative managers.¹³ Roles expected to emerge are data analysts and scientists, AI and machine learning (ML) specialists, robotics engineers, software and application developers, and digital transformation specialists. Newer and emerging roles also include process automation specialists, information security analysts and Internet of Things (IoT) specialists.¹³

The call for these roles can be industry specific, for example, materials engineers in the automotive sector, e-commerce and social media specialists in the consumer sector, renewable energy engineers in the energy sector, FinTech engineers in financial services, and remote sensing scientists and technicians in mining and metals.¹³ There are some industry differences, for example results from a global survey on reskilling found that respondents in advanced industries and industrial organisations reported less of a focus on building basic digital skills than other industries – possibly because such skills were already present before the pandemic in these industries – but respondents from these industries are more likely to prioritise technology design, engineering and maintenance.²¹ On the other hand, their peers in the public and social sectors, as well as in healthcare and pharmaceuticals, are nearly twice as likely as those in industrial organisations to say that they have focused on interpersonal skills and empathy. A survey by the World Economic

Forum asked employers what proportion of core skills will be different for employees required to perform their roles well (referred to as skills instability).^{13,102} The data shows that heavy industry and technical roles (in automotive, health and healthcare, and professional services) will have the greatest skill instability while those in agriculture, food and beverage, transportation and services, and government and the public sector will have the least.^{13,102}



Box 5. New technologies define the demand for new skills

Demand for new skills align with technological trends as companies are most likely to seek out skills relating to emerging technologies such as blockchain, cloud computing, AI and advanced analytics, as well as skills related to big data and cyber security.^{11,15,34} New roles are emerging which can adjust to these changing technological demands such as data analysts and scientists, AI and ML specialists, robotics engineers, software and application developers, digital transformation specialists, process automation specialists, information security analysts and IoT specialists.^{13,17}

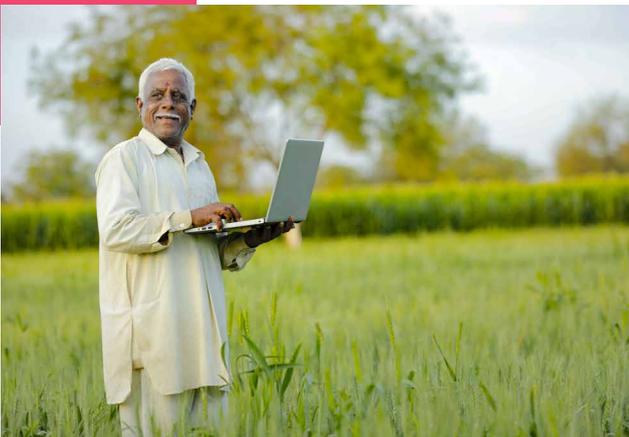
Digital and social inequalities affect opportunities to develop digital skills

The digital divide can be regarded as a distinction between those who are able to access new technologies and are benefiting from rapid digitalisation versus those who experience barriers accessing and using technology – potentially exacerbating pre-existing social inequalities.

Previous digital divide research concentrated on unequal access to the internet but recently the conversation has shifted towards identifying the skills needed to exploit the full potential of the internet, making access to digital infrastructure a first level digital divide and digital skills a second level digital divide.^{35–38} Without access to the internet there are limited opportunities to develop digital skills, but it becomes more challenging to use the full capacity of digital technologies without digital skills. For example, 85% of EU citizens in 2019 had used the internet but only 58% had at least a basic level of digital skills.⁹ This shift in interest from access to digital infrastructure to digital skills highlights that **the digital divide is a consistently evolving concept, as digital inequalities appear to mirror pre-existing social inequalities.** The digital divide is a multi-dimensional phenomenon with several moving parts, which are continuously evolving.³⁸ For example, during the pandemic, teleworking emerged to be a new form of the digital divide, as there were social inequalities between those who could and could not work at home and varying levels of capacity between different teleworkers.³⁹ While teleworking has been available for several years now, it has taken a dramatic shift in workplace environments and changes public conversations to consider teleworking as a potential topic in the digital divide concept. Just like social inequalities, digital inequalities are evolving and may never be fully closed; digital inequalities reinforce existing social inequality and as social inequality increases in parts of the world, digital inequality is expected to follow.³⁸

There are a range of barriers which can affect access to digital infrastructure and development of digital skills. Barriers to accessing digital infrastructure can vary by the affordability of services which can broaden the gap between rich and poor,

internet bandwidth affecting the ability to transmit and receive information over networks, speed between basic and more advanced broadband services, and whether a person has easy access to a mobile phone, a laptop or desktop computer.⁴⁰ Each of these in turn can create barriers to the development of digital skills, as easy access to the internet and digital infrastructure remains a core issue which impacts the development of digital skills.³⁶ When people have less access to digital resources, they have fewer opportunities to practise their digital skills. For example, digital resources in classrooms can potentially serve as an equaliser between students who may or may not have access to digital technologies at home,⁴¹ but a potential inequality could arise with different opportunities to practise digital skills at home. However, divides in digital skills continue to develop even as physical access to digital infrastructure (such as access to the internet or mobile phones) has become almost universal.³⁶ For example, a study in the Netherlands on internet skills found that only having access to a mobile device (instead of a desktop or laptop) limited internet activities; using a range of digital devices leads to more internet use and outcomes;¹⁰⁵ maintaining internet devices contributes to internet skills and the frequency and diversity of internet use (including maintaining hardware, software and subscriptions, which all require financing); and negative attitudes (such as computer or internet anxiety) can also impact internet skills and use.³⁶ This demonstrates the range of socio-economic and structural barriers that people face when accessing the internet.



Here are some examples of key groups that face barriers when developing digital skills. This is not an exhaustive list of the inequalities which can influence digital skills development nor does it comprehensively cover the groups that could benefit from further digital inclusion; instead they are examples which are currently most supported by the literature. It is important to flag that those subject to digital inequalities exist on a relative scale (where they may have more or fewer digital skills than others) rather than absolutely (as in they have or do not have digital skills).³⁸ There are also variations within these chosen groups depending on a variety of pre-existing inequalities and barriers (for example socio-economic or structural). The recent literature highlights that although these groups may be digitally excluded they represent untapped potential in society – an area of opportunity to ‘build bridges’ across the digital divide.

In 2020, estimates suggest that urban–rural disparity was most evident in Indonesia, Brazil and South Africa

Source: OECD, 2020. ‘Disparity in Broadband Uptake between Urban and Rural Households.’ OECD Going Digital Toolkit.

(i) Inequality of access can particularly impact rural areas (over those in urban areas). People living in rural areas are more likely to struggle to access digital resources owing to the high cost of creating digital infrastructure in remote areas.⁴² In 2020, it was estimated that urban–rural disparity was most measurable in Indonesia, Brazil and South Africa (with a disparity of more than 20% between rural and urban households).⁴³ A rural–urban divide can lead to high centralisation of skills in cities and ‘high-tech’ regions, as the development of jobs, training and wealth creation receives more focus and attention in these regions.⁴⁴ For example, in the United Kingdom, London has a high concentration of highly skilled individuals working in roles related to professional services.⁴⁵ Rural areas are also predicted to be more negatively affected by automation. For

example, in the United States, the risk of automation is greater in small metro areas, where the average worker in an area with a population less than 250,000 works in a job in which 48% of tasks are potentially automatable.⁴⁶ In large metro areas, the risk of job automation is divided by educational attainment.⁴³ So, while rural populations are under more pressure to develop digital skills (at risk of future job losses to automation), there could also be fewer opportunities to develop digital skills (because there is lower internet access in rural areas and greater centralisation of skills in larger cities).



(ii) The younger generation have an advantage when developing digital skills. There is a frequent generalisation that the younger generation are ‘digital natives’, fluent in the use of digital technologies, while the older generation is ‘left behind’.⁴¹ Though this broad generalisation could be challenged by robust analysis, there is some data that supports the idea that the digital skills of younger and older generations differ. It is important to note that this difference can vary depending on the socio-economic situation, structural or cultural barriers, or pre-existing social inequalities a person may be affected by. This was reflected in European population statistics in 2020 showing that 82% of 16–24 year olds had at least basic levels of digital skills compared with 35% of 55–74 year olds having similar skills.⁹ The current older generation (45–65 year olds) perform less well on numeracy tests than younger generations (16–44) (this finding is consistent across all OECD

countries) and numeracy is considered one of the foundational skills that inform digital skills.⁴⁷ The younger generation tends to have more opportunities to improve their digital skills than older generations today.^{12,48} However, age can influence opportunities in a workplace: just over a fifth (22%) of workers report missing out on career advancement or training as a result of their age (younger and older workers equally likely to be affected), and younger workers report not being given the same opportunities as workers in other age cohorts to progress in an organisation during the pandemic.⁴⁸

(iii) Digital skills distribution is also influenced by gender. According to a UNESCO report, ‘women and girls are 25% less likely than men to know how to leverage digital technology for basic purposes, 4 times less likely to know how to programme computers and 13 times less likely to file for a technology patent’.⁴⁹ Some studies report this gender divide beginning at primary education, where in the United Kingdom girls’ and boys’ interest in science, technology, engineering and mathematics (STEM) varies at the ages of 10 and 11.⁴⁹ Cross-national assessments show that most students taking advanced STEM courses are boys, and girls tend to drop out of STEM subjects earlier than boys, so are increasingly less likely to pursue tech-related subjects later on in their education.⁴⁹ This later affects tertiary education. For example, in 2016, of all women graduates 33% in Singapore, 30% in Canada and 18% in Germany had ICT tertiary education.¹⁵ Attrition rates for women within technology-related fields are also high, speculatively because of gender discrimination, competitiveness and a lack of female

**Globally, it is estimated that
40–160 million
women may need to change
occupation by 2030 as a
consequence of automation**

Source: McKinsey, 2019. The Future of Women at Work: Transitions in the Age of Automation.

peers.⁴⁹ This results in a gender gap in the labour market. Data from 2020 showed that women make up only 14% of the cloud computing workforce, 20% of engineering, and 32% of data and AI workforces.⁵⁰ Women's jobs are more at risk of automation in the future, with a projected estimate suggesting that 40–160 million women globally will need to transition to new occupations by 2030.⁵¹ This is impacted by wider labour market discussions about promoting women and gender pay gaps, which can also influence women in tech.⁴⁹

While it could be presumed that digital gender inequality reflects wider gender inequality at large (influenced by socio-economic, cultural or structural factors), countries with lower levels of gender equality actually have relatively more female STEM graduates over more gender equal countries.^{49,52} Women in countries with low levels of gender equality are more likely to be attracted to ICT jobs, perhaps because in these countries ICT jobs provide a clear route to financial independence.⁴⁹ The reason for the negative correlation in high gender equality countries is unclear, but it highlights that gender equality in society does not always directly translate to gender equality in digital spaces or digital professions.⁴⁹

(iv) Ethnic minorities are also subject to social inequalities along the digital divide.³⁸ For example, a 2016 report from the United States found that people of colour and people from low-income household were far less likely to have access to the internet (owing to inequalities of accessing digital infrastructure and income).⁵³ If they do have internet

connection at home, Hispanic or Black internet-connected homes are more likely to be 'mobile only' households (28% compared with 18% in White households), and this is again more likely among the poorest households (White households 25%, Hispanic 36% and Black 37%).⁵³ As discussed above, internet access and the type of devices used to access the internet can impact digital skills. However, **few recent sources have gone one step further and explored digital skills among minority ethnic groups.** More work could be done to understand the barriers that different communities face when developing and using digital skills and what is driving this digital divide in these communities.

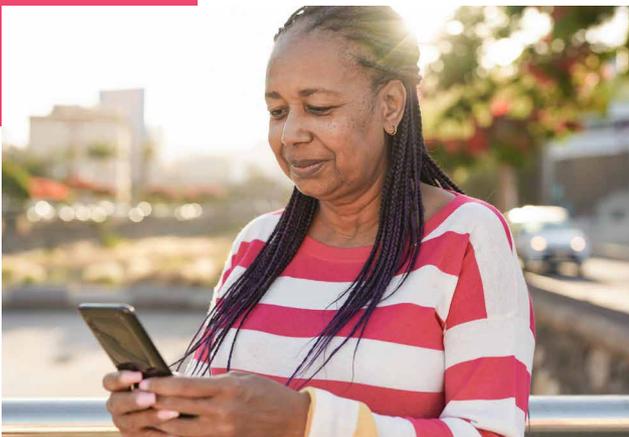
Traditional modes of education alone may not be keeping up with employers' needs for digital skills

While higher education can lead to increased digital education, the number of graduates is still not meeting the level of digital skills employers' demand. Educational attainment level is one of the key determinants of digital skills level, partly because of the overlap between learning digital skills and basic education requirements. Numeracy and literacy skills are key when developing digital skills.^{41,54}

In Europe, 82% of individuals aged 16–24 and 87% of students have at least a basic level of digital skills

Source: European Commission. 2020. *Digital Economy and Society Index (DESI) 2020: Human Capital.*

Those with higher levels of education (such as undergraduates or graduates) are most likely to have digital skills.^{9,45} This was seen in EU countries, where 82% of individuals aged 16–24 (85% of whom had high formal education) and 87% of students have at least a basic level of digital skills, compared with 35% of those aged 55–74 and 30% of the retired or inactive having basic digital skills.⁹ Advanced digital skills are needed in specialised areas such

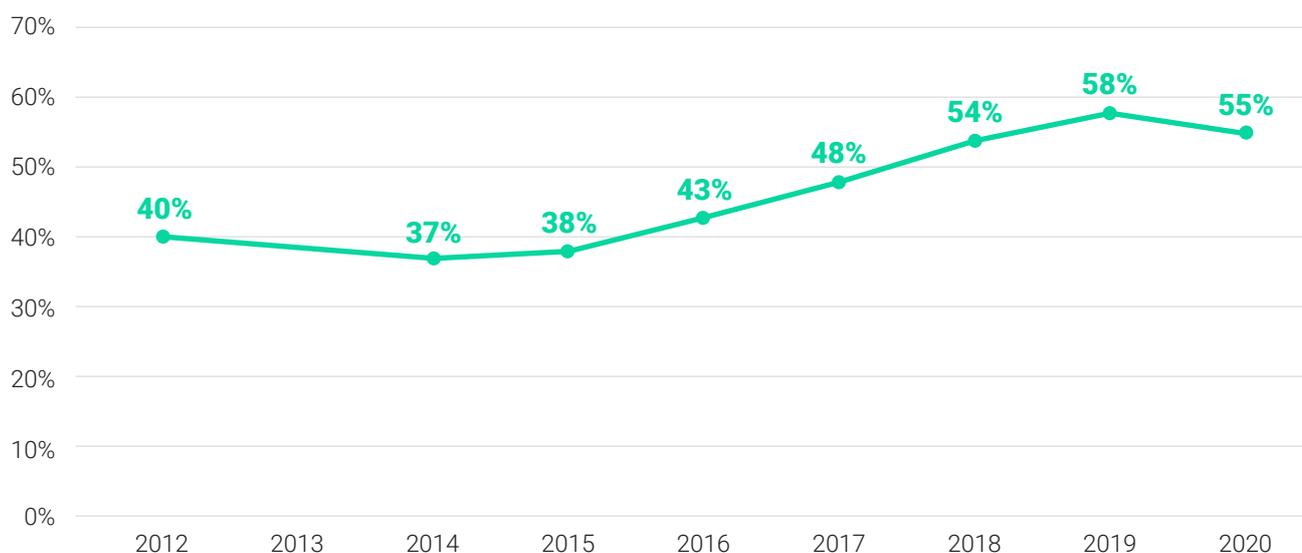


as developing, designing, managing, producing, consulting, selling, installing, administrating, maintaining or servicing ICT systems, which are traditionally gained with a computer science degree.⁵⁵ However, there are increasing concerns around employers' demand for digital skills because of the number of school leavers with some digital skills; for example, the UK's Learning and Work Institute found that only 48% of employers thought young people were leaving full-time education with sufficiently advanced digital skills (with 40% disagreeing young people have the advanced digital skills they need) and that 76% of business leaders thought a lack of digital skills would impact the profits of their business.⁵⁶

In EU countries, increasing numbers of students are enrolling in ICT degrees, however the number of graduates is unable to fully meet the demand for specialist digital skills. In EU countries, ICT specialists withstood the effects of the 2008 global financial and economic crisis, with the sector expanding in 2012, and the total number of employed persons in ICT specialisms grew by 50% between 2011 and 2020.^{57,58} An observation was made in 2015 whereby the number of ICT graduates in the

EU was 205,000 but the ICT workforce increased by 426,000, demonstrating there was a large number of 'lateral entries' into the labour market, where people without formal ICT degrees moved into the sector.⁵⁵ More recent data suggests there has been a continuation of this phenomenon, whereby employers still struggle to fill ICT vacancies due to the shortage of ICT graduates. Having an ICT degree leads to a high probability of employment: in 2019 there were 2.8 million ICT graduates in EU countries of whom 2.6 million (approximately 93%) were employed.⁵⁸ Nonetheless, enterprises in the EU found it increasingly hard to fill vacancies for ICT specialists. The number of enterprises with hard-to-fill vacancies rose from 40% in 2012 to 55% in 2020 (Figure 1).^{59,103} There seem not to be enough ICT specialists (with ICT degrees) in the EU to meet the increasing demand for digital talent, or ICT graduates are being employed in jobs in non-ICT sectors, suggesting there is a skills mismatch, with challenges varying across sectors: for example, manufacturing and administrative and support services find it more challenging to fill ICT vacancies than accommodation, food and beverage service sectors (Figure 2).

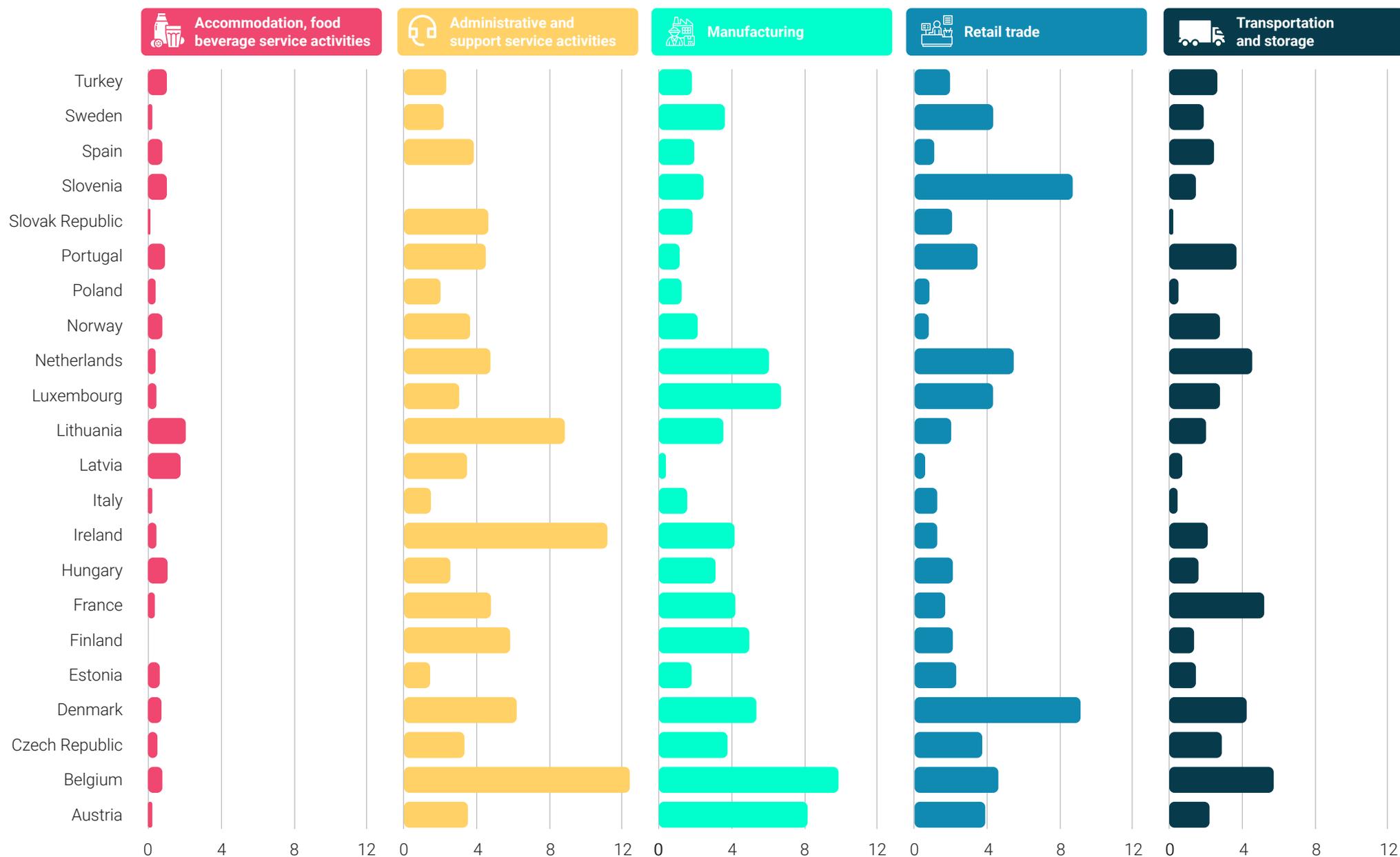
Figure 1. Enterprises with hard-to-fill vacancies for ICT specialists in the EU, 2012–2020



Source: Enterprises that recruited or tried to recruit ICT specialists from 2012-2020 in Eurostat database, https://ec.europa.eu/eurostat/databrowser/view/ISOC_SKE_ITRCRN2_custom_1308604/default/table?lang=en

Note: Data for 2013 are not available. Data corresponds to EU-27.

Figure 2. Hard-to-fill vacancies for ICT specialists in 2020 (%)



Source: ICT Access and Usage by Businesses database in OECD.Stat, https://stats.oecd.org/Index.aspx?DataSetCode=ICT_HH2#

At a global level, **there are also indications of a disparity between the market value of ICT skills and the relatively low uptake of ICT degrees.** An OECD analysis of 2019 data showed that while the potential salary of someone with an ICT degree is high, the uptake of ICT degrees is low.⁶⁰ Engineering, manufacturing and construction, and ICT are the two degrees with the highest relative earning advantage (81% for the former and 78% for the latter), but the share of students entering into engineering degrees (16%) is more than triple the number taking ICT courses (5%).⁶⁰ The uptake of ICT degrees is the lowest of all measured degrees, on a par with natural sciences and education (both degrees which have significantly lower earning potential).⁶⁰ While the earning advantage and share of new entrants are not correlated, it appears that while industries highly value and need students with specialised ICT degrees, the supply of ICT graduates is low. In turn, this trend could offer an explanation for the high valuation of ICT degrees.⁶⁰ More exploration is needed to clarify why this mismatch is occurring and to look into global levels of ICT graduates and graduates with (sought-after) digital skills.

There is an underlying assumption within this discussion that formal academic degrees are the 'best' or the only way to develop digital skills.

However, when there is a skills mismatch, traditional education outputs (like higher education qualifications) may not be the most suitable route for many employees who already have higher education degrees or tertiary education.

For example, in the EU in 2018, close to a third of



tertiary education graduates felt overqualified for their current jobs.¹² As workers progress in their career, they gain skills which are valuable but may be different from their higher education qualification, for example, with one in five (22%) EU workers over the age of 55 already having the necessary skills to complete the job, despite being officially deemed 'underqualified'.¹² Therefore, the emphasis is less about developing new formal qualifications and instead about recognising skills.

Further expansion of higher academic education attainment rates may not always be the right recipe for employment. By contrast, good-quality and labour-market-relevant vocational education and training, which argues for more work-based learning, has proved its worth. It is also widely accepted that strengthening key competences and soft skills within education curricula is desirable, given that a significant part of employer recruitment difficulties reflect such skill deficiencies.¹²

As people progress in their careers, formal higher education qualifications can become out of date and be an imperfect indicator of skills, so there needs to be further consideration of which modes of education are most appropriate to bridge the digital skills gap. While traditional degrees remain the conventional pathway to working in ICT roles, it has been highlighted that a more holistic view is needed and that educators also need to focus on transversal skills.^{19,31,34,55,61}

The COVID-19 pandemic has amplified the urgency to create conditions which effectively leverage digital solutions for virtual work and commerce

The COVID-19 pandemic has acted as a disrupter in the socio-economic landscape, sparking a global recession and pausing several global industries.

A global survey showed that as a result of the pandemic, digitalisation of supply chains has been brought forward by three to four years, whereas the share of digital or digitally enabled products has been accelerated by seven years.²⁰ In March 2020, the risk to life caused governments to order the partial or

full closure of businesses with only a few 'essential' organisations (such as hospitals) continuing face-to-face operations, whereas industries that once might have been thriving (such as hospitality or retail) were suddenly deemed 'non-essential'.¹³ The crisis peaked in mid-March to mid-April 2020 when nearly 55% of economies (in about 100 countries) across the world ordered workplace closures for all but essential business.¹³ Limitations on work continued throughout 2020 and into 2021 – in January 2021, it was estimated 93% of the world's workforce still experienced some form of workplace closure.⁶²

The pandemic created a 'double-disruption' scenario for workers as they adjusted to the rapid use of digital solutions and the COVID-19 recession.^{13,67}

Workforces were seemingly segmented into three groups 'essential workers', 'remote workers' or 'displaced workers'.¹³ The exact number of remote workers during the pandemic is unclear⁶⁸ but a global survey estimated an average of 52% of employed adults worked from home at some point since the beginning of the pandemic.⁶⁹ This varied by country with Japan, Hungary and South Korea reporting the lowest working from home percentages (26–37%), and Colombia, India, South Africa, Peru and Malaysia some of the highest (65–74%).⁶⁹ Even within countries there were disparities, with home working favouring highly educated, high income workers who already had the opportunity for remote working before the pandemic.^{39,68}

Alongside this, companies sought out automation and new digital solutions as a way of adapting to the 'new normal'. The pandemic caused 38% of companies to accelerate their digitalisation and automation processes, and 86% of the companies which are automating are doing so to recruit or retain staff.⁶⁷ This varied across countries, with some employers more likely to automate (including those in Germany, Austria, Greece, Switzerland, Panama, Costa Rica, Japan, Guatemala, Italy and Mexico), while others were least likely to automate (including those in China, the United Kingdom, Portugal, India, Spain, Slovenia, Israel, France, Czech Republic and Hong Kong).⁶⁷



Box 6. The COVID-19 labour paradox

COVID-19 sparked an emerging 'labour paradox' where, despite high levels of unemployment and disruption to global industries, employers are struggling to recruit the labour they need (this is a general demand for labour, not just specific to digital talent). Survey data records an average of 69% of employers across the world finding it difficult to fill jobs in 2021, up 11 percentage points from 2019 when 58% of employers had difficulties, and up 29 percentage points from five years ago (2016) when 40% of employers had difficulty filling jobs.⁶³ News outlets have speculatively given three explanations for this issue: over-generous benefits (like furloughing, stimulus cheques or job protection schemes) disincentivise workers to come back to work full time; workers remain fearful of the health threats to coming back to work; and labour has been reallocated across industries.^{64–66} It is the third, labour relocation across industries, which relates back to the digital skills discussion, as there are some industries which are hiring cautiously (e.g. finance and the IT sector) and some which were hit hardest by the pandemic and are in a persistent hiring slump (e.g. recreation and travel, consumer goods and manufacturing).¹³ There is a possibility of mismatch of skills between industry positions or the need for workers to adapt to new working conditions which did not exist pre-pandemic (e.g. working from home capabilities and skills). This is an evolving area which needs further consideration.

While the pandemic demonstrated the importance and benefits of technological solutions, it also prioritised digital skills. In a business survey of 2021 with 700 respondents from various regions, industries, company sizes, function specialities and tenures, 58% of respondents reported that closing the skill gaps was a more important priority now than before the pandemic.²¹ Specifically, prioritisation of digital skills has increased by 16% in comparison with 2019 results.²¹ Remote working leveraged the use of technologies such as cloud computing and online collaboration, which rely heavily on digital skills.^{11,34} Workers who had digital skills before the pandemic were arguably better equipped to respond to the crisis and adapt to new ways of working.⁷⁰ Specifically, employees who already had experience of working remotely (such as ICT professionals, managers, and legal, business administration and science sector personnel) were able to transition more easily to remote working.⁷⁰

A business survey shows that since 2019 prioritisation of digital skills has increased by

16%

Source: McKinsey, 2021. *Building workforce skills at scale to thrive during – and after – the COVID-19 crisis.*

Businesses and workers alike sought out opportunities to upskill and reskill. No matter the allocation of workers (essential, remote or displaced), the pandemic placed new pressures on workers to develop new skills and resilience. Essential workers had to adjust to consistent physical safety concerns, displaced workers had to manage job uncertainty and consider short-term or permanent career switches, and remote workers had to adjust to digital working, which included managing their well-being and mental health.¹³ The number of individuals seeking out opportunities for online learning through their own initiative increased four times over since before the pandemic; there was a five-fold increase in online learning opportunities offered by employers; and a



nine-fold increase in enrolment for online learning through government programmes.¹³ Data from Coursera showed a significant increased enrolment for online training courses with an emphasis on learning reskilling and upskilling as well as personal development and self-management courses, but the demand changed depending on worker status, reflecting the different 'stressors' these cohort groups faced.¹³ Employed workers placed greater emphasis on personal development and self-management courses (e.g. mindfulness, meditation, gratitude and kindness) but unemployed individuals placed greater emphasis on digital skills (e.g. in data analysis, computer science and technology).¹³ The unemployed targeted their online training courses to match emerging job roles in engineering, cloud computing, data and AI.¹³

It remains to be seen how long the impact of the pandemic will last on the world economy and people's lives, but it is increasingly clear that some of these short-term relief measures will have long lasting effects on the recovery effort.^{62,71} According to a recent global survey, the temporary business relief measures are likely to be long term, with 80% of business leaders reporting an increase in the automation of their work processes and consolidation of arrangements for remote work.¹³ Furthermore, there is an increase in job advertisements requiring employees to work remotely.⁷² Such changes are being driven top-down (by employers) and well as bottom-up (by



job seekers), with data⁷³ showing a strong demand from job seekers and employees for remote working arrangements. This is a trend further supported by the outcomes of a recent global survey that showed that only 9% of employees would be willing to return to a traditional commuting and working arrangement full time.⁴⁸

Technological progress is necessitating agile skill adaptation from workers

As emerging technologies develop and are adopted, the skills required by workers will need to change. Therefore, the speed of technological advancements is a key element to consider within this discussion. Investment in digital skills is based on a premise whereby humans are able to work alongside new technologies and ultimately build their skills to remain employable, even as workplaces and industries increasingly incorporate automation and augmentation.⁵ However, this skills demand may fluctuate depending on the speed of technological development – the skills which are in demand today may not be needed tomorrow. For example, speed of technological development can differ between countries depending on progress with technologies and their applications in specific sectors within the country's economies (e.g. financial services and the automotive industry).⁶² Certain technologies may advance quicker than expected, such as quantum computing, which may ultimately change the technological landscape. For example, the engineers of today may be working in cloud computing, engineering, data and AI or product development

roles when the jobs of the future emerge.¹³ This is partly why those discussing current skill requirements do not just focus on the demand for digital skills today but also aim to understand what jobs might exist in five to ten years' time and consequently what digital skills a workforce will need.^{13,74}

Within the last year, there has been an increased demand for a range of skills which complement digital skills and allow people to adapt to new conditions. For example, during the pandemic, a survey of 700 respondents from various industries and regions asked about 25 specific skills that companies have prioritised to address through reskilling, and more than half of respondents reported a focus on developing leadership, critical thinking and decision making, and project-management skills.²¹ Compared with the results from 2019, the biggest increases were among social and emotional skills (three of the five biggest increases) alongside advanced cognitive skills, with the share of respondents reporting companies addressing interpersonal and empathy skills nearly doubling in a year.²¹ Cognitive skills (such as creativity, critical thinking, decision making and information processing) are strongly awarded in current labour markets (with an increased wage premium) and it has been estimated that by 2030 their demand will grow in the United States by 19% and in Europe by 14%.^{75,109} Furthermore, in digitally intensive environments, soft skills such as self-organisation, management and communication are increasingly valued.⁷⁵ Such trends have become more evident during COVID-19, with the increased need for soft skills such as active learning, resilience, stress tolerance and flexibility to 'self-manage'.¹³

It is estimated that by 2030, demand for cognitive skills will grow by 19% and 14% in the United States and Europe, respectively

McKinsey. 2018. Skill shift: Automation and the future of the workforce.

Positions across the hierarchy of businesses are subject to fast change, as business leaders are now faced with a shift of markets, new ways of working and communicating, and new attitudes to work.⁷⁶ Remote working, increased connectivity and information availability has levelled traditional hierarchies through a decentralisation of power within companies.⁷⁷ E-leadership has become a key factor in fostering a productive virtual work environment⁷⁷ and in adopting a proactive approach for developing business models that identify innovation opportunities and leverage the latest ICT developments.⁷⁸ This has demanded new management styles and skills from business leaders in order to navigate various virtual communications platforms.⁷⁷ A recent survey shows that soft skills such as empathy, ability to communicate and resilience have become more valued qualities in business leaders.⁷⁶

All levels of roles within companies are shifting.

At a senior level, roles such as digital and analytics champions are emerging; elsewhere other roles such as data scientist and data analyst, data engineer, IT architect, product owner, agile coach, scrum master, AI and ML learning specialist, robotics engineer, software and application developer, process automation specialist,

information security analyst, IoT specialist and digital transformation specialist are increasingly required.^{13,17} The growing demand for these roles reflects the push for automation, digitalisation, as well as concerns with cyber security risks.¹³



Box 7. E-leadership

For this study, we use the definition of e-leadership provided by Van Wart (2019):⁷⁹ ‘the effective use and blending of electronic and traditional methods of communication. It implies an awareness of current ICTs, selective adoption of new ICTs for oneself and the organisation, and technical competence in using those ICTs selected.’



How can organisations address the digital skills gap?

Traditionally, employers have relied on university graduates and postgraduates to help close any talent gaps and bring new knowledge, skills and capabilities to an organisation, but with the demand for digital skills rapidly increasing, organisations cannot solely rely on recruiting talent to match employers' skill demand.^{12,80} Companies already have a range of initiatives in place to address the widening digital skills gap, with one report finding over 400 inclusive ICT skills training programmes in selected countries (in France, Germany, Ireland, Poland, South Africa, Spain and the United Kingdom).⁵⁵ Employers attempting to close the digital skills gap and prepare for the jobs of tomorrow should begin by developing a strategy (perhaps including a skills audit of current

skills and those needed in the future) identifying how skills will be developed within a workforce, and taking action to ensure that new learnings are effectively implemented.⁸⁰

As highlighted in this report, the issues related to the digital skills gap are varied, wide-ranging and complex, and have become even more apparent during the COVID-19 pandemic. Tackling these pressing and dynamic concerns will require an active and concerted approach involving multiple stakeholders across public and private sectors. This chapter provides an overview of some of the core actions that companies are currently taking, or could be taking, to help close the digital skills gap.

Box 8. Potential priority actions to tackle the digital skills gap



A common skills framework could be used to match talent with business skill demand



Skill-based hiring practices could help fill digital skills gaps within companies



Upskilling and reskilling initiatives can play a key role in building resilient workforces



Redistribution of labour and skills across businesses can create opportunities to address skill mismatches



Digitally inclusive initiatives and programmes can help develop digital skills



Industry experience opportunities can provide effective alternatives for building skills



Businesses can support workers by adopting a lifelong learning approach

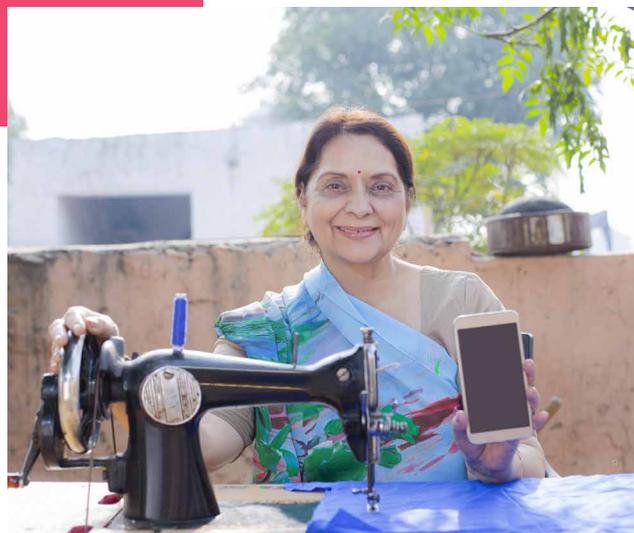


Developing cross-cutting partnerships between different stakeholders can help tackle the skills gap

A common skills framework could be used to match talent with business skill demand

One of the main challenges underpinning the digital skills gap is the need for a standard framework for defining digital skills that allows employers to determine the level of digital competence across

different sectors of society. There are currently efforts to build a common 'skills language' to try and communicate key skills which employers will recognise, but challenges remain as there is no one common framework to identify and communicate basic digital skills. Frameworks vary: some include digital skills as a subset of digital literacies; some separate digital skills from digital competencies; and some develop a global digital skills taxonomy.^{74,81} While conversations about digital skills are evolving (and are likely to continue to develop), creating a common skills language helps workers communicate qualifications in a way that employers can recognise. Many adult employees acquire skills on the job or through relevant life experiences, but these skills are not always recorded in formal qualifications.¹² The logic behind developing a common skills language is to shift to a skills-based labour system, where employers can hire talent based on potential employees' skills over traditional qualifications (such as four-year college degrees).⁷⁴ The benefits of this approach could include creating fairer labour markets which allow easy transition between roles, opening up greater access to learning opportunities, and skill-based job matches where hires are made unbiasedly based on a worker's skill profile.⁷⁴ However, in 2021 there is an overabundance of terminologies and frameworks, which creates further confusion about the best way to make digital skills programmes,⁸² and challenges continue in getting the labour and educational eco-systems to recognise and promote a commonly agreed skills-based language.





Box 9. European Skills, Competences, Qualifications and Occupations

In July 2017, European Skills, Competences, Qualifications and Occupations (ESCO)⁸³ launched. This is the European multilingual classification of skills, competences, qualifications and occupations. It seeks to connect job seekers with employers and improve job mobility across Europe by offering a common language for occupants and skills. ESCO describes, identifies and classifies professional occupants and skills. It helps people identify what skills are needed for a particular occupation, what skills are obtained during a specific qualification, and what qualifications are often required by employers (then connecting job seekers to upskilling and reskilling information). This helps job seekers to align their CVs to open positions and can also convey job qualifications and skills across the European market.

Skill-based hiring practices could help fill digital skills gaps within companies

A major part of any digital skills strategy is attracting digital talent, but there are issues with current hiring practices in evaluating skills within the hiring process and the discrepancy between job descriptions and actual job requirements.⁵⁵ There is a need for companies to better understand job markets and job requirements in order to develop a skills-based hiring practice. For this to happen, more emphasis would need to be placed on skills in addition to (and sometimes instead of) formal education degrees, in a way which employers can



Box 10. Skills Engine

Another example of a social innovation organisation is the US-based Skills Engine,⁸⁴ which uses AI to translate CVs and curriculums into a structured industry skills language – trying to bridge the gap between the language used in job postings and the language workers use to describe their skills.

easily recognise and respond to. For example, some companies are removing degree requirements from job postings, leading to an increase in new hires without college degrees for some roles.¹³ Certain ML, AI and automated pre-selection platforms can potentially assist with a skill-based hiring approach, by standardising recruitment and creating structured interview settings (e.g. removing personal and demographic information, conducting interviews, evaluating hard and soft skills).¹⁰⁴ There are benefits of this skill-based hiring approach: it expands the available talent pool for open roles, potentially reduces unconscious bias through objective assessment of relevant skills, and facilitates internal moves faster between departments.⁸⁵ However, if algorithms are used to match job seekers with employers, there should be careful consideration to address and remove any biases within the algorithms in order to ensure a fair recruitment process. Overall, creating skills-based hiring practices provides incentives for workers to invest in their skills, signalling the 'market value' of new credentials.¹³



Box 11. Opportunity@Work

Opportunity@Work⁸⁶ aims to expand career opportunities for STARS (individuals Skilled Through Alternative Routes). The organisation champions skill-based hiring practices through their stellarworx* programme, which matches trained STARS with inclusive employers ready to hire. An employer can specify the criteria they wish to hire for, and the programme creates a 'match score' for candidates, who are chosen for their pre-existing hard and soft skills. Training partners provide ratings, reputation and feedback information.

Upskilling and reskilling initiatives can play a key role in building resilient workforces

Companies currently focus on upskilling and reskilling programmes to build digital skills among their employees. There is a general view that attending training about internet applications and digital skills develops multiple digital skills, can lead to more network and content sharing, can increase employed professionals' problem-solving skills, and can increase the creativity skills of self-employed individuals.⁸⁹ Workplace learning allows employees to develop work-relevant skills and improve their employment prospects.¹² Learning in the workplace can open up opportunities for under-skilled workers (or workers who lack experience) and improve overall job satisfaction.¹² A recent global survey showed that 71–90% of the executives and managers surveyed reported positive impacts from investing in employee skill building, by improving employees' ability to deliver company strategy and strengthening the company's reputation as an employer, as well as improving employee performance and satisfaction.²¹



Box 12. HackerRank for work

HackerRank⁸⁷ is a global tech industry hiring platform which helps hiring managers to evaluate developers objectively. Companies can define their specification for a role and create challenges for developers to complete. Candidates must complete them and their submissions are scored for accuracy of outputs. This process helps test a candidate's problem-solving abilities and technical skills, and standardises the hiring process.

In a global survey, 71–90% of the executives and managers surveyed said that they could see positive impacts from skill building investments

Source: McKinsey. 2021. *Building workforce skills at scale to thrive during - and after - the COVID-19 crisis.*

A global survey indicates that skills building has become the most sought-after strategy to close the skills gap with 69% of organisations doing more skill building now than they did before the COVID-19 pandemic (more than hiring, contracting or redeploying employees).²¹ In the same survey, more than half of respondents said their companies are planning to spend more on learning and skill building over the next year than in 2019.²¹ In 2020, a study found that companies estimate around 40%

of workers will need reskilling in the next six months (or sooner), and 94% of business leaders expect employees to pick up new skills on the job (+29% from 2018).¹³



Box 13. MySkills myFuturework

MySkills myFuture⁸⁸ is an American job centre network website page which helps candidates identify their pre-existing skills and find careers that require similar skills. It gives candidates potential future roles, businesses and trainings which may be suitable for their future career.

Training programmes need to have a structured approach to ensure that participants remain engaged and supported, but it has also been highlighted that **companies could look into mixed and integrated approaches to training** that can include using a wide range of trainee delivery methods (e.g. classroom training, bootcamp intensive training programmes, workshops, online training and online platforms, experimental learning or mentorships).^{10,55} For example, online learning has advantages as students can take part in digital learning where the sources of knowledge, teaching and materials are all online and can be accessed at any time.⁹¹ Online learning can be challenging, however, as it is hard to identify who is actually performing an online assessment, and it requires pre-existing digital skills and access to digital technologies to take part.⁹² To create tailored digital skills training programmes some companies have sought out third-party companies and outsourced their training, making this an area for economic



Box 14. Workplace training in SMEs versus larger enterprises

ICT training is mostly concentrated in large enterprises. It has been reported that in Europe in 2018, 24% of enterprises provided ICT training, however 70% of the training was given by large enterprises.⁹ Nonetheless, a global survey has shown that reskilling programmes at organisations with fewer than 1,000 employees are often more successful than those at large ones, as managers of small companies are more agile and tend to make bold moves faster than managers of larger companies, and smaller company managers tend to have a clearer view of their organisation's skills deficiencies so can be better at prioritising the gaps they need to address for reskilling.⁹⁰

growth with coding boot camps alone thought to be a \$240 million business in North America.⁸²

By investing in training programmes employers can set themselves up to be more competitive, attract the 'best' digital talent, and become the 'employer of choice'. A study in 2017 showed that over half (55%) of digitally talented personnel would be willing to move to another organisation if they feel their digital skills are stagnating at their current employer.¹⁸ The study also found that over half (58%) of those with digital talent are likely to gravitate towards organisations that offer better than average digital skill development.¹⁸ Investing in training and development can enable companies to future proof themselves and build up digital skills among their workforces.



Box 15. Creating IT Futures

Creating IT Futures⁹³ is a US charity which provides skill development programmes and aims to close the skills gap in the IT industry. Performance-based certifications are then offered to validate the training. Courses provided include accelerated versions of traditional courses and customised training to meet business needs.

Redistribution of labour and skills across businesses can create opportunities to address skill mismatches

It is important for companies to consider how digital talent is distributed within the organisation. Traditionally, when an economy has a high level of skills mismatch, labour mobility is promoted through reduced employment protection legislation, easing of business regulations and removing other barriers which prevent workers from changing jobs.¹² This is beneficial from a worker's perspective as it is easier to change jobs to match their skill level than to transfer internally within a company.¹² However, for companies a loss of labour can be inefficient and uneconomical. It is therefore important for companies to focus more on how they can potentially redistribute labour and skills accurately across the business (e.g. transferring those who have digital skills to teams which have a high demand for digital skills). This appears to have been a successful strategy during the pandemic for some companies, where 46% of respondents in a business survey reported redeploying talent within their organisation – making it the second most popular activity for addressing the digital skills gap

(behind only reskilling investment).²¹ With increasing automation and augmentation, some studies report that companies hope to redeploy nearly 50% of their workers instead of implementing layoffs or automation-based labour-saving strategies.¹³ This type of internal redeployment is regarded as a future proof 'good jobs strategy', by moving people away from declining job roles and placing them in emerging roles with well-funded reskilling and upskilling opportunities.¹³ To do this successfully, companies can (for example): correctly identify workers who are being displaced from their roles, establish internal committees to manage the displacement of roles, fund reskilling and upskilling, motivate employees through the process, and track the success of transitions.¹³



Box 16. Rework America Alliance

Rework America Alliance⁹⁴ is a nationwide collaboration in the United States to help move unemployed or low wage workers to good jobs in the digital economy, by providing effective training for employees to align their skills with jobs that employers need to fill.

Digitally inclusive initiatives and programmes can help develop digital skills

Companies can contribute to the development of digital skills in many ways (e.g. through knowledge sharing and setting up specific initiatives). At the same time, companies could consider approaches by which they do not exacerbate pre-existing



Box 17. Cyber Seniors

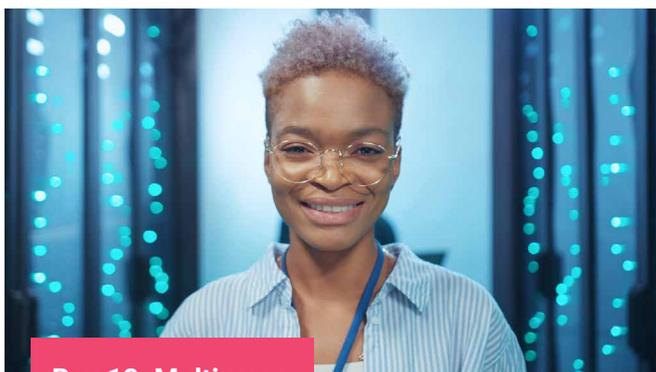
Cyber Seniors⁹⁵ is a US-based non-profit group which specialises in mentoring senior citizens in digital skills. They provide online courses and tutorials to teach basic digital skills, and have a volunteer hotline in three languages (English, Spanish and French) to enable senior citizens to call in and receive technical support. This allows the programme to access and communicate with senior citizens in a way that best suits them, rather than assuming pre-existing basic digital skills.

digital divides. Being aware of digital divides and championing diversity is not only socially responsible but also improves companies' competitiveness, as inclusive workplaces are found to be more successful and more likely to recruit and retain diverse talent.^{55,82} When companies create initiatives, it has been suggested in the literature that they could consider the 'five As' of technological access: availability (to whom is the technology available?); affordability (to whom is the technology affordable?); awareness (who is aware of the technology?); ability (who has the skills to use the technology effectively?); and accessibility (who can and cannot access the technology – for example, is there a language or disability barrier?).⁴⁰ Thinking about alternative delivery options for the initiatives is also important. Often the digital skills space focuses on using online courses and e-learning platforms (e.g. Coursera, Udacity, Udemy, Skillshare, edX) to deliver key training. However, always having 'digital first' strategies risks leaving behind the already marginalised groups, for 'expanding

technology provision without an understanding of the multi-dimensional nature of the digital divide comes with the risk that digital divides in access are bridged without the necessary capacities to translate access into digital dividends'.⁴⁰ By taking an inclusive approach to recruitment and digital training programmes and initiatives, companies can both mitigate growing digital inequalities and tap into a reserve of high-potential underused talent.⁸² On the other hand, companies that do not follow an inclusive approach to workforce diversity risk facing unintended consequences in competitiveness and reputation.⁵⁵

Industry experience opportunities can provide effective alternatives for building skills

Many of the major tech companies sponsor or have set up their own employment training programmes, aiming to both train the next generation of 'tech talent' as well as give employment opportunities to disadvantaged groups. These programmes often target unemployed workers and job seekers, teenagers and young adults or anyone looking to build new skills with the aim of opening up opportunities to these cohorts to enter the technology sector.^{55,80} If a programme is sponsored by a private company, there is often an effort made to match the taught digital skills with the skills that particular company needs (or thinks it will need in future). These are often delivered as vocational education and training programmes, apprenticeships or internships. These types of training programmes and initiatives focus on non-traditional educational outputs that emphasise building skills and experiences rather than contributing towards official degrees (and instead rewarding participants with (for example) 'badges', 'certificates' or 'nano degrees').^{55,82} These programmes are potentially advantageous to traditional education outputs as they provide qualifications more swiftly and are more flexible to adaptations, keeping up with the pace of change with industry demands.⁵⁵ They can remove obstacles to adult learning opportunities and offer flexible opportunities for adults to update their skills.⁹⁶ Companies can find such programmes



Box 18. Multiverse

Multiverse⁹⁷ is a tech start-up providing apprenticeship programmes in the United Kingdom focusing on the skills of the future, including data science and software engineering. Programmes are targeted at university graduates and non-graduates. The programmes include learning opportunities, coaching, accredited qualification and opportunities for applied learning.

a forward-looking strategy as they develop quality-focused apprenticeships that concentrate on the skills needed for the new labour market.³

Businesses can support workers by adopting a lifelong learning approach

A continuous challenge with digital skills is the rate of change within the technology sector, whereby the skills needed today may not be relevant tomorrow, and employers (and employees) need to consider this when developing a digital skills programme. Therefore, building a 'lifelong approach to learning' is consistently cited as an important step to ensure digital skills remain up to date.^{21,55} Workers need

77% of workers are willing to learn new skills or retrain, according to a 2021 survey of the general public

Source: PWC. 2021. *Hopes and Fears 2021: The Views of 32,500 Workers.*

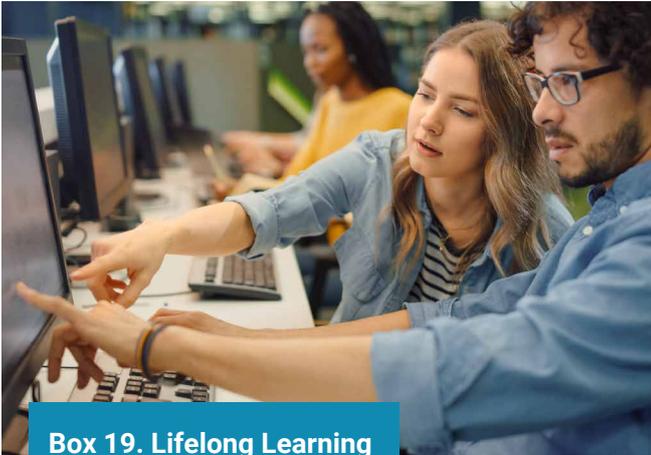
to invest in their own skills, potentially attaining nationally recognised credentials to verify workforce skills and embrace the idea that they may have periodically to 'reinvent' themselves.²¹ There is some evidence that this mindset already exists among workforces, with a 2021 public survey reporting that 77% of workers are willing to learn new skills or retrain and 74% are prepared to consider learning new skills as a matter of personal responsibility.⁴⁸

Company training is often misdirected based on what companies think employees should know with 42% of employees describing their organisation's training as 'useless and boring'

Source: Capgemini. 2017. *The Digital Talent Gap: Are Companies Doing Enough?*

Employees may also prefer self-directed learning over workplace training programmes. A study has shown that more than half of the employees with digital skills at the organisations analysed suggested that training programmes are not helpful or that they did not have time to attend them.¹⁸ More than one-third (42%) of employees describe their organisation's training as 'useless and boring' and prefer to look outside the organisation for training, e.g. 52% prefer learning through massive open online courses (MOOCs), often investing their own time and money.¹⁸ Company learning programmes tend to be based on what training managers at the company think the employee 'should' know, but employees prefer to drive their own learning experiences and tend to better understand what skills they need to accomplish their goals and/or progress in their careers. There is further evidence that employees are investing in their own digital skills; for example, in a survey in 2017, 38% of respondents said that they wanted to be on par with their colleagues on required digital skills, 23% noted the need for flexibility in choosing programmes in their area of interest, and 19% highlighted interest in expanding digital

skills that helped them in their personal and non-professional life.¹⁸



Box 19. Lifelong Learning Council Queensland Inc

The Lifelong Learning Council Queensland Inc⁹⁸ is a non-governmental organisation dedicated to build a learning society. Its members believe adult learning is a way people can grow and develop, and plays an important role combating social inequalities.

However, there are challenges to this lifelong learning approach. Self-directed learning requires some prior knowledge to identify what skills will be needed in the future.⁵⁵ There are also concerns over funding: is it the employer or employee who takes on the financial burden of training? The lifelong learning approach also places extra pressure on employees to keep up with employers' expectations. This already occurs when businesses expect that workers will take some degree of responsibility for their skills investment. For example, in a survey in 2020, 94% of business leaders expected employees to pick up new skills on the job (up from 65% in 2018).¹³ There is a risk that placing too much responsibility on workers to develop their own skills might exacerbate pre-existing social inequalities, as those people who are permanently or temporarily out of work will have less or no access to company-provided learning opportunities. Some governments are already aware of this potential digital inequality to training access; during the pandemic, several governments rolled out

open and free digital skills training programmes to unemployed individuals or those with low digital skills (e.g. Portugal's Activar.PT, the EU's Digital Guarantee, the French France université numérique).⁷¹

Despite the challenges, having a lifelong learning mindset can help people keep up with the pace of technological change. Companies can facilitate this by supporting employees with their self-directed learning (e.g. as a core part of their working environments), whether through knowledge sharing, financial support or developing training resources.

Developing cross-cutting partnerships between different stakeholders can help tackle the skills gap

Digital transformation requires a holistic approach, bringing together key stakeholders. A holistic approach is critical for increasing investment in digital technologies and digital skills, particularly where the scale and risks of investments are not feasibly covered by an individual stakeholder (e.g. in relation to high performance computing, quantum technologies, shared data spaces for scalable and efficient data updates) or investments are less



Box 20. FutureDotNow

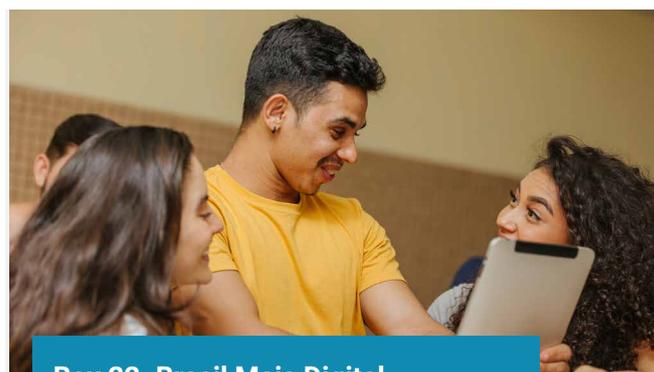
FutureDotNow¹⁰⁰ is a UK-based coalition which brings together organisations working together to accelerate digital upskilling through co-ordinated industry action. It aims to motivate people and business employees to boost their digital skills.

likely because there is no strong business case (e.g. investments in rural areas).⁹⁹ Knowledge can be shared through partnerships with academia, industry and the public sector, allowing for the best adoption and scaling of digital skills.⁸⁰ Thinking about the problem through a multi-stakeholder perspective can increase the probability of a successful digital skills initiative. For example, a study in 2019 demonstrated that if the private sector in the US invested \$4.7 billion then 25% of workers at risk of job displacement could be reskilled, but if the government invested \$19.9 billion then 77% of workers expected to be displaced could be reskilled.³¹ In this study, while private companies had an important role to play in reskilling and upskilling their workers, a company's cost-benefit balance is lower (as they are constrained by the interest of their shareholders and various financial considerations), while the government is incentivised to invest more in digital skills to offset future job displacements or job losses (otherwise they risk paying out larger welfare payments or lose out on taxation opportunities).³¹ By involving multiple actors, economy of scale could broaden opportunities for reskilling and upskilling, whereby it will potentially become more economical as a result of pooled resources, venues and training.³¹ A holistic approach also opens up opportunities to treat the digital skills gap as a pressing social issue, reaching the people and workforces who are most at risk of falling behind, potentially 'updating' education systems and providing financial incentives to renew skills.⁵⁵



Box 21. Digital Skills Cadetship Trial

The Digital Skills Cadetship Trial is an Australian-based initiative that supports innovative approaches to cadetships for digital career paths, to improve the level of digital skills among Australian citizens.¹⁰⁷



Box 22. Brasil Mais Digital

Brasil Mais Digital is a Brazilian-based online education programme directed at young people aged 16–25 which fosters capacity building in the IT sector.¹⁰⁸

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105. Internet outcomes are measures adapted from Van Deursen et al.'s (2017) paper, covering a range of 26 outcomes related to the same domains as considered for internet usage. Respondents were asked about each outcome and responses were measured on a five-point scale of agreement (1 Strongly agree to 5 Strongly disagree). Examples are 'I save money by buying products online', 'I have a better relationship with my friends and family because I use the internet' and 'Online entertainment made me feel happier'. This information was drawn from: Van Deursen, A. & Van Dijk, J. 2019. 'The First-Level Digital Divide Shifts from Inequalities in Physical Access to Inequalities in Material Access.' *New Media & Society* 21 (2): 354–75.
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Annex. Details of the methodology

The research presented in this document offers a snapshot view of key aspects of the digital skills landscape. To achieve the objectives of the research within the scope and timescale of the study, we conducted a rapid review of the academic and grey literature available online using Google or Google Scholar as the main databases. Our literature search was based on the set of search strings illustrated in Table 1.

Table 1. Search strings used to conduct the rapid review of relevant literature

Search number	Synonyms
#1	('digital' OR 'digital skills' OR 'digital literacy' OR 'ICT skills' OR 'digital competence' OR e-skills OR 'internet skills')
#2	(industry OR 'labour market' OR labour OR employ* OR work* OR profession* OR unemployed OR workplace OR office OR 'working from home' OR career* OR profession OR job* OR sector* OR recruit* OR hir*)
#3	(gap OR inequality* OR divi* OR unequal OR demographic OR inclusi* OR exclusi* OR equity OR equality OR 'social inclusion' OR driver)
#4	(develop*OR course* OR train* OR initiative*OR fund* OR education* OR teach* OR learn* OR participat* OR engag* OR curriculum OR moocs OR certificate OR invest* OR vocation* OR 'digital literacy' OR 'digital fluency')
#5	('fourth industrial revolution' OR revol* OR future OR develop* OR econom* OR marketplace OR societ* OR trend* OR crisis)
#6	(covid OR covid-19 OR covid19 OR pandemic OR 2020)
#7	#1 AND #2
#8	#1 AND #3
#9	#1 AND #4
#10	#1 AND #5
#11	#1 AND #6

We developed an initial long-list of articles and screened them for relevance on the basis of their titles and abstracts or short descriptions. The article selection was informed by the criteria listed in Table 2. The timeframe for publication was restricted to 2017 onwards as we wanted to capture recent relevant evidence. While we reviewed a substantial body of literature associated with the digital skills gap, we cannot claim to have reviewed all articles on the topic. As we intended to carry out a rapid rather than a comprehensive systematic review of the literature to better understand developments occurring at the macro level, we focused on gathering evidence at the global level rather than for specific countries and sectors. Where relevant, however, we used illustrative examples of developments within regions, countries and sectors.

Table 2. Inclusion criteria for selected articles

Criteria	Inclusion
Type of data source	Journal articles, reports, policy briefs
Year of publication	Between 2017 and 2021
Geographical location	Global
Language	English
Accessibility	Open access

We compiled the results of the search using the Zotero bibliographic software and extracted information from each article into a data extraction table, containing the fields relevant for our study (Table 3). This facilitated cross-analysis of the gathered evidence against the key study questions and themes.

Once the extraction was completed, we analysed the information captured across the different fields of the template to determine the key trends driving the digital skills gap at a global or macro level and identify approaches being implemented to tackle this challenge. We conducted supplementary targeted searches to fill any gaps in the evidence initially collected in the extraction template and integrated the key findings into this report.

Table 3. Extraction table

Document information							
Article ID	Authors	Title	Year of publication	Link or DOI	Country of corresponding author	Type of document	Brief description of the purpose and objectives of the work

Digital skills landscape					
Trends (e.g. how priorities and requirements for digital skills in the job market have changed over time)	Enablers of digital skills update	Barriers in digital skills uptake	Uncertainties in digital skills landscape	Gaps in digital skills	Initiatives and programmes to address the digital skills gap