Report on the European Educational and Training Landscape

Training Needs of Citizens and SMEs
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Project

Digital SkillUp is the brand name of the outputs created under the European Digital Academy project, funded by the European Commission with support of the European Parliament. The project is dedicated to making basic knowledge on emerging technologies available and accessible to all citizens and SMEs. Its aims to create an online training space that will offer learning content and opportunities on topics like AI, Blockchain, robotics, cybersecurity and IoT for everyone.

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Introduction

The increasing variety of technologies available today offer many opportunities for those who have the competences to take advantage of them. Emerging technologies offer tools both for the daily lives of citizens and the lives of professionals. However, many businesses and citizens across Europe struggle with even the most basic digital skills and competences. ¹

Against this background, the aim of Digital SkillUp is to make basic knowledge on emerging technologies available and accessible to citizens and small and medium-sized enterprises (SMEs).

Further, Digital SkillUp will support citizens and businesses in their understanding and ability to use tools, relying on emerging technologies. Through Digital SkillUp’s online training portal, citizens and SMEs can access learning modules on topics like AI, blockchain, robotics, cybersecurity, and Internet of Things (IoT). Further, the users of the Digital SkillUp portal can also access a catalogue of trainings, tools, resources, and best practices in upskilling and reskilling initiatives across the EU. Providing access to relevant online trainings has the potential to empower citizens and SMEs in developing and improving skills related to their personal or professional development goals. For employees in SMEs, the access to training can also support the transformation of their businesses into innovative, modern organisations.

The ‘Report on European Educational and Training Landscape and Training Needs for Citizens and SMEs’ (hereafter occasionally referred to as “the report”) takes stock of the current European educational and training landscape, taking into account the specific trainings needs of both citizens and SMEs. The aim of the report is to identify the skills needs of both citizens and SMEs, map the landscape of online training, and define key elements and requirements of learning and training needs that will feed into the course design.

For the report, an initial desk research was conducted, which mapped, assessed, and analysed available studies, trends, and statistics in terms of the skills and training needs related to emerging technologies. The report provides a comprehensive overview of technology trends and their predicted impact on society and the economy. In doing so, it aims to identify key trends related to emerging technologies and their impacts on citizens and SMEs. Further, it provides an overview of the state-of-the-art of the available online training offer in Europe. The desk research was complemented by expert interviews and a survey about online training offers, which helped to further refine the analysis of the training landscape and the skills needs of SMEs and citizens.

This stock-taking and mapping exercise will pave a way for the development and design of training modules, which will be made available on the Digital SkillUp portal. These modules intend to support citizens and SMEs in the uptake of key skills, needed to take full advantage of the digital transformation and associated emerging technologies. Finally, it provides the basis for the online catalogue of training offers.

¹ A Council Recommendation of 22 May 2018 defines digital competence as follows: “Digital competence involves the confident, critical and responsible use of, and engagement with, digital technologies for learning, at work, and for participation in society. It includes information and data literacy, communication and collaboration, media literacy, digital content creation (including programming), safety (including digital well-being and competences related to cybersecurity), intellectual property related questions, problem solving and critical thinking.” (Council Recommendation of 22 May 2018)
1.1 Research approach of this report

The ‘Report on European Educational and Training Landscape and Training Needs for Citizens and SMEs’, applies a mix of different methods with the aim of painting a comprehensive picture of the EU training landscape and skills needs. Going beyond the desk research, the analysis was complemented by carrying out interviews with experts in the field, and by an online survey. This mix of methods helped to gain a thorough understanding of the training landscape and to identify specific training needs.

Thus, the research was carried out in four phases: 1) desk research, 2) online surveys and expert interviews and 3) validation via a focus group in a strategic seminar and by an online consultation with stakeholders. In the subsequent (4) gap analysis, the demand side is contrasted with the findings of the supply side analysis (mapping of available online trainings) to identify major gaps in the training landscape and draw lessons learnt on how to close these gaps.

1.1.1 Desk research

The desk research phase relied on extensive literature and web source review of policy papers, studies, strategies, reports, databases, and training initiatives to analyse the current state of play with regards to skills needs and the training landscape. For the analysis of the skills needs, the research team gathered information and data on the skills gaps and needs of European citizens and SMEs. The core objective of this task was to map and identify the skills needs of citizens and SMEs in terms of the everyday and general workplace-related use of emerging digital technologies.

The same approach was taken for the mapping of existing training courses, initiatives, and tools. An initial desk research was carried out to map trainings already available in the EU (paid and free of charge, provided by private initiatives, NGOs, as well as formal vocational education and training [VET] providers). The initial research also considered trainings promoted through, for instance, pledges of the Digital Skills and Jobs Coalition (DSJC), SME trainings already mapped by Capgemini Invest, Technopolis and DIGITAL SME, initiatives listed by the CONCORDIA pilot project, as well as trainings provided by specialised Digital Innovation Hubs, amongst others. Finally, the biggest and most popular massive open online courses (MOOC) platforms and their training offers were also analysed.

1.1.2 Survey & expert interviews

As a next step, expert interviews and a survey among key stakeholders and intermediaries were conducted to gather additional insights from a core group of relevant stakeholders, representing citizens and civil society organisations, SMEs, training providers and content experts. The research team aimed at conducting 3-4 expert interviews per geographic area (see Chapter 2 of this report), thus 22 interviews overall. A survey among stakeholders was circulated online and shared within the wider stakeholder network and community. The survey allowed the consortium to gather an overview of available training initiatives and supported the first version of the catalogue of available trainings.

1.1.3 Strategic seminar

The first strategic seminar in the context of Digital SkillUp took place in May in the form of a half-day online event. It brought together representatives of European SMEs, citizen organisations (including youth and women’s’ organisations), VET providers, digital skills experts, as well as representatives from emerging-technologies-related communities and training providers. The seminar was conducted in a format similar to a
focus group meeting. Firstly, the seminar presented and validated initial findings, derived from the desk research. Secondly, its objective was to also generate new insights on future skills and training needs by employing a strategic foresight method (scenario building).

Experts were given the opportunity to strategically draw up scenarios for skills development in emerging technologies, as well as to exchange and discuss topics related to skills and training needs. Finally, the strategic seminar was followed by two rounds of online consultations that further engaged the stakeholder community and led to the development of key takeaways about skills and training needs.

1.1.4 Gap analysis & Lessons learnt

In the context of the gap analysis, the demand side (i.e. the identified training needs) were evaluated and compared against the results of the analysis of the training landscape (mapping and analysis of available online trainings, i.e. the supply side). The aim of this approach was to identify the main gaps between the skills needs of citizens and SMEs and existing training offers. During this phase of the analysis, the different key elements of online training offers were compared to the corresponding elements of the identified training needs. Based on the gap analysis and the general findings of the report, the research team formulated final lessons learnt on the type and format of courses that would best address the skills needs of citizens and SMEs, whilst filling and fill the gaps in the training landscape. Figure 1 below presents the analytical approach.

*Figure 1: Analytical approach of this research*

**Demand-side: Training & skills needs**
- Mapping skills needs of citizens and SMEs
- Scenarios for digital skills in emerging technologies

**Supply-side: Training landscape**
- Identifying key actors in the training landscape
- Mapping available training

Gap analysis + Lessons learnt
Chapter 1: Emerging technologies and their impact on skills and employment

In an increasingly digital world, emerging technologies are transforming business processes and social activities. Nowadays, many citizens from different regions of Europe rely on digital tools for daily activities, ranging from online banking to administrative services. Businesses are also starting to transform their business models, employing digital solutions such as applications or websites to reach out to their customers.

This introductory chapter will provide an overview on the trending themes and key topics related to the digital transformation and emerging technologies. Further, it will examine how these technologies affect citizens and SMEs, how they may change the way we work, and impact future skills needed in everyday life and in the labour market.

This chapter will also include figures and trends on the existing gaps in the area of skills, for example, by relying on data from the Digital Economy and Society Index (DESI) and the OECD.

Finally, in the last section of this chapter, specific emerging technologies (AI, robotics, IoT, blockchain, cybersecurity, big data) will be briefly presented, and their potential impact on the economy and society overall will be analysed.

1.1 How does the digital transformation affect skills needs and employment?

Digitalisation can be characterised as a mega-trend. But what exactly do we mean by digitalisation? In a 2018 study, Eurofound defines the 'Digital Revolution' as “a general acceleration in the pace of technical change in the economy”. The language used to describe the technologies and forms of work varies (computerisation, robotisation, artificial intelligence, advanced automation, uberisation, gig work).

The study describes three vectors that are driving the change with respect to employment:

- digitally-enabled machines with artificial intelligence (AI);
- the digitalisation of processes enabling enhanced possibilities of processing, storage and communication of information;
- the use of digital networks to coordinate economic transactions with algorithms through platforms.

Digitalisation is affecting the way we work in different ways, which may also have an impact on overall employment. The overview of existing literature points to different mechanisms at work when it comes to the replacement or complementation of certain tasks by machines: 1) Displacement effects: machines mainly

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4 Ibid.
seem to be capable of substituting tasks that can be codified easily and follow certain repetitive patterns; 2) Productivity and reinstatement effects: machines tend to complement tasks that need non-routine analytical and interactive skills such as abstract thinking, creative work, problem-solving and negotiating.\(^5\)

This categorisation can increase our understanding of how machines or new technologies interact with skills in the workforce. It seems as though, until now, technological change has had little effect on the aggregate number of jobs.\(^6\) However, technological developments have prompted a shift in skills requirements and to an increasing share of alternative work arrangements (due to outsourcing, standardisation, fragmentation and online platforms).\(^7\) Other studies present evidence that tasks in low-skilled jobs could be replaced. A study by Elliott (2017) suggests that the general cognitive capabilities of a third of all workers in 2016 and up to two thirds of all workers in 2026 are or “will be below the level of proficiency reached by computers”.\(^8\)

Notwithstanding, the adoption of new technologies is likely to affect the job tasks and related skill requirements of existing occupations and workplaces.\(^9\) According to Spitz-Oener (2006), skills can change within occupations. For instance, the tasks of fixed-job occupations such as secretaries or car mechanics have changed dramatically.\(^10\)

The study ‘The Impact of Technological Innovation on the Future of Work’ summarises key findings on how digitalisation affects the labour market.

- Until now, “technological change has had little effect on the aggregate number of jobs”.
- However, digitisation leads to “shifts in skill requirements, and workers’ fate in changing labour markets crucially depends on their ability to keep up with the change”.
- Digitisation “requires an accompanying process of organisational change”.
- There is an “increasing share of alternative work arrangements, due to more outsourcing, standardisation, fragmentation, and online platforms”.\(^11\)

To sum up, digitalisation is affecting work in a variety of ways, which also impact the types of tasks that may need to be carried out in future jobs and the corresponding skills needed to fulfil these tasks. In order to develop responses and measures to ensure that the workforce is ready for the digital transformation, there is a need to understand the nature of the changing skills requirements brought about by it.\(^12\) The following section will further examine the types of skill sets needed in future jobs.

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\(^6\) Ibid., p. 28.

\(^7\) Ibid., p. 15

\(^8\) Ibid., p. 10

\(^9\) Ibid.

\(^10\) Ibid.

\(^11\) Ibid., abstract, pp. 4-5; 8, 9, 28.

\(^12\) Ibid.
1.1.1 What are the skills needed in future jobs?

In terms of the skill sets that future jobs may require, both the Joint Research Centre (JRC)\(^{13}\) and the study by the European Commission on ‘The changing nature of work and skills in the digital age’\(^{14}\) highlight the importance of fostering a "moderate level of digital skills and strong non-cognitive skills" (for example, abilities to communicate or work as a part of a team).

Furthermore, in order to cope in unknown and evolving circumstances — which best characterises expected future work environments — jobs will require workers to be equipped with both cognitive and meta-cognitive skills (e.g. problem-solving, etc.).\(^{15}\) There is also evidence that "the EU labour market is already demanding more non-cognitive and digital skills, and specifically a combination of both".\(^{16}\)

Other studies suggest categorising skills rather along three parameters: hard skills, soft skills, and business expertise. Here, hard skills refer to technical skills, whereas soft skills refer to cognitive and social skills. Business expertise, on the other hand, is related to knowledge of the sector and concepts related to the area of work.\(^{17}\) Similarly, the expert interviews conducted for the European Commission’s report ‘Skills for SMEs: Cybersecurity, Internet of Things and Big Data for Small and Medium-Sized Enterprises’, the importance of both hard skills, soft skills and business expertise was brought up by the experts.\(^{18}\)

These considerations on skills are complemented by the view that digitalisation may actually lead to a bias with regard to personality traits.\(^{19}\) Following this line of thought, as automation and advanced technologies may be able to take over some tasks which require highly developed cognitive skills, inter-personal skills may become more important. Finally, digital skills seem to be an area that constantly needs investment and revision due to the likelihood of certain skills becoming outdated.\(^{20}\) Hence, the ability to learn and to adapt to new technological environments could be identified as a key competence in the digital era.\(^{21}\)

To sum up, different types of skills identified in during the process of literature review seem to be important in terms of future jobs’ requirements. These range from digital and technical skills, to ICT, and other


\(^{17}\) European Commission (2019), Skills for SMEs: Cybersecurity, Internet of Things and Big Data for Small and Medium-Sized Enterprises.

\(^{18}\) Ibid.


\(^{21}\) Ibid., p. 12.
categories, such as non-cognitive, and social skills. Since some of the categories overlap, an explanation and definition of the aspects covered by each type of skill is provided.

Skills mentioned in the literature and studies in relation to skills needs in future jobs:

- **Digital skills** (Council recommendation definition\(^{22}\)), i.e. information and data literacy, communication and collaboration, media literacy, digital content creation (including programming), safety (including digital well-being and competences related to cybersecurity), intellectual property related questions, problem solving and critical thinking.\(^{23}\)

Specialist/technical/ICT skill-categories mentioned in the literature in relation to future jobs:

- **Technical skills**, i.e. specialist knowledge needed to perform job duties, knowledge of particular products or services, ability of operating specialized technical equipment.\(^{24}\)
- **Information and Communication Technologies (ICT) skills**, i.e. ICT practitioner skills which cover capabilities required for researching, developing, designing, strategic planning, managing, producing, consulting, marketing, selling, integrating, installing, administering, maintaining, supporting and servicing ICT systems.\(^{25}\)

Other skills categories mentioned in the literature in relation to future jobs:

- **Non-cognitive skills** (e.g. teamwork and communication, self-management skills, communication skills\(^{26}\))
- **Meta-cognitive skills** (e.g. critical thinking)
- **Cognitive skills** (e.g. problem-solving skills, analytical skills, system skills, process skills)
- **Social skills** (e.g. social intelligence, cross-cultural competency)

\(^{22}\) A Council Recommendation of 22 May 2018 defines digital competence as follows: "Digital competence involves the confident, critical and responsible use of, and engagement with, digital technologies for learning, at work, and for participation in society. It includes information and data literacy, communication and collaboration, media literacy, digital content creation (including programming), safety (including digital well-being and competences related to cybersecurity), intellectual property related questions, problem solving and critical thinking."\(^{22}\) (Council Recommendation of 22 May 2018).

\(^{23}\) This also includes ICT user skills, i.e. capabilities required for the effective application of ICT systems and devices by the individual. ICT users apply systems as tools in support of their own work. User skills cover the use of common software tools and of specialised tools supporting business functions within industry. At the general level, they cover "digital literacy". Definition of digital literacy, see: Eurostat Glossary, Eurostat, available at: https://ec.europa.eu/eurostat/statistics-explained/index.php?title=Glossary:Digital_literacy;\(^{22}\) Definition of e-skills along ICT user, ICT practitioner skills, including digital literacy, see: Eurostat Glossary, Eurostat, available at: https://ec.europa.eu/eurostat/statistics-explained/index.php/Glossary:E-skills.\(^{22}\) [Accessed 29 June 2020].


• **Other skills** (e.g. novel and adaptive thinking, computational thinking, new media literacy, transdisciplinarity, design mindset, cognitive load management and virtual collaboration)\(^27\)

While this section has examined what types of skill sets will be required in a future work setting, the following one will examine the supply of skills currently available in the market and summarise forecasts and predictions of skills gaps to draw some observations about general skills needs in Europe.

Given the different skill sets that will be required in a future work setting, the following subsection of the report will examine the supply of skills and current trends in the labour market and summarise forecasts and predictions on the skills gap in order to draw some observations on the general skills needs of citizens and SMEs.

### 1.1.2 Main trends in the labour market and employment

The number of ICT specialists in the EU has increased from 7.3 million in 2013 to 8.2 million in 2016. At the same time, the demand for ICT specialists is growing. In 2018, 53% of companies had difficulties in filling vacancies for ICT specialists.\(^28\) This has grown from 41% in 2017.\(^29\) According to DESI, this situation suggests that the gap between demand and supply of ICT specialists may be widening in the EU. Also, due to the growing use of digital technologies in formerly non-digital sectors such as transport, energy, health and finance, the demand may increase further and a shortage on the supply side can be expected.\(^30\)

The growing demand for digital skills and ICT skills is not likely to slow down. According to estimates by the European Commission, 9 out of 10 jobs will require digital skills.\(^31\) A European Commission study pointed out that “around one in seven employers (15%) consider that some of their staff are not fully proficient when carrying out tasks using digital technologies at work”,\(^32\) and therefore report digital skills gaps among their workforce. Equally, the study points out that this situation may be “problematic given the increasing digitalisation of different areas of life and work”, with current figures pointing to “around 90% of occupations requiring digital skills.”\(^33\) At the same time, according to the DESI Report of 2019, 39% of EU workers said that they had to learn how to use new software or computerised equipment for their job over the previous year.\(^34\)

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\(^{29}\) Ibid.


\(^{33}\) Ibid., p. 35, citing Curtarelle et al., 2017 and Servoz, 2019.
year (of workers already using some sort of ICT device or equipment). A majority of respondents (64%), using ICT devices or equipment, actually stated that their skills relating to the use of computers, software or applications at work corresponded well to their duties, while only 11% said that they needed further training. This is contradictory to the results of our expert interviews (Chapter 2, section 2.2), which emphasised the need for training on basic digital skills. Studies have looked into an apparent over-confidence of users in their ICT user skills, which do not seem to match their actual capabilities — this may explain the perceived relatively high levels of digital competence in society.

According to a JRC report, employment growth is concentrated mainly on higher skill levels and lower skills levels. Based on Cedefop and Eurofound (2018), occupations that are predicted to "grow most in the EU by 2030 appear to be disproportionately high-education, intensive in social and interpretative tasks, and requiring at least a basic knowledge of ICT". On the other hand, "employment in elementary occupations is expected to grow, whereas jobs involving skilled manual tasks are expected to decline". At the same time, it is difficult to predict future job creation as it depends on knowing how new or emerging technologies will evolve. For example, according to the study, "about 30% of new jobs created in the USA over the past 25 years did not exist".

Others (Lane and Conlon, 2016) find evidence that "IT skills can compensate for the lack of higher formal qualifications" while formal education cannot compensate for a lack of IT skills. Falck et al. (2016) and Lane and Conlon (2016), point to "substantial returns to ICT-literacy, i.e. the ability to solve problems using ICT-based applications (e.g. Internet browser, email, word processing, spreadsheet tools)".

Thus, while it is difficult to predict the development of future jobs and the corresponding skills needs, there is substantial evidence that ICT skills are and will stay in high demand, while basic digital skills are predicted to be required in a variety of different jobs.

The following section will depart from the more general analysis of how the digital transformation affects skills needs and employment, and rather focus on the impact of the specific emerging technologies which are associated with digitalisation on society and the economy.

### 1.2 Emerging technologies and their impact on society and the economy

In the yearly Gartner Hype Cycle for emerging technologies, AI, IoT, blockchain and smart robots or some of their applications are all represented as emerging technologies. Some of them are still at the stage of breakthrough technologies (artificial general intelligence, smart robots) and others are already in the "buzz

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37 Ibid.
38 Ibid.
39 Ibid.

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phase" with high expectations (IoT platforms, blockchain). As they are very recent technologies, all of them are expected to reach the plateau of productivity in 10 to 15 years, leaving them a decade to mature until penetrating the market on a large scale. Thus, data-related technologies such as AI, robotics, IoT, blockchain, and related transversal aspects such as cybersecurity and big data have been identified by the European Commission as having enormous potential to boost the European economy and to bring benefits and opportunities for the European society. This wave of emerging disruptive technologies is impacting businesses and citizens and transforming social and business processes.

In this section, selected emerging technologies (AI, robotics, IoT, blockchain, cybersecurity, big data) will be briefly presented, analysing their potential impact on the economy and society overall.

### 1.2.1 Artificial Intelligence

By 2030, around 70% of companies worldwide will have adopted at least one type of AI technology (computer vision, natural language, virtual assistants, robotic process automation, and advanced machine learning), according to a simulation approach from the McKinsey Global Institute. Nonetheless, AI is still in its early stages; the opportunities and possibilities this technology could offer seem to be endless. AI can be applied in various sectors, in products and services, from the health and care sector – e.g. predicting disease outbreaks, to the agricultural sector – e.g. analysing weather patterns to optimise crops. According to the European Commission’s Communication ‘Artificial Intelligence for Europe’, AI can help to address the world’s biggest challenges and has been identified as “one of the most strategic technologies of the 21st century”. This makes AI both very promising and very challenging, and the risks increase as the applications widen.

AI brings about huge opportunities for companies, as completely new business models are enabled. Advances in artificial intelligence are in the top ten trends that will positively impact business growth up to 2022, according to the World Economic Forum. According to McKinsey, AI will generate around $13 trillion of additional global economic activity by 2030, augmenting the global GDP by about 1.2% a year. AI could boost the European economy by 20% in 2030, if Europe adopts AI and remains at the same global position and with the same competences as in 2018. This would mean a contribution of an additional €2.7 trillion to European GDP in 2030.

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47 Ibid.
On the other hand, the deployment of AI solutions raises a lot of issues for companies, and even more for SMEs. AI implementation and data accessibility is more difficult for SMEs: as AI requires gigantic amounts of data, this gives an advantage to stakeholders who either own or can afford that much data – these are often large companies. Moreover, integrating AI solutions in a company’s system is a costly process. This may limit SMEs in the adoption of AI. On top of this, the issue of being an “AI laggard” would primarily concern SMEs: according to McKinsey Global Institute, among their six main characteristics, early AI adopters are “larger businesses”. Thus, barriers to the adoption of AI should be made as small as possible for SMEs. Furthermore, European businesses face an AI-skills gap: the two biggest barriers to AI adoption in European companies are related to companies’ need for skilled workforce, according to another McKinsey study.

AI will also have an impact on society at large. In its more basic forms, AI is already a part of European citizens’ and businesses’ everyday lives. For instance, AI systems stand behind the generation of automatic subtitles in videos, voice assistants or the autonomous categorization of mails as spams, among many other examples.

At the same time, AI has the potential to bring benefits and opportunities to society, for instance in the detection of fraudulent activities, e.g. fake news, or in areas such as disease prevention and treatment. Similarly, AI can be used to improve product safety. For instance, it is projected that autonomous cars would be beneficial in terms of road safety, as most road accidents are currently caused by human errors.

On the other hand, AI presents risks of unfairness and discrimination: Autonomous decision-making, one of the main characteristics of AI, could become a threat to users. Similarly, AI can detect fake content, but its capacity to create it in a very realistic manner (counterfeit reality, deepfakes) is even higher. By 2022, the majority of the population in advanced economies will face more false information than true information. Also, European citizens have a low awareness of AI: According to a Eurostat survey, in 2017, 52% of European citizens had not heard, read or seen anything about artificial intelligence in the last 12 months. Among the respondents, men, respondents under 55 and those more educated, were more likely to have heard about

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48 Ibid.
55 Ibid.
AI. In addition, there is a lack of trust regarding AI: if a digital service or mobile application is using artificial intelligence, 80% of those who responded to the survey think they should be informed.

1.2.2 Robotics
Robots have been introduced and increasingly used in the manufacturing sector and have revolutionised the production in the context of the 4th industrial revolution (also called Industry 4.0). More advanced robots, so-called “smart robots”, integrate AI components in order to act ‘smart’: they can adjust their decisions and take actions according to the data transmitted by another device or an application. Advancement in robotics can bring many opportunities to businesses. For instance, they can boost productivity and optimise the quality of manufacturing. The automation of production processes leads to higher productivity across the economy, thus to lower production costs and higher competitiveness of manufacturing companies. Indeed, industrial robots improve the efficiency, the reliability, and the quality of the manufacturing process. Moreover, Europe’s competitiveness in manufacturing and robotics seems high: Europe is a world-leading region in advanced robotics. According to a survey from McKinsey, 25% of European firms that responded to the survey were using smart robotics at scale in 2017, while 23% of the companies were located in the US. On the adoption of the three other technologies that were part of the survey (big data, AI tools and advanced neuronal algorithms), European companies were lagging behind the US. Finally, there is a wide use of robots across sectors: In Europe, industrial robots are mostly used by manufacturers of rubber and plastic products and manufacturers of metals and metal products. Outside of the manufacturing sector, robots are used in accommodation and food service, transportation and warehousing, and retail trade.

Despite these advances, the use of robots in SMEs is still very low compared to large companies: according to a Eurostat survey from 2018 on the use of robots in the EU, 25% of large enterprises use both industrial and service robots, while the percentage of SMEs using robots is four times less at only 6.2%. Also, SMEs often lack the skilled workforce which could implement robotics solutions, unlike large companies.

European Commission (2017), Special Eurobarometer 460 – March 2017. Attitudes towards the impact of digitisation and automation on daily life, TNS OPINION & SOCIAL. Available at: https://doi.org/10.2759/835661.

Ibid.


In the next decades, robots are likely to gain more and more relevance in the everyday lives of European citizens. For instance, the use of robots at home could ease the life of consumers: in the past decade, intelligent robots have been introduced in households (vacuum cleaner robots, connected autonomous cooking machines, etc). When it comes to jobs, the picture is more nuanced, but the increasing presence of robotics can bring benefits in terms of security of workers and may lead to the eradication of boring, routine tasks. Further, more jobs are retained in Europe through the adoption of robots in European companies: according to a publication from Fraunhofer experts, manufacturing companies using robots are less likely to relocate their productions outside of Europe, allowing jobs to be retained within Europe.

On the downside, while the automation of production processes leads to the creation of new jobs like robotics engineers, robot maintenance professionals and others, there is also the risk of eliminating a whole range of jobs. According to McKinsey, around 50% of workers’ tasks in Europe could be automated. These are mainly physically demanding tasks, as well as tasks related to the collection and treatment of data. Further, the adoption of robots increases inequalities between low and high qualification jobs: the newly created jobs through the adoption of robots will not necessarily go to the same people, whose tasks were replaced by robots. Indeed, jobs with lower required qualifications tend to be more automatable and will thus be less needed, while jobs with higher qualifications will be in demand.

In addition, there is a low acceptance of a wider use of robots by citizens: 51% of respondents were uncomfortable with the idea of having a medical operation performed on them by a robot. It has to be noted that the longer respondents remained in education, the more likely they were to be comfortable with this scenario. For instance, 14% of the respondents with the lowest education levels would be comfortable having a medical procedure performed by a robot, compared to 34% with the highest levels. There is a better acceptance for more basic uses of robots, for example having goods delivered by a robot.

### 1.2.3 Internet of Things

Like the other technologies of this report, the development of the IoT market has started only recently. The size and the value of the market for connected devices is difficult to measure, as the border to complementary technologies is blurred and the definition of IoT varies substantially from one stakeholder to another. Moreover, it is almost impossible to distinguish between the consumer market and the market for industrial

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69 Ibid.


72 European Commission (2017), Special Eurobarometer 460 – March 2017. Attitudes towards the impact of digitisation and automation on daily life, TNS OPINION & SOCIAL. Available at: https://doi.org/10.2759/835661.
use. Thus, market growth estimations and forecasts vary from one study to another. However, many experts agree on one thing: the promise and potential of IoT is substantial. The number of connected IoT devices has been growing rapidly as of 2015 and will continue to grow as the use cases become wider. An Ericsson study foresees that the number of IoT devices will increase at an average annual growth rate of 21% between 2016 and 2022. The growth in connectivity is expected to bring economic benefits, with IoT reshaping and transforming existing industrial structures. According to a Gartner analysis, the number of IoT devices increased from 6.4 billion in 2016 to 20.4 billion in 2020. Two third of these devices are consumer-oriented (information and entertainment, home automation, automotive, home security and safety, home energy management, health and fitness) and one third is business-oriented (physical security, utilities, energy, automotive). Moreover, the size and flexibility of small and medium-sized businesses make them ideal to integrate Industry 4.0 components, according to the OECD. On the other hand, the risk of cyberattacks will likely increase with the hyperconnectivity of IoT.

IoT devices can enable an improve consumer safety by allowing for automatic updates and direct communication about safety issues to the users. At the same time, as connected devices become increasingly complex, the risk of safety and security issues increase as well. For example, the remote update of a software can lead to defects that were not present at the time the product was purchased by the consumer. Also, IoT devices can be misused for cybercrime purposes.

1.2.4 Blockchain

Blockchain technology emerged in the computer science technology around 2008 with the aim to enhance trust in transactions. Blockchain technology has the potential to benefit citizens, private companies, and governments by ensuring trustful interactions and reducing transaction costs.

Blockchain enables trust, which is a fundamental element to ensure the growth of the digital economy: “Without [trust], individuals, firms and governments won't use digital technologies, and an important source of potential growth and social progress will be left unexploited”. Europe is in a good position to reap the benefits of blockchain. Indeed, in 2019, 32% of the world’s blockchain start-ups were located in Europe.

whereas 41% were located in North America and 22% in Asia. As of the mid 2020s, the blockchain economy is expected to skyrocket. The global business value added by blockchain is projected to reach $176 billion by 2025, and to exceed $3.1 trillion by 2030.

However, blockchain is a recent technology which has to mature first in order to be fully beneficial to the economy. According to Gartner, successful or complete blockchain implementations are currently rare. In addition, the company’s forecasts indicate that the business value created by blockchain within the next five years will be low. At the same time, according to a PwC survey from 2018, the biggest barrier to blockchain adoption cited by companies is the regulatory uncertainty.

Blockchain is currently mostly used by businesses, but its integration into the society’s daily life is evolving. Blockchain can reduce fake news: by 2023, up to 30% of world news and video content will be authenticated as real by blockchain, countering “deep fake” technology. Blockchain can also help to reduce inequalities: By 2025, 50% of people with a smartphone but without a bank account could have a mobile-accessible cryptocurrency account.

1.2.5 Cybersecurity

The emergence of new technologies increases information security and privacy risks and may negatively impact companies. According to the World Economic Forum, cyber threats are in the top ten trends that will negatively impact business growth up to 2022. Victims of cybercrime face tremendous costs. According to Cybersecurity Ventures, by 2021, cybercrime will cost the global economy $6 trillion annually, twice the cost of 2015. Besides the monetary damage directly linked to a cybersecurity incident, the consequence on the company’s reputation can lead to a loss of consumer trust and thus negatively impact sales. For SMEs, overcoming such costs as well as customer loss could be more fatal than for larger companies. Smaller companies may not have the resources or expertise to effectively assess and manage risk. This means that SMEs are not always aware of the possible cyber threats and thus do not take enough measures to protect themselves from cybersecurity attacks.

According to Eurostat, in 2019, 76% of large companies had available documents on measures, practices or procedures on ICT security, whereas only 30% of small companies had such documents. Moreover, 91% of

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81 Ibid.
82 Ibid.
85 Ibid.
90 Ibid.
large companies taught their employees about ICT-security-related issues, while 78% of medium and only 58% of small enterprises did so.\textsuperscript{91} According to the 2019 ‘ISC cybersecurity workforce study’, there is a shortage of approximately 291,000 cybersecurity professionals in Europe. In comparison to the previous same study in 2018, this shortage has doubled (142,000 professionals in 2018).\textsuperscript{92}

At the same time, the security of connected tools presents good market opportunities for European companies: 61% of the respondents in a Eurobarometer survey considered that the security and privacy features of an IT product play a role to some extent (or even to a great extent) in their choice when they buy a smartphone or a laptop. 27% of respondents stated they would pay more for better security and privacy features.\textsuperscript{93} Therefore, efforts to develop secure products and services may be beneficial for businesses, especially in terms of attracting more clients and customers.

According to a Eurobarometer survey, in 2019, more than three quarters of European citizens (76%) use the Internet daily.\textsuperscript{94} Nowadays, the use of the internet expanded to nearly all activities of citizens’ daily life and increases from year to year: online shopping, online banking, video and music streaming through online platforms, online socializing, online learning, etc.\textsuperscript{95} Cybersecurity issues can decrease trust and limit business-to-consumer (B2C) e-commerce growth: “There is strong evidence showing that Internet users (including individuals and businesses, and in particular SMEs) are increasingly concerned about digital risks and that these concerns may have become a serious barrier for the adoption of digital technologies and applications.”\textsuperscript{96}

European citizens have a high awareness of their personal data and the risks of cybercrime. Indeed, according to a Eurobarometer survey conducted in October 2019, 76% of respondents believe there is an increasing risk of being a victim of cybercrime.\textsuperscript{97} and 46% are concerned about misuse of their personal data. This concern has been increasing since the first survey of this type in 2013: it has increased by six points and is now at its highest level. As a result, more than three quarters of respondents (78%) stated that they avoid disclosing personal information online (78%). Furthermore, more than half of respondents (55%) believe that they come across fake news once a week at least.\textsuperscript{98} As a result, European citizens want support in order to be able to better identify disinformation. When responding to the question about the type of actions public authorities should take to tackle fake news, this is the most frequently mentioned measure.\textsuperscript{99} Finally, the


\textsuperscript{93} European Commission (2017), Special Eurobarometer 460 – March 2017. Attitudes towards the impact of digitisation and automation on daily life, TNS OPINION & SOCIAL. Available at: https://doi.org/10.2759/835661.

\textsuperscript{94} European Commission (2020) Special Eurobarometer 499 - Europeans’ attitudes towards cyber security – October 2019, Kantar. Available at: https://doi.org/10.2837/672023.


\textsuperscript{97} European Commission (2020) Special Eurobarometer 499 - Europeans’ attitudes towards cyber security – October 2019, Kantar. Available at: https://doi.org/10.2837/672023.

\textsuperscript{98} European Commission (2020), Special Eurobarometer 503 - Attitudes towards the impact of digitalisation on daily lives – December 2019, Kantar. Available at: https://data.europa.eu/8ebp/8en/data/dataset/S2228_92_4_503_ENG.

\textsuperscript{99} European Commission (2020) Special Eurobarometer 499 - Europeans’ attitudes towards cyber security – October 2019, Kantar. Available at: https://doi.org/10.2837/672023.
increasing use of digital tools and the internet causes increasing risk of cyber threats: for citizens, cyber threats can take the form of online fraud such as identity theft, misuse of their personal data, phishing (e.g. fake bank websites), spam, malware, illegal online content, racial hatred or terrorist content, or glorification of violence.\textsuperscript{100}

At the same time, cyberattacks are becoming more sophisticated, making individuals less confident in their ability to detect, and protect themselves from cybercrime. Only 52\% of the respondents to the ‘Special Eurobarometer 499 - Europeans’ attitudes towards cyber security’ think that they can protect themselves against cybercrime. Besides, more than two thirds of Europeans do not know who to turn to in case of a cybercrime: 77\% say they are not aware of the existence of a website, email address, online form or contact number where they can report cybercrimes or other illegal online behaviour.\textsuperscript{101} Also, European citizens feel under-informed in cybersecurity matters.\textsuperscript{102}

### 1.2.6 Big Data

Data is considered “an essential resource for economic growth, job creation and societal progress” by the European Commission.\textsuperscript{103} Big Data has changed the way we collect, process, analyse, and leverage the increasing volumes of data generated in today’s world. Between 2018 and 2025 alone, there will be a 530% increase in global data volume.\textsuperscript{104} The value of data is skyrocketing in Europe: According to the European Commission, the value of the data economy in the EU is expected to grow from €301 billion in 2018 to €829 billion in 2025.\textsuperscript{105} Further, data analytics of digital platforms can be used by companies to analyse the behaviour of individuals and social groups. Based on the user’s preferences and consumption pattern, companies can improve their production planning and forecasting.\textsuperscript{106} Also, big data seems to be boosting global trade: according to McKinsey, the amount of cross-border data flows has been multiplied by 45 since 2005 and is likely to increase by an additional nine times over the next five years.\textsuperscript{107}

On the other hand, especially in SMEs, there is a lack of understanding of big data as well as a shortage of skilled in-house data analytics experts, which hinders SMEs from benefitting from the opportunities that big data analytics bring about.\textsuperscript{108} In general, European firms are behind US and Asian firms when it comes to adopting big data at a large scale.\textsuperscript{109}

\textsuperscript{100} ibid.
\textsuperscript{101} ibid.
\textsuperscript{102} ibid.
\textsuperscript{104} ibid.
\textsuperscript{105} ibid.
\textsuperscript{109} ibid.
Big data brings a lot of job opportunities to European citizens: the number of data professionals in the EU will increase from 5.7 million in 2018 to 10.9 million in 2025, according to the European Commission.\footnote{European Commission (2020). The European data strategy. Shaping Europe’s digital future. Available at: https://op.europa.eu/en/publication-detail/-/publication/4c34e6f9-5391-11ea-aece-01a75ed71a1/language-en/format-PDF/source-135579332. [Accessed 29 June 2020].} Healthcare is one of the most promising sectors where big data can be applied to benefit society. In 2009, when the H1N1 flu spread, the internet giant Google was able to identify the spread of the flu through much faster than the American Centre for Disease Control and Prevention (CDC) by analysing user queries (e.g. symptoms).\footnote{Mayer-Schonberger, V., & Cukier, K. (2013). Big data: A revolution that will transform how we live, work, and think. Boston, MA: Houghton Mifflin Harcourt.}

However, there are risks associated with big data: the use of big data platforms, especially social media, can be monitored by employers, the government and other players present on these platforms. This can lead to reputational damage, unfair dismissals, and discriminatory measures.\footnote{Federal trade commission (2014), How Big Data Enables Economic Harm to Consumers, Especially to Low-Income and Other Vulnerable Sectors of the Population. Available at: https://www.ftc.gov/system/files/documents/public_comments/2014/08/00015-92370.pdf.} According to a research which processed the data of over 58,000 volunteers who provided their Facebook likes as well as their answers to psychometric tests from Facebook applications, researchers proved that “Facebook likes can be used to automatically and accurately predict a range of highly sensitive personal attributes including: sexual orientation, ethnicity, religious and political views, personality traits, intelligence, happiness, use of addictive substances, parental separation, age, and gender”.\footnote{Kosinski M, Stillwell D, Graepel T (2013), Private traits and attributes are predictable from digital records of human behavior. Proc Natl Acad Sci 110(15):5802–5805.} The negative impacts would especially be harming low-income sectors of the population, thus increasing economic inequality: some scammers use behavioural profiling based on people’s social media profiles to identify more vulnerable populations that might not be able to detect economic scams.\footnote{Ibid.} Finally, user data is monetised by big data platforms without or with very little financial compensation. Users are often not aware of the economic value or the amount of personal data they are sharing with these platforms.\footnote{Ibid.}

### 1.3 Conclusions

This chapter provided an overview of the main trends related to emerging technologies. Firstly, it examined the impact of the digital transformation and associated emerging technologies on skills requirements and the labour market (i.e. how digitalisation changes the way we work and how this affects the need for certain skills and the labour market). Secondly, it discussed the impact of each emerging technologies on society and the economy.

The impacts of emerging technologies on skills requirements, employment as well as society and the economy overall, can be summarised along three main areas (see Graph 1 below for illustration of the impact of emerging technologies).

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\footnote{114} Ibid.

\footnote{115} Ibid.
1.3.1 Skills requirements in society and in future jobs

- Skill sets for future jobs may require a combination of technical and non-cognitive skills (soft skills) as well as digital skills; others suggest a categorisation along hard, soft, and business skills. In any case, both digital skills/ICT-user skills and non-cognitive skills are said to be important.\textsuperscript{116}

- There is an increasing need for digital skills at all levels (basic to advanced ICT skills) and there seems to be a high return on investment on ICT skills.\textsuperscript{117} There are an estimated 1 million ICT specialists missing in the market, 53% of companies cannot fill ICT vacancies and 9 out of 10 jobs will require digital skills in the future. At the same time, only 57% of Europeans have basic digital skills.\textsuperscript{118}

1.3.2 Societal impact, mismatches & inclusion

- There are important mismatches and divides across the EU member states and different societal groups (e.g. women vs. men; rural vs. urban population, higher education levels vs. lower level education)\textsuperscript{119};

- Generally speaking, citizens see a positive impact of digitalisation on their quality of life. At the same time, essential and everyday services and activities are increasingly available online only, which may lead to an exposure to cyber risks ranging from cybercrime to exposure to fake news and misinformation.\textsuperscript{120}

1.3.3 Economic impact & employment

- Effects on the labour market are difficult to predict. Until now, the effect of recent technological change on the overall number of jobs has been neutral.\textsuperscript{121} There are divergent effects on job tasks: displacement vs. productivity and reinstatement of different types of tasks,\textsuperscript{122} leading either to complementarity of technology to certain tasks or the replacement of those tasks.

- The predicted impact of emerging technologies such as AI, IoT, blockchain for the EU economy is largely positive. Those technologies may allow for the transformation of business processes and business models and for large efficiency gains.\textsuperscript{123}

A summary of the above-mentioned implications, can be found in Figure 2 below.

\textsuperscript{116} See sections 1.1 and 1.2 of this chapter; Warhurst, C. and Hunt, W., (2019), The Digitalisation of Future Work and Employment. Possible impact and policy responses, Seville: European Commission, JRC117404, citing Vuorikari et al., 2016; Carretero et al., 2017. p. 32.
\textsuperscript{118} See Section 1.1 of this chapter.
\textsuperscript{120} Interviews conducting in the scope of this research, April 2020.
\textsuperscript{123} See Section 1.2 of this chapter.
Significant gaps at all skills levels (basic to advanced) have been identified, while digital skills will be important in many future jobs. Emerging digital technologies seem to offer opportunities and challenges to both citizens and SMEs. Emerging technologies have the potential to stimulate economic growth, to transform business models, and to improve well-being - if challenges are managed well and if citizens and SMEs possess the necessary skills to take advantage of them. Some of the identified challenges are directly linked to skills, for example a lack of skilled staff knowing how to implement big data. At the same time, the potential of these technologies is enormous. Therefore, it is crucial to foster the development of skills in these areas so as to ensure that citizens and companies are ready to make use of these technologies.

The following chapter will examine in more detail skills and training needs of citizens and SMEs.

*Figure 2: The impact of emerging technologies*
Chapter 2: Skills needs of citizens and SMEs

The purpose of this chapter is to provide an overview of training needs of citizens and SMEs to take up emerging technologies.

The analytical approach of this chapter relies on different stages, based on sources identified via the desk research, expert interviews, and the interactive forecasting methodology applied during the strategic seminar, followed by a stakeholder online consultation. Quantitative and qualitative findings from all three research stages are summarised below, identifying the key trends for training needs and course design: topics, target audiences, difficulty levels, key elements of the trainings, prices, languages, assessment and certification.

The first section looks at the general skills needs identified for SMEs and citizens relying on desk research. Here, it will build on the results of the desk research carried out for the previous chapter and key statistics about skills levels and skills gaps of citizens gathered at a European level. At the same time, it will look at the training needs defined by SME organisations on the European level.

The second section provides an overview of the training needs identified via the expert interviews.

The third section briefly explains the scenario technique that has been applied to define desired scenarios for digital skills in emerging technologies in Europe and present the key findings from the interactive strategic seminar as well as the stakeholder consultation with experts.

2.1 Desk research: Overview of main skills needs

This chapter considers insights from European-wide statistics such as the Digital Economy and Society Index Report 2019 (DESI) and the general desk research conducted to determine the main training needs of citizens. To present an overview of SMEs' skills needs, it builds on an analysis of SME networks and the network of chambers of commerce to identify the main skills needs of SMEs in Europe. For this purpose, the websites and position papers of the European Small Business Alliance (ESBA), SMEunited and Eurochambres were consulted, together with a number of studies related to identifying skills and training needs.

2.1.1 Skills needs of citizens

EU citizens need digital skills for a variety of purposes. Firstly, the digital transformation is not stopping at commercial or entertainment-related activities: government services are increasingly becoming available online. Other essential sectors, such as health care or provision of basic supplies like electricity also increasingly work with online portals and tools. Therefore, we can assume that a basic level of digital literacy will be necessary to many citizens and parts of society.

Further, social activities are also relying more extensively on digital platforms and digital tools. Thus, the forming of ideas and discussions via the media is also increasingly taking place in social media networks, which are more prone to disinformation, "mal-information" and other phenomena such as echo chambers. At the same time, societal discourse is essential for functioning democracies and therefore, a basic level of digital literacy will be necessary to many citizens and parts of society.

Digital literacy refers to the skills required to achieve digital competence, the confident and critical use of information and communication technology (ICT) for work, leisure, learning and communication, see: https://ec.europa.eu/eurostat/statistics-explained/index.php?title=Glossary:Digital_literacy. [Accessed 29 June 2020].
literacy would be essential for society as a whole. This applies in particular to the understanding of information security and data protection. Commercial activities such as banking or ordering goods and services online are vulnerable to malicious attacks. However, evidence from the 2019 DESI Report shows that today, only 57% of Europeans have sufficient basic digital skills.125

When it comes to emerging technologies, these can bring benefits and opportunities to society, but also hold some risks. Citizens already encounter emerging technologies in daily activities: for example, AI applications run on smart phones, and will continue to do so in the future, (e.g. autonomous cars). IoT devices are already present in many homes, but the associated risks in terms of cybercrime and data protection/privacy are not necessarily known by all users. While blockchain is currently mostly used by businesses, its integration into society’s daily life is evolving. Blockchain is a technology that can enhance privacy and trust in transactions and could therefore contribute to safer technology overall. However, if users are sceptical or do not understand how it functions, the benefits of this technology for daily life may not be fully used. While there are specific needs and situations where citizens may be faced with emerging technologies and may require skills and understanding to deal with them, surveys point to a lack of awareness, at least in some areas. For instance, European citizens have a low awareness of AI: according to a Eurostat survey, in 2017, 52% of European citizens had not heard, read or seen something about artificial intelligence in the last 12 months.126

When it comes to cybercrime, only 52% of the respondents think that they are able to protect themselves against cybercrime, while more than two thirds of Europeans don’t know who to turn to in case of a cybercrime. 77% say they are not aware of the existence of a website, email address, online form or contact number where they can report cybercrimes or other illegal online behaviour.127 As for robotics, most citizens (51%) are uncomfortable with the idea of having a medical operation performed on them by a robot.128

Last but not least, citizens also form the workforce, making awareness of emerging technologies and digital skills essential for their employment and employability. At the same time, the DESI Report of 2019 points out that approximately 28% of EU’s internet users do not have software-related skills.129 These skills range from carrying out basic text treatment and spreadsheet-based work to video editing and coding.130 However, these types of skills are necessary for entry into many jobs. The literature shows that digital skills, especially advanced skills (i.e. developing and programming software or applications, using computer syntax or statistical analysis packages) are increasingly important. However, most workers use much simpler IT skills or do not use digital skills at all.131

To sum up, citizens require different skills for different roles they take up in society: as citizens in a democratic society, as entrepreneurs, employees, or in their diverse social roles in private life. While there are specific skills needs associated with each of the emerging technologies, a bottom line requirement seems to be enhancing the understanding of the practical implications of these emerging technologies for citizens’ daily lives and ways to address associated challenges and to weigh possible risks against benefits.

126European Commission (2017), Special Eurobarometer 460 - March 2017. Attitudes towards the impact of digitisation and automation on daily life, TNS OPINION & SOCIAL. Available at: https://doi.org/10.2759/835661.
127Ibid.
128European Commission (2017), Special Eurobarometer 460 - March 2017. Attitudes towards the impact of digitisation and automation on daily life, TNS OPINION & SOCIAL. Available at: https://doi.org/10.2759/835661.
130Ibid.
The following subsection will look at specific mismatches in society, before diving into the skills needs of SMEs in the next subsection.

### 2.1.1 Mismatches and divides

The DESI 2019 report illustrates a divide when it comes to the distribution of skills across different societal groups. For instance, there are proportionally more men than women with at least basic digital skills (respectively, 60% and 55%). In addition, only about 31% of people with low education levels or no education have at least basic digital skills (versus 57% on average). 49% of those living in rural areas have basic digital skills, compared to 63% in urban areas.\(^\text{132}\) This can be problematic since well-paid jobs in the future may increasingly depend on basic digital proficiency.\(^\text{133}\)

There are also major differences between EU member states.\(^\text{134}\) The share of people with at least basic digital skills ranges from 29% in Bulgaria and Romania (despite noticeable progress in both these countries in 2017) to 85% in Luxembourg and 79% in the Netherlands.\(^\text{135}\) Furthermore, the study *The changing nature of work and skills in the digital age* compares the projected growth in the number of occupations requiring advanced digital skills with recent trends in graduation rates and forecasts mismatches in advanced digital skills in over half of the EU Member States in the period of 2016 to 2030.\(^\text{136}\)

Finally, the European workforce is growing older, which is due to low birth rates and a higher overall life expectancy. These factors are transforming the shape of the EU’s age pyramid.\(^\text{137}\) At the same time, there is a risk of a generational digital divide, as older workers tend to have comparatively lower digital skills.\(^\text{138}\) These demographic issues were also mentioned as particularly important by stakeholders during the strategic seminar of this project, carried out in May 2020.

### 2.1.2 Skills needs of SMEs

The positions of the three business networks, European Small Business Alliance (ESBA), SMEunited and Eurochambres, point to the need for skills in different areas. One area relates to skills that support the digital transformation in SMEs, i.e. skills for technologies such as artificial intelligence, automation, robotisation, blockchain, and datamining. In addition, cybersecurity risks are identified as crucial and need specific attention due to the associated negative effects for business continuity. Thirdly, there is an emphasis on basic digital skills, as well as more applied skills needs which would allow SMEs to embrace digitalisation opportunities: e.g. building a website, learning how to use digital tools, social media for branding and recruiting, etc.

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\(^{135}\) Ibid.  

This project has received funding from the European Union. This communication reflects only the author's view. It does not represent the view of the European Commission and the EC is not responsible for any use that may be made of the information it contains.
According to ESBA, digital risk is one of the most significant yet underestimated threats facing SMEs in Europe. When speaking of digital risks, they refer to online trading and market digitisation, which inevitably affects all businesses. Thus, the risk for cybersecurity incidents increases, and the associated damages in terms of direct financial or reputational damages can be severe, as data shows that 60% of those suffering a cybersecurity incident are out of business within six months. In terms of upskilling, ESBA believes the EU should put more investment into providing the long-term unemployed and low-skilled with basic digital skills, so that current efforts can be rolled out across the EU and all those benefitting from training can acquire EU wide certifications. ESBA also proposes the creation of a “Digital Skills passport for ICT-professionals” to help new actors to enter the field and foster higher mobility thanks to EU-wide recognition.

SMEUnited has developed detailed recommendations on how to strengthen the skills level in Europe in its position paper ‘SME2024: Strengthening Crafts & SMEs for the Future of the European Union’. In the paper, SMEUnited describes how “SMEs are suffering from a lack of skilled staff due to a growing skills-mismatch, a decreasing and ageing workforce and a changing demand for labour”. The paper suggests focusing on robust future-proof skills through vocational education and training (VET), life-long learning, and awareness/opportunities for digitalisation. Further, the SME network suggests that the EU and member states “should move from traditional education policy to a more future-proof skills policy based on lifelong learning, on-the-job training, a closer cooperation between education institutions and companies, a better recognition of informal and non-formal learning and an increased cross-border mobility of young talents and experienced professionals between Member States”. Here, and to bridge the skills gap, the role of VET is deemed important. SMEUnited states that “an adequate skills mix is best obtained through vocational education and training (VET), work-based learning and apprenticeship, largely provided by SMEs”. The network also recognises the importance of life-long learning, which, however, requires the involvement of employers, workers, individuals and public authorities.

The skills that are required according to SMEUnited are a good balance of general, technical, digital, and transversal skills.

In the policy paper ‘Digital transformation in SMEs’, SMEUnited identifies the following areas as important for skills development: artificial intelligence, automation, robotisation, blockchain, and datamining. These are areas with “rapidly changing skills needs” and in which SMEs face skills shortages and mismatches. Further,

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141 Ibid.
143 Ibid.
145 Ibid., p. 16.
146 Ibid., p. 16.
147 Ibid., p. 17.
149 Ibid.
they identify the need to “upskill entrepreneurs to become ‘digital proof’”.\textsuperscript{151} This could be supported by more offline policy measures, such as providing entrepreneurs with a space and means to exchange about opportunities of digitalisation. Training needs related to skills which will allow SMEs to embrace digitalisation opportunities are also identified: building a website, learning how to use digital tools, social media for branding and recruiting, etc. Thus, SMEunited suggest that “entrepreneurship education should comprise dedicated modules on all facets of digitalisation”.\textsuperscript{152} In their policy recommendations, SMEunited link this to the role of Digital Innovation Hubs (DIHs) and the “Digital Knowledge Centre”, which could serve as a platform to share knowledge and expertise on digitalisation.\textsuperscript{153} These could “coordinate the exchange of best practices, the organisation of specific seminars, webinars and workshops, the development of toolkits and learning material and the planning of awareness raising campaigns”.\textsuperscript{154}

Eurochambres emphasises the “increasingly pressing issue for the competitiveness of SMEs” resulting from skills gaps and mismatches.\textsuperscript{155} Like the other organisations representing SME interests, Eurochambres sees a need for close cooperation between companies and educational institutions and perceives VET as a key factor to improve the situation.\textsuperscript{156,157} The new edition of the Eurochambres Economic Survey (EES2020)\textsuperscript{158} states that the skills gap puts a break on Europe’s socio-economic progress. It shows that “a shortage of skilled staff ranks higher than ever before among the challenges for the year ahead in EES2020”.\textsuperscript{159} Eurochambres advocates for a “coordinated, concrete and ambitious initiative across Europe to identify and prepare the competences required for the labour market”, which includes VET schemes and “lifelong learning culture”.\textsuperscript{160}

Several constraints, preventing SMEs from adopting new technologies have also been identified, such as budgetary hurdles, but also general awareness and knowledge of the management.\textsuperscript{161} A report conducted as part of the DigitaliseSME project refers to a survey among SMEs, which points to “lack of knowledge among members of the management and employees” and lack of awareness (“not aware of how or to what extent digitalisation could have improved their business”) as factors that prevent businesses from going digital (indicated by 34% and 22% of respondents as reasons preventing them from going digital).\textsuperscript{162} This is confirmed by research in the field of education, which states that, besides the budget constraints, a lack of knowledge within the company, difficulty to connect to a reliable expert, and inability to understand

\textsuperscript{151} Ibid. p. 3.
\textsuperscript{152} Ibid.
\textsuperscript{153} Ibid, p. 1.
\textsuperscript{154} Ibid., p. 4.
\textsuperscript{156} Ibid.
\textsuperscript{158} Based on feedback from 53.000 businesses – 90% of which are SMEs – across 28 countries in the European Chamber network.
\textsuperscript{160} Ibid., p. 1.
\textsuperscript{161} Ivona Skultetyova, Ivan Cutaia, Salvatore Di Misa and Jovana Savić, DigitaliseSME – Final Draft Report, 2020 p. 3.
\textsuperscript{162} Ibid.
digitalisation and its imminently added value (financial or operational) are other reasons leading to the lack of digitalisation.\textsuperscript{163}

### 2.1.2.1 Different requirements for diverse sectors and roles

The role of SMEs for the economy is undisputable\textsuperscript{164} – at the same time, a large group of SMEs seem to be lagging behind in innovation.\textsuperscript{165} This is an issue, especially when considering the enormous potential of emerging technologies to reinvent business processes and stimulate economic growth overall. SME surveys consistently show that lack of skills is identified as one of the key hurdles for SMEs to growth.\textsuperscript{166}

In the context of business models and processes, digitalisation is defined as “enabling, improving and/or transforming business operations and/or business functions and/or business models/processes and/or activities by leveraging digital technologies and a broader use and context of digitised data, turned into actionable knowledge, with a specific benefit in mind”.\textsuperscript{167} The impacts of digitalisation on a company can be grouped under three different categories: internal efficiency gains, external efficiency gains and disruptive change.\textsuperscript{168} This categorisation is very useful to identify the corresponding skills needs. While a general basic skills need has been recognised by SME organisations and researchers in general, the expert interviews conducted in the scope of this report point to the need to identify more closely the different skills needs according to different roles in a company, but also with respect to different sectors. In addition, the different intended impacts of digitalisation help to categorise the skills and training needs. For example, a training aimed at increasing the internal efficiency of a company needs a different set of skills than a complete disruptive change of the business model.

Finally, it is important to consider that while SMEs constitute 99.8% of businesses in Europe, there are large differences between the types of SMEs and sectors that SMEs operate in. SMEs are a very diverse group, and this also reflects on the uptake of digital solutions and the distribution of skills. For instance, only 20% of SMEs in the EU are highly digitised in comparison to the 58% of large enterprises.\textsuperscript{169} Thus, when addressing SMEs with specific technologies, there is a need to think about the different target groups within the heterogeneous group of SMEs (frontrunners, appliers and followers) and within each organisation (e.g. CEO, mid-


management level, IT specialists, professionals using ICT frequently, basic users, etc.)\textsuperscript{170} as well as differences between sectors.

\textbf{2.2 Interview results: Main skills and training needs}

In the following sections, the results from the general demand-side desk research are going to be complemented with insights gathered via expert interviews. Together with the desk research, 22 semi-structured interviews with experts from SMEs, education, libraries, training providers and public administrations from across Europe were conducted. The interviews aimed informing this report and the content and delivery of the online learning modules developed within this project.

The research aims to gather a broad overview of the training landscape and training needs throughout Europe. Therefore, in order to reach a wide scope and representation, expert interviews were organised on the basis of geographical areas. The areas, identified (taking in consideration geographical proximity), are the following:

- East - Greece, Romania, Bulgaria, Cyprus, Croatia
- West - The Netherlands, Belgium, France, Germany, Luxembourg, Ireland
- North - Latvia, Lithuania, Estonia, Sweden, Denmark, Finland
- South - Malta, Spain, Italy, Portugal
- Central - Poland, Czech Republic, Slovakia, Hungary, Austria, Slovenia

The approach of grouping countries has been identified as most appropriate, as it ensures feasibility and at the same time representativeness of different geographic areas.

As evident from Figure 3, experts were selected based on their experience in the domain (experts from SME organisations, education providers, libraries, and civil society organisations) and their expertise at national and regional/international level, with a priority for those that have a broader experience of the contexts in these areas. The interview approach aimed to have at least 4 experts for each area and to interview at least 1 expert per country from the expected country reach of the Digital SkillUp portal.

During the semi-structured interviews, conducted in the scope of this study in April 2020, experts answered a set of about 20 key questions and follow-up questions for clarification. The interviews were structured in two parts: 1) Questions on emerging technology trends and associated skills needs; 2) Questions on course design and target groups.

As the sample is small, this research cannot claim representativeness of the results for the whole EU or the possibility to generalise claims. However, many of the results resonate with findings from the desk research and were also validated and taken up during the strategic seminar, which gathered 40 experts from across Europe. Thus, while there is no statistical significance of the results, the interviews can still serve as a strong basis for discussion and “food for thought” on digital skills development and training needs.

\textit{Figure 3: Overview expert interviews}

\textsuperscript{170} European Commission (2019), \textit{Skills for SMEs: Cybersecurity, Internet of Things and Big Data for Small and Medium-Sized Enterprises}; Expert interviews conducted in the scope of this research, April 2020.
2.2.1 Topics and technology trends

During the interviews, a number of main trends have been identified. Many experts related skills needs to the current “forced digitalisation” through Covid-19. For instance, one interviewee stated: “With coronavirus outbreak over the past 2-3 weeks, circumstances changed (...) There is a need to equip people with core digital skills”.\(^{171}\) It should be noted that the interviews were conducted during a peak period of the Covid-19 pandemic in Europe, which seems to have highlighted skills inequalities among groups of society in the context of an increased use of digital tools.

In general, experts confirmed the findings derived from the desk research and agreed that the skills gap has been one of the most pressing issues faced by the European economy and businesses. For instance, one interviewed expert stated: “It doesn’t matter where you go; the gaps are enormous with both high-level and low-level digital skills”.\(^ {172}\) When it comes to the skills that should be addressed, and as presented in Figure 4 below, many of them pointed to cybersecurity, AI, and big data/data ecosystems as technologies to focus on first, adding also that there is still a clear need of basic digital skills training, including basic digital literacy and the use of basic tools/programmes for sharing files or online conferencing.

As a starting point, experts were asked which technology a digital skills training focus should on in order to be most beneficial to the European society and economy (see Figure 4 below).

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172 Expert Interviews, April 2020.
2.2.1.1 Skills for citizens

Many experts expressed the need to focus on digital skills in general, including a strong focus on digital literacy, e.g., to discern fake news. At the same time, experts expressed a need for skills to use basic digital tools, e.g., programmes for sharing files or online conferencing. There was general support for the statement that if citizens do not have basic competences such as digital literacy, it will be difficult for them to also understand emerging technologies.

Further explaining the skills needs that form part of basic digital competence, experts noted the importance of online privacy and cybersecurity related awareness and skills. Most experts agreed that for citizens in general, basic digital literacy in combination with cybersecurity and information security skills and awareness is important.

Skills for emerging technologies were seen as important because they are going to change society and work and will therefore be relevant for the wider society. However, experts recognised that emerging technologies are still quite abstract and that there is a need to explain their relevance and application in practical everyday examples. At the same time, experts voiced the need to foster a more critical understanding of these technologies, especially when it comes to data-related technologies such as AI and big data. For instance, one expert stated: “Emerging technologies are… far from everyday life, so very basic information is needed: to explain how/where people face them, how these technologies are/should be experienced, etc.”

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173 For instance, one expert said: “Digital skills in general are important. There is a need for a wide range of people to adapt to working online and to be able to use different platforms. Further, it is vital to be digitally literate, e.g. when it comes to fake news and similar phenomena.”

174 One expert expressed the need “to look at digital skills as a tree or stem: at the root, strong basic digital literacy is crucial to the health of the rest - people need to be comfortable with technology. Building and branching out from the root, specialised skills are required in different areas for the jobs of today to be done. Farthest out, you have more refined skills in areas like the internet of things & AI.”

175 One expert stated: “[Emerging technologies are] ... far from everyday life, so very basic information is needed: to explain how/where people face them, how these technologies are/should be experienced, etc.”
expert stated that "people tend to put a lot of trust in the answers derived from big data and AI – however, this is problematic as the information collected is usually imperfect."

Experts also expressed the need to tailor training on these technologies to different target groups and needs. Different approaches on how to tailor training were developed during the interviews, ranging from options focusing on the current skills level and educational background of individuals (e.g. people who have received formal training in ICT vs. those who have never received formal training) to adopting the training to age groups. Courses on emerging technologies could be offered to those with an IT background, while courses and training offered to citizens should focus on digital skills in general, entrepreneurial skills, skills for digital citizenship, eGovernance and eDemocracy.  

2.2.1.2 Skills for SMEs
Experts agreed that more “advanced topics”, i.e. skills for emerging technologies, are very important for companies. Skills in handling emerging technologies were seen as essential as they bring opportunities, but also because they may be a necessity for every company, e.g., when it comes to cybersecurity.

In order to reap potential benefits for business growth, business experts suggested to focus in particular on big data, blockchain, IoT and AI. The interviews supported the view that increasing the level of basic knowledge and awareness about emerging technologies is generally important for the economy, businesses overall, and SMEs in particular. On the other hand, the specific knowledge and skill sets required to take advantage of these technologies depend on the sector. For example, knowledge of robotics may be useful for the workforce in the automated industry, while someone working in the tourism sector may have different needs for skills in emerging technologies, rather focusing on data analytics skills combined with website or application programming skills. These discussions pointed to the need to combine business and sectoral knowledge with the right technical skill sets and awareness of opportunities of emerging technologies.

Experts frequently mentioned the need to provide companies with the ability to recognise opportunities in emerging technologies. For instance, one expert pointed to a survey which gave companies a list of technologies and asking them which of them they think they need in the future for their company. However, the "majority of respondents could not really tell what they need: they did not know what all those technologies are, so they could not chose/differentiate". Thus, there still seems to be a gap when it comes to explaining the potential of emerging technologies in a simple and practical way, which is ideally tailored to the specific sector a company is active in.

There seemed to be a consensus among experts that adoption of new technologies is challenging if employees do not have a general understanding of related opportunities and the technologies’ usefulness. This could be

176 For instance, one expert stated: “For example, robotics is a subject that seems to be interesting for students, it makes them excited about the topic. Having learned and experienced robotics, many students become interested in coding and IT in general. On the other hand, blockchain is particularly needed for various jobs, e.g. in supply chain process management, etc. So, it depends on the purpose/end goal of the courses. You need to ask what you want your learners to achieve?” See: Expert Interviews, April 2020.

177 For instance, one expert said: “There are different age groups, people with different cultural, educational, professional backgrounds, different linguistic capacities (people might not speak well the language of the country where they reside), etc.”

178 For instance, some experts stated that “knowledge of all the technologies is beneficial to the European economy and society”.

179 One expert stated “What is important is that the companies need an understanding of customer needs and solutions as well as a good business sector understanding in the area they operate. For example: maritime industry and technical skills, or automation robotics in manufacturing. It is not possible to offer training only in one area as a wide range is necessary.”

180 Expert Interviews, April 2020.
supported by showcasing good practices for specific use cases. Equally, it is important to tailor the training and communication to the background of those who are being trained.\textsuperscript{181}

Finally, when it comes to developing these skills, there was an understanding that organisations dealing with emerging technologies tend to be big or advanced enough to have structures in place to nurture the talent. This does not hold true for “follower type” SMEs, i.e. those SMEs that do not themselves develop technologies and only apply technologies for specific business aims.

In general, experts recognised the need to adapt to a changing environment.\textsuperscript{182}

### 2.2.2 Target audience

#### 2.2.2.1 Citizens

The majority of experts expressed the need to train all parts of society, while there was a recognition for the need to differentiate training according to different target groups.\textsuperscript{183} Differentiation may be needed for the working population, some of which lacks digital skills and does not attend any educational institution anymore, while younger generations can still acquire skills via formal training.\textsuperscript{184} Disadvantaged groups such as the unemployed or the “digitally and socially excluded”, which can also include other groups like the elderly, were also deemed an important target audience. Experts recognised challenges to address the more “IT distant” groups, which may not possess digital devices, or in general those groups that do not have access to IT equipment.\textsuperscript{185} Figure 5 below illustrates the different societal segmentations of the target audience.

\textsuperscript{181} As one expert stated: “A general training on digital transformation for companies – e.g. by adopting a new software – needs to build on good practices. Also, it is important to tailor the training to the background of those to be trained. E.g. a training for economists on understanding what is AI can easily be a highly successful training.”

\textsuperscript{182} For instance, one expert stated: “However, if one speaks about the SMEs – in today’s market they need to be more and more specialised, only those with high level of expertise/specialisation can survive. Therefore, technologies such as AI, quantum computing, etc. are crucial to survive in a future economy. In addition, these highly specialised SMEs should look for answers to the major social challenges (e.g., sustainable batteries for car and other green ICT solutions, biodiversity, etc.). Therefore, SMEs must understand what are the ‘skills’ and the main topics of the future.”

\textsuperscript{183} Generally, many experts expressed the need that “everyone should gain digital skills and understand basics of IT”.\textsuperscript{183} One expert said: “We have to train people like we do with basic subjects, such as mathematics. Everyone in the relevant age group of 20-50 needs to be trained, even if they have left school already. I would recommend to design courses according to specific needs and target groups. For instance, to allow an individual to gain skills in AI, you need to train them for at least 6 months, including courses on relevant programming languages. Not everyone can become an AI engineer, so there needs to be differentiation according to target groups.; Experts recognised the need for general skills training adopted to the age group, but stated that all age groups need to be trained: “No matter whether you are 5 or 95 years old, the need to have a basic understanding of technology and general digital literacy, remains”.

\textsuperscript{184} Similarly, another expert said: “Generally, we need to train everyone: working population (business people) – with more advanced skills, helping them to keep up with the emerging technologies and new requirements at work and those who are unemployed, between the jobs or are just willing to upskill – with more basic skills (entry level technologies needed at the work place, etc.).”

\textsuperscript{185} For instance, one expert said: “Elderly or unemployed often do not have the necessary IT equipment, so it’s better for them to go to training centres. Besides, they have more time.” Similarly, another expert argued: “The main target group should be those who do not have other opportunities to learn (Elderly, unemployed, etc). Students and young people have a lot of opportunities available to learn.” In addition, there may be a need to focus on those who are not so well educated. As one expert said: “We
Finally, on one hand students and young people were not mentioned that much as a necessary target group. On the other hand, schools were seen as institutions to focus on, while the role of SMEs was also deemed important. The role of schools was perceived as significant due to their broad reach. SMEs on the other hand were seen as those that may currently not have enough resources, but that could still reach a large portion of workers.

In order to be able to offer training that fits most of these groups, one expert suggested that “the offered courses should tackle the basic impact of technologies: show how it changes the way we all work and live together”.

![Figure 5: Target audience (society)](source: Expert Interviews, April 2020)

### 2.2.2.2 SMEs
When it comes to SMEs, many experts recognised that digital competence is a bigger problem in SMEs than large companies. As one expert said: "In general, large companies have the resources to [create] their internal need to talk especially about those who are not so well educated. Those lagging behind are those who are not so well trained or educated. Elderly workforce – they made their degrees decades ago – they haven’t received training in digital which they now need."
training programmes”. Also, “large companies tend to have more HR functions and training offers, while SMEs are lacking this resource”.

To tackle this issue, experts suggested different strategies. For instance, one strategy would be to focus on managers to allow them to recognise opportunities, so they could then arrange training for their staff and thus increase the overall level of digital skills expertise. Similarly, technical people may need more targeted and detailed training in a technology and respective skills of how a technology can be used in a company. Experts agreed that managers needed to be targeted as they are the ones making decisions, which bring about change in a company, while IT professionals may already be aware of available technical solutions but require support to bring about change. Building on this, a more detailed strategy would be to divide the SME workforce into different categories — the leaders/managers, the supervisory level, and the more hands-on level — and to adapt training offers accordingly.

Figure 6: Target audience (role in company)

Source: Expert Interviews, April 2020

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186 As one expert stated: “There may be a need for trainings for managers. Here, the training should focus on the potential of the technology and general understanding. More in-depth training would be mainly for IT and for workers with technical or IT exposure.”

187 As one expert suggested, “each of the 3 above-mentioned categories should have their relative trainings. For example, the management level should receive training on how technology can improve their company’s productivity and their revenue, how they can be electronic digital leaders, how to communicate in the digital era. Thus, the training should have a different focus for managers / technicians.”
While citizens and SMEs have different skills and training needs, there seems to be one common denominator: cybersecurity skills and awareness. Experts mentioned the particular need to focus on cybersecurity for all staff in SMEs,\(^{188}\) while this seems to be an area that is also relevant for citizens in general.\(^{189}\)

### 2.2.3 Level of difficulty

While most experts agreed that the skills gap is enormous at every level, they highlighted the need to focus on skills gaps at the introductory and intermediate level (see Figure 7). However, when it comes to skills in emerging technologies, experts stated that the intermediate to advanced level is the most needed and that the shortage is in the higher levels of skills. Thus, advanced courses could be addressed to specialists and part of the workforce in SMEs. However, there is no clear evidence if there is a need for publicly funded courses on these specialist domains as the relevant “frontrunner” companies may have the competence to define their training needs themselves and even offer trainings. Nonetheless, experts expressed the need to convey basic digital competence and a general understanding of the impact of emerging technologies in simple language and practical real-life examples. Therefore, courses aimed at the introductory and intermediate level could also focus on emerging technologies to provide a base-level understanding of what these technologies may mean for everyday life and general workplace applications.

![Figure 7: Difficulty level](image)

*Source: Expert Interviews, April 2020*

### 2.2.4 Frequency & duration

The interviews revealed that the length of the course depends on the level and aims the learner wants to achieve. For instance, if the aim is to receive a title/degree, the programme has to be longer, more or less around 600 hours, and include practical training, while basic training which may allow to gain an overview of

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\(^{188}\) As one expert said: “Cybersecurity is needed horizontally. At the moment, the general level of literacy in cybersecurity is fairly low. Thus, basic literacy about how to be more careful online would be needed by most people”.

\(^{189}\) One expert said: “All of them need to understand the digital shadow (digital footprint on the internet) that we are leaving without being conscious about it (like geolocation)”. This point is relevant both for citizens and SMEs from a privacy and data protection perspective, as well as cybersecurity.
technologies may only require 30-60 hours.\textsuperscript{190} Shorter courses can be relevant for a job but they tend to convey awareness rather than practical skills. The learners, for example, may emerge with an understanding of what data management constitutes, or what the importance of cybersecurity is, but they will not be a practitioner of either discipline. These courses that convey awareness have value for non-technical employees that work close to digital teams, but not within them.\textsuperscript{191} Instead of referring to the ideal length in terms of hours, others preferred to speak of a length in weeks/months. Here, a length of up to one week was considered necessary for basic skills and up to three months for more advanced skills (AI, blockchain, etc.)

At the same time, experts voiced the need for a variety of different lengths and flexibility, e.g. the possibility to do a module at a chosen time and continue to upgrade with other modules later on.\textsuperscript{192} Experts expressed a preference for self-paced courses, which would however require at least a weekly engagement. Some even said that engagement 2-3 times per week were necessary for a stable rhythm. Further, self-paced courses should provide timely deadlines also limited in time (e.g., clear certain deadlines or the end-date to finish the training). As one expert put it: "Deadlines are important because people need to 'feel' some structure (easy pressure) to be more committed. It helps people to regulate how they spend their time."

Further, networking and social aspects were deemed important, which may require some fixed-time classes and are difficult to arrange in self-paced courses.\textsuperscript{193} In addition, experts mentioned the need for peer groups and accountability to limit drop-out rates. One expert stated that the drop-out rate seems to be higher in online courses than real life. Figure 8 below presents a breakdown of experts’ opinions on how long an individual lesson should be.

\textit{Figure 8: Length of an individual lesson}

\textsuperscript{190} For example, one expert mentioned an example on how long it would take to become a practitioner in software development. In this case, there are different steps to follow: completing the course, receiving a certificate, entering an organisation to apply the skills. An introductory programme can be anything from 5-30 hours, while a full-stack course may take 600 hours.

\textsuperscript{191} Another expert mentioned the need to practically ‘try’ and apply the technology, face it in real life, ‘play with it’. In total, 40-60 hours might be needed to gain an overview of technologies. This time should also include ‘tasks’ – practical exercises which follow the theory and allow people to actually understand and ‘live’ the technology.

\textsuperscript{192} Experts also highlighted the importance to give flexibility to learners in shaping their own learning process. For example, one expert interviewed stated that “there should be at least one interaction per week, one module, but time should be given to work on a personal pace (self-paced). It should allow people to take their time and calmly complete their tasks: tasks should be completed within 1-2 weeks.”

\textsuperscript{193} As was stated by one expert: “Discussions among the participants should be triggered and motivated. If people attend the same course and get a triggering question, it will foster the discussion among them and thus a better take-up of the content. It is important that you allow people to help each other and to feel part of the community by having a good discussion environment.”
When it comes to the length of an individual class, experts voted for rather short individual lessons, i.e. 30-45 minutes or even only up to 20 minutes. At the same time, the length depends on the content and complexity of a topic. However, some experts explained that people have shorter attention spans and need more breaks when learning online. Thus, when learning online, lessons should be divided to the “smaller bites”. Another expert advocated for longer lessons, which would however include exercises and where talking/listening should be limited to 20 minutes.

### 2.2.5 Key elements of the online trainings

Regarding key elements of online trainings, a mix of different elements and methods was favoured. One expert stated that “courses should entail a mix of presentations (explaining the content) and tasks (allowing learners to present their own solutions, share their opinions with everyone) and that people like to get their work appreciated”. While MOOCs were recognised as a great tool for online learning, experts warned that watching a video does not guarantee comprehension of the learning content and that other elements to support learning (practical elements, quizzes, etc.) are important. Also, to make sure that the learner takes up the content, it is important for these videos to be interesting and attractive.

Trainings should be personalised and offer opportunities for networking. Many experts agreed that even if the course is fully delivered online, the interaction with a human tutor/teacher should be ensured (see also social aspects covered above). According to the experts, human contact and learning from real experience is still particularly important for the learning process. In addition, face-to-face interaction ensures the development of soft skills. Further, elements like short video tutorials, quizzes, self-assessments, etc. were seen as important. Figure 9 illustrates the elements of online training, highlighted by experts as the most effective ones.

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One expert suggested that “there can be different timings of one ‘lesson’. It depends on the course/lesson itself; it can vary based on a topic, complexity, etc.”
2.2.6 Costs & other incentives

The cost of taking a course was mentioned as an element which would influence the decision to take a course, especially for citizens who may not be willing to spend money on training if they do not see immediate benefits.
or receive something in exchange (e.g. a certificate).\(^\text{195}\) However, the costs were not identified as the most important factor making people decide for a course – professional/personal development was seen as much more important. Thus, when speaking about cost of the course, it is important to consider the value of the course for the learner.\(^\text{196}\) User-friendliness was also identified to play an important role, as well as aspects such as collaboration and networking with peers. Further, a link with specific professional and educational objectives seems important. Figure 10 presents the elements identified by experts which can motivate users to take a course.

**Figure 10: Motivation to take a course**

<table>
<thead>
<tr>
<th>Factor</th>
<th>Importance Level</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total duration in length</td>
<td>6</td>
</tr>
<tr>
<td>Language</td>
<td>4</td>
</tr>
<tr>
<td>Cost of course</td>
<td>8</td>
</tr>
<tr>
<td>Compatibility with work/study schedule</td>
<td>4</td>
</tr>
<tr>
<td>Format: self-paced or moderated</td>
<td>2</td>
</tr>
<tr>
<td>Accreditation for professional purposes</td>
<td>2</td>
</tr>
<tr>
<td>Certification or accreditation for...</td>
<td>2</td>
</tr>
<tr>
<td>Collaboration and networking with trainers</td>
<td>2</td>
</tr>
<tr>
<td>Collaboration and networking with peers</td>
<td>2</td>
</tr>
<tr>
<td>Activities and features offered</td>
<td>2</td>
</tr>
<tr>
<td>User-friendly format</td>
<td>4</td>
</tr>
<tr>
<td>Content formats</td>
<td>1</td>
</tr>
<tr>
<td>Previous knowledge/understanding of the...</td>
<td>2</td>
</tr>
<tr>
<td>Topic</td>
<td>10</td>
</tr>
<tr>
<td>Professional/personal development</td>
<td>12</td>
</tr>
<tr>
<td>Level of the course</td>
<td>14</td>
</tr>
</tbody>
</table>

**Source: Expert Interviews, April 2020**

\(^{195}\) For instance, one expert said: “For general citizens, I’m not sure if they will attend if it’s not free (like applications). Companies are more willing to pay but need good marketing in order to be convinced that this is the best possible course.”

\(^{196}\) Motivation to take a course seems to be driven mostly by professional/personal developments. Some experts stated that it was important for learners to get clear benefits and a clear return on investment, e.g. in jobs available in that field. One expert pointed to professional development: career advancement is an important factor to determine the choice to learn something. Another important element could be how closely the course relates to personal interest and jobs. However, the relevance of the topic should not be underrated. One expert stated: “The topic is most important. For the other incentives, it depends on your personal situation. If you need certification, you will be more interested than someone who is just doing it for the topic. The cost of the course also plays a major role.”
2.2.7 Languages
Language was mentioned to play an important role, both in terms of the actual comprehension of a language and its style/level of difficulty. Language could be a barrier, especially in regions in the EU where English is not widely spoken. Going beyond a particular language, experts expressed the need for simple, accessible language to speak about emerging technologies.

2.2.8 Assessment and certification
According to the expert interviews, certification or accreditation for educational purposes was rated as being key. In order to fully align online courses and general learning with an individual goals and learning paths, experts also pointed to the need to align accreditation and certification with learning in work-related contexts. Finally, accreditation or certification can point to a certain level of quality of the course. The quality aspect is an important one and could be supported by having quality labels that will allow learners to make better choices in their trainings and to gain a better overview of what might be suitable to them.

While the expert interviews systematically covered the aspects that will also be examined in the supply side analysis of training offers (i.e. training focus, target groups, difficulty, elements of online training, etc.), the stakeholder seminar and online consultations took a more open approach to extract key statements about future skills needs in society and SMEs. The key takeaways that were derived in consultation with the expert stakeholder group will be presented and explained in the following.

2.3 Stakeholder consultation: Key takeaways
During the strategic seminar, experts were confronted with scenarios presenting potential paths for future skills development in emerging technologies (see ‘Strategic Seminar Report’ for more details). The strategic seminar relied on a strategic foresight method (scenario building) to gain insights on future skills and training needs. Experts were given the opportunity to develop scenarios for skills development in emerging technologies as well as to exchange and discuss topics related to skills and training needs.

The developed scenarios touched upon a variety of aspects. They cover the need for basic digital competences, an understanding of IT infrastructure and software, and an understanding of advanced emerging technologies like AI, cybersecurity, and blockchain. The different scenarios also included different

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197 For instance, one expert said that “certification might play a role, especially when targeting employed workforce (SMEs), because employers often want to see the result (some certificate or a badge). At the same time, there are also trends in HR, which build on assessments to determine the skills levels by conducting tests/exercises.”

198 One expert stated: “One cannot prove in your CV that you did certain things, but you can prove that you have upskilled if this is certified. E.g. a company can have a special deal with a university. A practical way to do this is to develop a partnership with bodies that can provide the audit, e.g. university or private businesses that are specialised in HR qualification/standards for professional occupations. So the university or other body can send experts and test employees based on a standard. E.g. for project managers, different standards apply and there are different sources of getting these competences, for instance by working in a project.”

199 As one expert said: “It is very hard for users to know which course is good for them, how to choose it. Employers also lack ways to ‘assess’ the courses and decide what should be suggested to the staff. Therefore, it is important to involve relevant stakeholders who would point people (especially companies) towards a particular training. This would grant for the quality of such training.”

200 Scenario building is a qualitative and explorative technique and is considered a strategy formation tool. Scenarios are logical and plausible descriptions of future developments. The results of the desk research and interviews led to the development of scenarios on digital skills in emerging technologies, which were brought forward to stakeholders during the strategic seminar held on 19 May 2020.
target groups, i.e. from disadvantaged and “digitally excluded” groups of society to the leaders of companies and society influencers.

The strategic seminar was followed by two rounds of online consultation through online collaboration tools that further engaged the stakeholder community and led to the development of key takeaways about skills and training needs. The key takeaways were validated via an online voting tool. Stakeholders were presented with the key statements extracted from the discussion and were asked to vote based on importance and to provide further comments. The following key takeaways have been extracted from the scenario building exercise and subsequent online consultation.

**Table 1: First Strategic Seminar consultation- key takeaways**

<table>
<thead>
<tr>
<th>Skills needs of citizens/society</th>
<th>Key skills needs / Focus / Incentives</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>A sound understanding of the impacts of emerging technologies on society and everyday life</td>
</tr>
<tr>
<td></td>
<td>Awareness of cyber risks and issues related to disinformation, such as fake news</td>
</tr>
<tr>
<td></td>
<td>Knowledge of data protection and privacy rights in a work context</td>
</tr>
<tr>
<td></td>
<td>Basic knowledge about fundamental IT infrastructure, software, and algorithms</td>
</tr>
<tr>
<td></td>
<td>Understanding of the history/development of the technology in general</td>
</tr>
<tr>
<td></td>
<td>Understanding of digital sovereignty, which also covers knowledge on internet governance, data ownership, critical infrastructures</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Skills needs of employees in SMEs</th>
<th>Key skills needs / Focus / Incentives</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Understanding of what a company is doing, i.e. the core business and business aims as well as sectoral knowledge</td>
</tr>
<tr>
<td></td>
<td>Understanding and awareness of why and how to use a specific emerging technology and technology in general</td>
</tr>
<tr>
<td></td>
<td>Understanding and awareness of cybersecurity risks</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Training focus and elements</th>
<th>Key skills needs / Focus / Incentives</th>
</tr>
</thead>
<tbody>
<tr>
<td>Real-life problems &amp; tailoring training to different target groups; Employ practical examples</td>
<td></td>
</tr>
<tr>
<td>Courses should focus on explaining the impact of the technology</td>
<td></td>
</tr>
<tr>
<td>Tailoring training to SMEs and sectors</td>
<td></td>
</tr>
<tr>
<td>Generic knowledge about a technology, its impact on real life and its implications.</td>
<td></td>
</tr>
<tr>
<td>A European platform</td>
<td></td>
</tr>
<tr>
<td>Simple inclusive language</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Motivation aspects</th>
<th>Key skills needs / Focus / Incentives</th>
</tr>
</thead>
<tbody>
<tr>
<td>Provide modular learning paths or customised learning experience</td>
<td></td>
</tr>
<tr>
<td>Certification-related modules</td>
<td></td>
</tr>
<tr>
<td>Universities to acknowledge course credits</td>
<td></td>
</tr>
<tr>
<td>Financial support, free courses, tax incentives, etc.</td>
<td></td>
</tr>
<tr>
<td>Leaders, ‘influencers’, front-runners in the companies/organisations have to be addressed</td>
<td></td>
</tr>
</tbody>
</table>

*Source: Expert Interviews, April 2020, First Strategic Seminar 2020*

**2.4 Conclusion**

This chapter provided an overview of skills and training needs of SMEs and citizens in emerging technologies and to support the digital transformation. Skills needs for different roles citizens may take in society and for employees in SMEs were identified. Finally, recommended elements related to online training were also outlined.

Overall, the demand-side analysis points to important skills needs in basic digital skills, with a particular emphasis on cybersecurity and data protection matters (i.e. safety-related aspects according to the digital
These skills would be required for all groups of society, especially the ones that may not be engaged in learning via institutions such as schools and universities. In addition, there is a need to increase the understanding of the impacts of emerging technologies on society and everyday life. Experts recommended to focus in particular on AI, cybersecurity, and data-related technologies. At the same time, a general understanding of emerging technologies and their impacts on society as well as their opportunities for businesses would be advantageous for society and the economy.

The next chapter is focusing on the supply side, i.e. it will provide an overview of the available training offers. After the end of the supply-side chapter, both the results of Chapter 2 on the demand side and chapter 3 of the supply side will lead to the gap analysis (Chapter 4), which will allow to generate lessons-learnt on training needs and course design. Thus, the reader should refer to Chapter 4 for a summary of the full analysis presented in this chapter.

---

A Council Recommendation of 22 May 2018 defines digital competence as follows: “Digital competence involves the confident, critical and responsible use of, and engagement with, digital technologies for learning, at work, and for participation in society. It includes information and data literacy, communication and collaboration, media literacy, digital content creation (including programming), safety (including digital well-being and competences related to cybersecurity), intellectual property related questions, problem solving and critical thinking.” (Council Recommendation of 22 May 2018).
Chapter 3: Training landscape and online courses

This chapter presents an analysis of the state-of-the-art regarding the existing online training courses on emerging technologies (IoT, blockchain, AI and robotics). The choice of various courses online, though, is enormous. In order to better understand the course offer and to navigate through this vast diversity, an online desk research and a stakeholder survey about the available online trainings were carried out.

The analysis concentrated on the main features of the identified online courses: key topics and technology trends, target audience, difficulty levels, frequency and duration, key elements of the online trainings, costs, language, assessment, and certification. The conclusions from this analysis of digital skills training offer feeds into the gap analysis, which allows to compare the supply and demand side, and to deduct lessons-learnt for the focus of training courses and course design, with the aim to contribute to digital skills development in emerging technologies in Europe.

At the first stage of the research, some of the biggest and most popular MOOC platforms (repositories) were analysed. With millions of users worldwide, the most famous MOOC platforms are widely known as the first access point when looking for online training opportunities.202

Some of the biggest and best-known platforms (both in terms of number of users and number of the courses offered) are Coursera203, edX204, Udacity205, FutureLearn206 and Swayam207. Table 2 below illustrates the distribution of users and courses among these platforms.

<table>
<thead>
<tr>
<th>MOOC Platform</th>
<th>Number of users</th>
<th>Number of courses offered</th>
</tr>
</thead>
<tbody>
<tr>
<td>Coursera</td>
<td>45 million</td>
<td>3,800</td>
</tr>
<tr>
<td>edX</td>
<td>24 million</td>
<td>2,640</td>
</tr>
<tr>
<td>Udacity</td>
<td>11.5 million</td>
<td>200</td>
</tr>
<tr>
<td>FutureLearn</td>
<td>10 million</td>
<td>880</td>
</tr>
<tr>
<td>Swayam</td>
<td>10 million</td>
<td>1,000</td>
</tr>
</tbody>
</table>

Table 2: Overview of MOOC platforms

Source: Class Central (2019)208

Class Central, a search engine and combined learning platform, was used to conduct a qualitative analysis across these platforms. Class Central is a so-called discovery platform, which is able to provide search results

from all these platforms (in addition to 39 other smaller platforms\textsuperscript{209}) simultaneously. Therefore, it was used to acquire some of the initial quantitative findings.

In addition, a qualitative analysis of existing courses available on the five biggest platforms has been conducted to better capture the main trends. Here, the analysis was focused on concrete traits and features of relevant courses on emerging technologies (e.g. robotics, blockchain, IoT and AI). Browsing these platforms and examining relevant courses did not only allow to identify main trends among the course offer, but also contributed to the creation of the catalogue of trainings and best practices within this project.

At the second stage of the analysis, further desk research was carried out with the aim to identify online training courses not offered through the main MOOC platforms. The goal was to point out trainings provided by the players that form the European ecosystem of training providers and that reach out to SMEs and citizens, such as chambers of commerce, associations, public libraries, etc.

In addition, EU-funded projects (particularly those funded by the Erasmus+ and H2020 frameworks) were scanned for training opportunities. Further, research was carried out to examine the training offer of the members of national digital skills and jobs coalitions across Europe in order to identify key trends among the courses offered by those players.

The third stage of the analysis was a stakeholder survey which was hosted on DIGITAL SME’s website and was conducted between March and June 2020. The purpose of the survey was to build upon existing best practices and training opportunities, analyse the main trends among them and include them in the catalogue of trainings and best practices. The survey has been shared with the experts who participated in the demand side interviews and the strategic seminar, as well as the extended list of relevant European stakeholders. It was filled in by 38 respondents, who added their best practices and online training opportunities to the survey.

Quantitative and qualitative findings from all three research stages are summarised below, identifying the key trends observed amongst the most prominent features of the training courses: topics and technology trends, target audience, difficulty level, frequency and duration, key elements of the online trainings, cost, language, assessment, and certification.

### 3.1 Main trends in online training

#### 3.1.1 Topics and technology trends

Multiple subjects related to emerging technologies can be tackled in online courses. Course offers range widely in terms of technologies discussed and courses on the different technologies vary in terms of level of detail versus broadness, and the application of the specific technology to specific sectors (see 3.1.3 Level of difficulty).

Among ICT-related MOOCs (1693 found in total on Class Central), a big part of them concentrates on programming: 224 courses teach the Python programming language, 205 teach mobile application development, 100 teach Java. The Python language (precisely, the usage of Python in high performance

\textsuperscript{209} Class Central, Providers, available at: https://www.classcentral.com/providers. [Accessed 29 June 2020].
computing) has also been the most popular course (by user activity) in the second half of 2019.\textsuperscript{210} Programming and Python are also the most common ICT topics among the top 100 most popular MOOCs of all times.\textsuperscript{211}

However, emerging technologies also play an important role. Almost 300 courses on artificial intelligence and machine learning were found, making it one of the most popular topics, with a big variety of courses offered in the field, as examples presented in Table 3 and Table 4. Machine learning and artificial intelligence are also the only emerging technologies covered by the most popular ICT MOOCs.\textsuperscript{212} This indicates that MOOCs on artificial intelligence seem to be the most widely covered and best attended ones. Meanwhile, there were 116 courses on IoT, 64 on robotics and 58 on blockchain, which shows a relatively lower offer of trainings related to these technologies.

\textbf{Table 3: Practical training example number 1}

<table>
<thead>
<tr>
<th>Training course</th>
<th>Elements of AI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Emerging technology</td>
<td>AI</td>
</tr>
<tr>
<td>Provider</td>
<td>Reaktor &amp; University of Helsinki</td>
</tr>
<tr>
<td>Target audience</td>
<td>Citizens</td>
</tr>
<tr>
<td>Topics</td>
<td>What is AI, Problem-solving AI, Real world AI, Machine learning, Neural networks, Implications</td>
</tr>
<tr>
<td>Key elements</td>
<td>Visuals (graphics, charts, illustrations, etc.), reading materials, links to external sources (readings), quizzes, discussion forum (online community)</td>
</tr>
<tr>
<td>Language</td>
<td>English, all EU languages (under development)</td>
</tr>
<tr>
<td>Assessment and certification</td>
<td>Quizzes, exercises, short open questions &amp; peer review for others Certification is possible, as well as ECTS credits (Finland, Sweden, Estonia and Latvia, discussion in other countries in progress)</td>
</tr>
<tr>
<td>Rationale for selection</td>
<td>The course provides an overview of AI technology for beginners. The course is designed in an easy but comprehensive manner, making it easy to any type of audience to understand the fundamentals of AI technology.</td>
</tr>
<tr>
<td>URL</td>
<td><a href="https://www.elementsofai.com/">https://www.elementsofai.com/</a></td>
</tr>
</tbody>
</table>

\textit{Source: Elements of AI online (2020)}

\textbf{Table 4: Practical training example number 2}

<table>
<thead>
<tr>
<th>Training course</th>
<th>AI in Business</th>
</tr>
</thead>
<tbody>
<tr>
<td>Emerging technology</td>
<td>AI</td>
</tr>
<tr>
<td>Provider</td>
<td>Agoria</td>
</tr>
<tr>
<td>Target audience</td>
<td>SMEs (all companies)</td>
</tr>
<tr>
<td>Topics</td>
<td>Definitions of AI-related terminology, Deep Dive into AI technology, Why Now?, AI in business, Let’s get practical (real life examples)</td>
</tr>
<tr>
<td>Key elements</td>
<td>Videos, animated presentations, interviews, practical use cases (videos)</td>
</tr>
<tr>
<td>Language</td>
<td>English</td>
</tr>
<tr>
<td>Assessment and certification</td>
<td>Upon completion of chapter 4 'AI in business', a certificate demonstrating the ability to set up an AI project is provided.</td>
</tr>
</tbody>
</table>


\textsuperscript{212} Ibid.
Finally, the desk research analysed other categories of ICT training and training in emerging technologies. Different keywords were used to identify and map the training offer: cloud computing, quantum computing, cybersecurity and privacy, big data, augmented reality, etc. (see table 5 below). Two trends stood out of these categories: There were more than 500 courses on big data and almost 200 on cybersecurity. However, both categories are very wide and cover multiple interdisciplinary approaches. Also, they are often offered tailored to advanced users only.

**Table 5: Overview of course topics**

<table>
<thead>
<tr>
<th>Course topics</th>
<th>Number of courses (based on Class Central)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Emerging technologies</strong></td>
<td></td>
</tr>
<tr>
<td>AI and machine learning</td>
<td>297</td>
</tr>
<tr>
<td>Blockchain</td>
<td>58</td>
</tr>
<tr>
<td>IoT</td>
<td>116</td>
</tr>
<tr>
<td>Robotics</td>
<td>64</td>
</tr>
<tr>
<td><strong>Popular ICT programming courses</strong></td>
<td></td>
</tr>
<tr>
<td>Python programming language</td>
<td>224</td>
</tr>
<tr>
<td>Mobile development</td>
<td>205</td>
</tr>
<tr>
<td>JAVA</td>
<td>100</td>
</tr>
<tr>
<td><strong>Other trending ICT topics</strong></td>
<td></td>
</tr>
<tr>
<td>Big Data</td>
<td>581</td>
</tr>
<tr>
<td>Cybersecurity</td>
<td>193</td>
</tr>
<tr>
<td>Data privacy</td>
<td>123</td>
</tr>
<tr>
<td>Quantum computing</td>
<td>28</td>
</tr>
</tbody>
</table>

*Source: Class Central (2020)*

The situation is quite different when one looks into courses offered by providers different from the big platforms. Subsequent desk research and the stakeholder survey revealed different trends among the online courses offered outside the biggest platforms. Most of the digital skills trainings appeared to be of a much more generic nature, covering wider topics relevant for both citizens and SMEs. These courses can be roughly attributed to the categories described below.

For citizens:

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213 Please note, examples of the courses provided here and below are only used to illustrate the points made, they are not necessarily considered as recommended courses.
• basic digital literacy (computer usage, concept and use of the Internet, e-mail, etc.), such as the digital literacy course developed by the UK charity organisation ‘Safety and Security Online’ or a widely used example from Singapore called ‘Basic Digital Skills’.

• basic software knowledge (e.g., Microsoft Office), such as the ‘GCF Global’ course.

• access to and usage of online services (online banking, e-government services, online shopping, etc.).

• online communication (e.g., use of social media and voice over IP (VoIP) technologies, behaviour while communicating online (cyber-bullying, online comments, misinformation and fake news, etc.) such as the ‘Social Media Literacy for Change’ course.

• online security and privacy, ranging from general security to cybersecurity (phishing, malware, etc., such as, e.g. basic courses on cybersecurity by CISCO) and implications of data sharing, basics of personal privacy rights, etc.

For SMEs:

• basic software knowledge.

• basic work-related software (e.g., task management software, data storage, etc).

• online marketing (from creation of a company’s website and social media accounts to basic SEO, online ads, etc.), such as beginners’ courses by Google.

• e-commerce.

• basics of online security and privacy such as courses by the Oxford Home Study Center.

It is important to note that the identified categories are not exclusive: they define only the largest groups of online trainings. There are a number of training topics that do not fall under these categories. However, these topics have not been encountered often during the desk research. This is also the case with emerging technologies – a few courses were found online, but they are seen as rather exceptional. In some instances, however, emerging technologies are briefly mentioned in the context of other generic topics. Robotics, though, stands out from other emerging technology topics, and receives greater attention among the online MOOCs offered outside the biggest MOOC platforms. There is a greater choice of online training initiatives on robotics, but they seem to mostly target robotics enthusiasts and concentrate on practical aspects of robot building.


To conclude, artificial intelligence is the most trending topic among online MOOCs, which can be found in the biggest MOOC platforms. However, insufficient attention is given to other emerging technologies. Moreover, trainings on the emerging technologies are rarely offered by alternative providers, outside of the biggest platforms.

### 3.1.2 Target audience

The target audience of MOOCs available via the biggest platforms that have been examined in this research is rarely defined precisely. Instead, the audience seems to be determined by factors such as the difficulty level, previous knowledge required for the courses, and the course curriculum. For instance, more specialised or technical courses are targeted at ICT professionals, engineers, etc., but not designed for the general public or SME managers. Such specialised and advanced courses make up the largest part of the available MOOCs.

Furthermore, courses which explicitly mention their applicability to SMEs or startups are in many cases designed to promote specific products, platforms, etc. (examples of such courses include Microsoft course on AI, which builds on its Azure service\(^{221}\) or Google’s ‘Machine Learning Crash Course’ which promotes Google Cloud Platform\(^{222}\)).

On the other hand, the MOOCs that are found outside the main platforms are likely to target specific audiences. This is particularly the case with trainings designed for citizens. The target audiences vary to a great degree: by different age groups (children, youth, working age population, seniors), by their occupations (students, unemployed, not in education, employment or training [NEET], working population), by sex (many courses specifically target women\(^{223}\)) and so on. Yet, most of such online training courses target the groups that are more likely to experience negative consequences of the digital divide.

It is difficult to draw general conclusions on the target audiences for online trainings on the emerging technologies offered by alternative providers, due to the low overall number of such courses. Most of them, nonetheless, also target ICT professionals or at least people with a certain level of knowledge, such as enthusiasts in robotics, people already aware of the basics in data science, etc. Only very few online courses on emerging technologies specifically target staff in small businesses (for example, Agoria’s course on AI\(^{224}\)).

### 3.1.3 Level of difficulty

Information about the level of difficulty is in most cases provided in the course descriptions and allows to assess whether the particular course matches the learner’s skills level, previous knowledge, etc. Each MOOC platform (or even each MOOC provider) might have different definitions of the difficulty level: often they are evaluated as ‘basic’, ‘intermediate’ or ‘advanced’, but sometimes they are also graded in the scale of 1-3 or 1-5.

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Furthermore, the difficulty level is often also determined by the required previous knowledge and the course topic. For example, even if the 'Python for Data Science and AI\textsuperscript{225}’ course on Coursera is aimed at beginners, it will be very hard for a complete beginner without previous knowledge of Python or programming languages to keep up with such training.

Due to the different difficulty levels across the platforms, a quantitative cross-platform comparison of difficulty levels is not possible. However, most of the courses found on the MOOC platforms require a certain level of prior knowledge around the topic (e.g., basics of statistics, data science, logics or programming for the AI courses; understanding and keen interest in mechanics for robotics). Therefore, such courses are not suitable for citizens and only partly suitable for some of the SME staff.

A similar pattern is observed among other MOOC providers. They either offer very generic digital literacy trainings, which do not require any previous technological knowledge, but also do not cover emerging technologies or are rather specialised and suitable for ICT professionals or people with relevant knowledge/experience. Only a small number of exceptions can be found among the MOOCs analysed in this research, such as the example presented in Table 6.

<table>
<thead>
<tr>
<th>Practical training example: basic training course on blockchain</th>
</tr>
</thead>
<tbody>
<tr>
<td>Training course</td>
</tr>
<tr>
<td>Emerging technology</td>
</tr>
<tr>
<td>Provider</td>
</tr>
<tr>
<td>Target audience</td>
</tr>
<tr>
<td>Topics</td>
</tr>
<tr>
<td>Key elements</td>
</tr>
<tr>
<td>Language</td>
</tr>
<tr>
<td>Certification</td>
</tr>
<tr>
<td>Certification possible (paid option)</td>
</tr>
<tr>
<td>Rationale for selection</td>
</tr>
<tr>
<td>URL</td>
</tr>
</tbody>
</table>

Source: EDX (2020)

3.1.4 Frequency and duration

Frequency and duration of online trainings vary from course to course: While some might last around 3 hours, others might take months to finish. Normally, the average course duration and frequency are indicated in the course description, but duration may vary based on the individual.

When it comes to frequency, most of the courses are self-paced. This is in particular the case with MOOCs. While they might have certain deadlines for the assignments to be completed (e.g., weekly or bi-weekly), the learners usually decide themselves whether they prefer to digest the information in small bits (such as one short video at a time) or whether they prefer to do all the weekly exercises at once. However, a pre-defined frequency is more common for paid online trainings which are offered by private providers – for example, when a training is offered as an online service via a series of webinars or online seminars.

The duration of the provided trainings also differs to a great extent. It depends on the course topics, level of detail, amount of additional practice exercises, quizzes, etc. It is hard to estimate the average course duration of online trainings on emerging technologies, but typically courses analysed in this research seem to last around 4 weeks and require between 2 and 5 hours per week.

Finally, duration depends on the individual: different people have different learning habits and apply varying learning methods and have different capacities. Thus, the same task might require a different time to be completed.

### 3.1.5 Key elements of the online trainings

The sample that has been considered in this research shows that a variety of elements are combined in different online training courses, which seems to depend on the provider’s choice, technical capacities, and suitability to achieve the required learning outcomes.

Most of the online trainings (both MOOCs found on the main platforms as well as those offered elsewhere) include either videos of the main presenter/teacher introducing the topic or guided presentations including a voice-over. Providing additional reading materials is also a common practice found in most of the online courses: these might be compulsory or optional selected articles, blog posts, extracts from books or simply additional written summaries of the presenter’s materials.

Besides, a big part of the analysed courses also contains additional visuals such as explanatory images, infographics, tables, or graphs demonstrating certain trends and statistics, technical schemes or just illustrations, which make the content more visually appealing. The use of GIFs, short animations or even memes is also common. An example of a course integrating a variety of visual elements is presented in Table 7.

<table>
<thead>
<tr>
<th>Table 7: Practical training example number 4</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Practical training example: training course on robotics</strong></td>
</tr>
<tr>
<td><strong>Training course</strong></td>
</tr>
<tr>
<td><strong>Emerging technology</strong></td>
</tr>
<tr>
<td><strong>Provider</strong></td>
</tr>
<tr>
<td><strong>Target audience</strong></td>
</tr>
<tr>
<td><strong>Topics</strong></td>
</tr>
<tr>
<td><strong>Key elements</strong></td>
</tr>
<tr>
<td><strong>Language</strong></td>
</tr>
<tr>
<td><strong>Certification</strong></td>
</tr>
</tbody>
</table>
Rationale for selection

It is an enjoyable course for beginners, which addresses the topic from various angles, incl. ethical issues, and provides multiple examples on real-life applications throughout different industries.

URL
https://www.futurelearn.com/courses/robotic-future

Source: Future Learn online (2020)

Furthermore, opportunities for discussion and exchange are integrated in many of the courses. Most of the major MOOC platforms offer the possibility to ask questions and raise discussions in a special online forum. Oftentimes, additional tools are foreseen to stimulate further discussions. Such is the case in the practical example presented in Table 8. In some of the courses, a guided discussion is one of the compulsory parts of the course. In such case, the discussion questions are already provided, while learners are requested to provide their thoughts on the issues raised.

Table 8: Practical training example number 5

<table>
<thead>
<tr>
<th>Training course</th>
<th>Digital Skills: Artificial Intelligence</th>
</tr>
</thead>
<tbody>
<tr>
<td>Emerging technology</td>
<td>AI</td>
</tr>
<tr>
<td>Provider</td>
<td>Accenture</td>
</tr>
<tr>
<td>Target audience</td>
<td>SMEs and citizens</td>
</tr>
<tr>
<td>Topics</td>
<td>Introduction to AI, AI in Industry, Adapting skills to work with AI</td>
</tr>
<tr>
<td>Key elements</td>
<td>Videos, animation, visuals (pictures, graphs), reading materials, summaries &amp; key concepts additionally summarised, active discussion/comment area, audio recordings</td>
</tr>
<tr>
<td>Language</td>
<td>English</td>
</tr>
<tr>
<td>Assessment and certification</td>
<td>Quizzes and tests are used for the assessment; certification is possible upon completion of the course and positive evaluation in the tests.</td>
</tr>
<tr>
<td>Rationale for selection</td>
<td>It is a very engaging and user-friendly course on the basics of AI. Supported by numerous of practical examples (including individuals’ experience), the course is easy to relate to. In addition, active discussions and polls allow users to share their thoughts and further engage with the subject.</td>
</tr>
<tr>
<td>URL</td>
<td><a href="https://www.futurelearn.com/courses/artificial-intelligence">https://www.futurelearn.com/courses/artificial-intelligence</a></td>
</tr>
</tbody>
</table>

Source: Future Learn online (2020)

Guest interviews, testimonials, and practical examples of the use of technologies are other elements commonly found in online training courses. In most cases, they are shown as videos, e.g. a video interview of a particular speaker, or a video of a speaker presenting a certain technology. However, in some cases, testimonials and interviews are also presented in a written and illustrated text, included as presentations, etc.

In addition, some courses offer small quizzes as a part of the learning process (not the assessment). For example, they might be offered at the end of each module to allow learners to evaluate their progress and stress the main takeaways. In some examples, quick questions are even posed during the video itself. Once the important information has been conveyed, the video pauses and the learner has to answer the question in order to continue.
Occasionally, other creative elements were encountered throughout the analysis. For example, a small number of courses include games (for instance, ‘Introduction to the Internet of Things’ (IoT) offered by the Curtin University, presented in Table 9 or ‘Science For You’ on the AI Decision trees), downloadable tools and takeaways (for instance key notes, infographics) and links to the external sources for additional information (videos, podcasts, guidebooks, etc.).

### Table 9: Practical training example number 6

<table>
<thead>
<tr>
<th>Training course</th>
<th>Introduction to the Internet of Things (IoT)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Emerging technology</td>
<td>IoT</td>
</tr>
<tr>
<td>Provider</td>
<td>Curtin University</td>
</tr>
<tr>
<td>Target audience</td>
<td>Citizens, SMEs</td>
</tr>
<tr>
<td>Topics</td>
<td>Concept of IoT, cybersecurity and privacy issues, how IoT can optimize processes and improve efficiencies in businesses.</td>
</tr>
<tr>
<td>Key elements</td>
<td>Readings, videos, animated videos, quizzes, games, visuals (infographics, pictures, etc.)</td>
</tr>
<tr>
<td>Language</td>
<td>English</td>
</tr>
<tr>
<td>Certification</td>
<td>Certification possible (paid option)</td>
</tr>
<tr>
<td>Rationale for selection</td>
<td>Rich case studies, analysing IoT applications in diverse industries, as well various games (e.g. canvanizer, blockly-games) allow to dive into subject and learn the presented concepts with a real hands-on feeling.</td>
</tr>
</tbody>
</table>

*Source: EDX (2020)*

### 3.1.6 Costs

Price is an important factor which allows citizens and SMEs to choose their online training courses. Nevertheless, it is hard to estimate the average prices as there is a vast variety of pricing policies among the different providers.

In general, the biggest MOOC platforms allow to audit (‘attend’) their MOOCs for free, however, quizzes or certificates require additional payment. Such payments might be in the form of one-time transactions to attend the chosen course but might also come as a ‘premium’ membership fee in some of the platforms.

Furthermore, as regards MOOCs offered outside the main platforms, the price mostly depends on the provider. The public or non-profit sector, as well as consortia of various EU-funded projects, often offer their online courses for free. On the other hand, private companies might charge from a few euros per course to a few thousand euros (e.g. some MTI or Stanford courses).

Finally, courses for citizens are more likely to be free of charge, compared to those targeting small businesses.

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3.1.7 Languages

An absolute majority of MOOCs is provided in English. On the other hand, online courses which are offered by private providers and are fee-based, such as specific series of online seminars or webinars, are often customised towards the client, also adapting the language. In many instances, such courses are offered to a local market, where the language of that country/market prevails. Such courses normally target SMEs, not the individual citizens.

Besides English, some MOOCs are also available in Spanish (the most common among other European languages) and French, but only a few courses in other languages can be found. Table 10 below shows the variety of languages found by analysing MOOCs through the Class Central portal.

![Table 10: Overview of languages](image)

Finally, online courses targeting citizens available via alternatives to the biggest MOOC platforms are more likely to be provided in local languages. However, as it was previously mentioned, not many trainings on emerging technologies exist online (outside the main MOOC platforms). Therefore, there are only a few examples of such courses in other European languages, such as a course on AI in Lithuanian ‘Dirbtinis intelekta’ or a blockchain course in Italian ‘Blockchain: dai concetti base alle applicazioni di business’.

The apparent dominance of English in the offer of the online courses might discourage some learners, especially citizens who are not confident in their English skills or who simply do not speak it.

3.1.8 Assessment and certification

Certification is one of the ways to motivate learners to complete a given course. Also, it is often required by employers (if they pay for the course) and much desired by most learners.

The research showed that all the analysed MOOC platforms offer the possibility to get certified. The certificate itself depends on the institution which provides the course (there are different types of certificates/badges, etc.). The institution also decides the requirements to obtain a certificate (such as successful quizzes, active discussion participation, other assignments). However, among the biggest MOOC providers, most of the certificates are fee-based. That is, the learner needs to pay for the attendance of the course and will receive a diploma/certificate upon successful completion of the course.

Providers outside of the biggest platforms also tend to issue some type of proof of successful completion of the course (such as a certificate). Yet, the impact and prominence of these certificates highly depends on the

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provider – for instance, if the provider is a known local association or chamber of commerce, the certificate may be very valuable for local users.

The requirements that need to be fulfilled to obtain the certificate vary among the different providers. In a few instances, it is possible to get a certificate upon successful completion of the course. However, the majority of the online trainings offers quizzes which the learner needs to pass in order to obtain the certificate. Very often, there are multiple smaller quizzes to be passed (~10-20 min after completion of some part of the training), but sometimes only one final quiz needs to be completed.

Moreover, some of the courses (notably, the MOOCs found within the main platforms) require the completion of bigger written assignments, such as open questions, short essays/discussions on the given topics, etc. These assignments are then reviewed and evaluated by the peers. Each learner also has to review other students to complete the training.

3.2 Conclusion

To conclude, the mapping of online training initiatives demonstrates that, although numerous online courses focusing on training in ICT are available (both MOOCs in the most popular platforms, but also various other initiatives), many of them concentrate on advanced topics for ICT professionals. Those trainings often target developers in need to learn advanced aspects of data analysis, or additional programming languages, etc. At the same time, there are only a few courses on emerging technologies offered via those platforms (with the exception of artificial intelligence).

When it comes to trainings on emerging technologies, they tend to be rather complex and not tailored to citizens and SMEs. Instead, they seem to either promote certain solutions by commercial tech providers or aim to train ICT professionals.

There is also a limited variety in terms of available languages, as the absolute majority of the online courses are provided in English. Therefore, the reach of these courses, especially towards citizens in rural areas or areas with low English proficiency, might be limited. When it comes to course delivery, most of the trainings are self-paced and therefore allow learners to access them at any time. Courses are also accessible when it comes to the pricing – many courses can be attended free of charge or for relatively low prices (through different pricing models). In addition, many courses offer the possibility to obtain certificates and assessments in exchange for a fee.

Finally, the courses rely on a variety of different learning elements, ranging from visuals, such as tables and infographics, to gamification. This results in rather attractive course solutions, which support the learning process. On the other hand, many courses are still limited to classroom-type filmed lessons. Thus, the learners need to invest time and efforts to identify the most attractive and relevant online learning offers.
Chapter 4: Gap analysis & Lessons learnt

This chapter will conclude the report by presenting the final analysis of gaps between the supply side and the demand side. The findings of the gap analysis have been consulted with the expert stakeholder community in an online consultation. Further, the results of the gap analysis will allow to draw lessons-learnt for the content and design of online training courses for SMEs and citizens.

4.1 Gap analysis

The gap analysis compares the main findings of Chapter 2 (demand side) with the findings of Chapter 3 (supply side of skills training). The purpose of the gap analysis is to summarise these main findings and to identify gaps between the state of play in terms of available training offers and the demand (as defined by scenario development and expert interview results). For a better overview, the results have been structured in two parts.

Part 1 discusses gaps around the skills needs and the focus of online learning, i.e. what technology areas are tackled, what target groups are addressed, as well as levels of difficulty.

Part 2, on the other hand, focuses on aspects related to the course delivery and design, i.e. frequency and duration of online training, key elements, incentives to take courses, etc.

The gap analysis table has been organised along the structure of the demand and supply side analysis: i.e. focusing on different elements such as: technology and training focus, target group, difficulty level as well as frequency and duration, key elements of online training, costs, languages, assessment and certification, learning platform. It sums up the main points discussed in this report and helps to define lessons-learnt and a way forward for the design of the Digital SkillUP online learning modules.

Table 11: Gap Analysis

Part 1: Focus of online learning (technology area and target group)

<table>
<thead>
<tr>
<th>Topic</th>
<th>Supply side: State of play in terms of available training offer</th>
<th>Demand side: Desired future defined by scenario development and expert interview results</th>
<th>Gaps between supply and demand side</th>
</tr>
</thead>
</table>
| Technology focus of courses (e.g. AI; Blockchain; Robotics; Cybersecurity; Big Data; IoT) | • A high number of courses are available on Artificial Intelligence and Machine Learning. These courses prove to be the most popular as well.  
  • In addition, courses on cybersecurity are also frequently encountered, while the choice of courses | • Experts advocated for a focus on AI, big data/data ecosystems, and cybersecurity  
  • At the same time, digital skills cannot be defined as only a very narrow set of technical skills (AI, Blockchain, etc.). If practitioners do not have basic ICT skills, they will be unable to adapt during their professional life. | • A need was identified to focus notably on AI, data-related issues, and cybersecurity.  
  • At the same time, these advanced skills in emerging technology require a basic understanding of technology and basic ICT skills. |
Basic digital skills and advanced ICT training for citizens

- In popular MOOC websites, there is a focus on programming when it comes to ICT skills.
- More general and basic ICT courses provided e.g. by EU funded initiatives, civil society organisations or other platforms, focus on broader ICT related or digital skills topics.
- The focus of ICT related training differs according to the target audience, i.e. citizens or SMEs.
- In case of the former, basic digital literacy, usage of popular software, access to the online services, communication tools and online security and privacy basics are the most common.
- There is a need to increase the understanding of the impacts of emerging technologies on society and everyday life and to increase awareness of cyber risks and issues related to disinformation, such as fake news.
- Experts pointed to a general need to increase the basic understanding of IT and basic digital skills including digital literacy. This knowledge may extend to teaching the basics of how IT works: networks, software, IT infrastructure, IT governance, cybersecurity and data related aspects, algorithms etc.
- The need for basic awareness of cybersecurity risks, data protection and privacy risks was brought up also in the context of the current Covid-19 health crisis and the need to increasingly work online. Data protection and privacy and an understanding of technology in general were also mentioned by the experts. In this context a need was identified to focus on the safe usage of latest technologies and requires knowledge of data protection and privacy rights also in a work context.
- Experts pointed to a need for an understanding of the concept of “digital sovereignty”, which includes knowledge on internet governance, data ownership, critical infrastructures.
- There is a lack of training in digital tools, e.g. social media, how to use a PC, etc. and how to use future technologies effectively and safely (e.g. e-health, etc.).
- Experts pointed to a need to explain the basics of IT and teach basic digital skills, including digital literacy and data protection/privacy aspects.
- In the context of the current Covid-19 health crisis, a need was identified to allow user to safely work online (e.g. raise awareness of cybersecurity, privacy and data protection risks online) and to handle basic online tools for remote working.
- Thus, a focus of online training modules developed in the scope of this project could be put on enhancing general awareness and providing a general understanding of technology, rather than providing technical training as this is covered by MOOCs via available platforms as well as universities.
- Courses provided outside the big online training platforms focus on basic digital literacy, usage of popular software, access to online services, communication tools and online security and privacy basics.
- This may point to a need that has been identified by alternative providers in these areas.

Focus SMEs

- When it comes to SMEs, basic work-related software knowledge, online marketing tools, e-
- For SMEs, experts pointed to the need to combine the understanding of what a company is doing, i.e. the core
- When it comes to SMEs, basic work-related software knowledge, online marketing tools, e-
commerce solutions and basics of online security and privacy are the most recurrent topics.

- Different roles need to be addressed with tailored skills training: Decision-makers/management; Project managers; Product development; Business development; Different roles in different sectors, e.g. in tourism sector; Sales Managers, etc.; Engineers in manufacturing sector, etc.; ICT staff or technical staff, practitioners; HR department staff and roles; Marketing staff.

- The different roles require different skills sets and levels of awareness about digital and emerging technologies. For instance, marketing staff may need awareness and technical skills on how to use data to run marketing campaigns, how to employ digital solutions for customer engagement. Other roles may require technical skills to implement technologies, e.g. data analytic related skills, ability to combine insights about business processes and sector with technical knowledge, e.g. integrate IoT or sensors to collect data, etc.

- However, there seems to be a gap when it comes to making these courses widely available and applicable to different situations, roles in SMEs and sectors.

- For SMEs, there should be more specific targeted training that takes into account their specific training needs of different job roles & profiles, structured along sectors and digital maturity levels of the companies.

### Target on focus group

<table>
<thead>
<tr>
<th>Traditional MOOCs mostly provide advanced courses for ICT professionals, while those that specifically mention small businesses and start-ups are normally meant to promote specific products, platforms, etc.</th>
</tr>
</thead>
<tbody>
<tr>
<td>However, other trainings outside the main MOOC platforms are often designed for distinct groups of citizens, classified by: different age groups (children, youth, seniors), occupational status (students, unemployed, NEET, working population), sex</td>
</tr>
<tr>
<td>Experts in the majority recommended to focus on introductory courses for a wider public, building on real-life applications and scenarios, and to tailor courses to different roles in companies (e.g. managers, IT staff, employees, etc.) and to different groups of citizens.</td>
</tr>
<tr>
<td>Experts recommend focussing on real-life cases and to target courses to different groups in society and different job profiles.</td>
</tr>
<tr>
<td>MOOCs do not necessarily provide training tailored to SMEs.</td>
</tr>
</tbody>
</table>

- Traditional MOOC platforms seem to target ICT professionals and digitally advanced professionals.

- Experts indicated the need to target different societal groups with tailored and introductory real-life related courses.

- There is a need to define target groups within SMEs and citizens and to tailor training to SMEs and sectors.

- To reach the particular target groups, courses should focus on referring to real-life problems &
(courses targeting women), etc.

- E.g. citizens could be split up in split according to their basic understanding of tech (e.g. people with digital education, e.g. via ICT studies, etc., medium tech, which are applied users of technology, and non-technical people, without prior exposure and understanding.
- E.g. SMEs can be split up tech, applied usage and non-tech and in groups with staff that includes no IT staff, IT staff, large IT department

**Difficulty**

- In the MOOC platforms, **advanced courses for the ICT professionals prevail**, these courses require strong pre-existing knowledge on the topics.
- Other training initiatives mostly offer very generic courses on digital literacy and do not cover emerging technologies, or provide very advanced content for the ICT professionals.
- **Basic courses covering emerging technologies are not as widely available.**
- Most experts voted for **introductory or intermediate courses**.
- They also explained the need to use **simple language and explain technology in real-life examples**.
- Experts mentioned that MOOC training is mostly in English and targeted at advanced levels of technology understanding.
- **Advanced courses prevail, while experts indicate a need for more introductory or intermediate courses in simple language, which employ practical and real-life examples to allow non-technical users to attend and complete the course.**
- There seems to be a **gap when it comes to explaining emerging technologies in a simple and accessible way, aiming at the introductory or intermediary level**.

The first part of the gap analysis has compared the technology and training demand to the available training offer and identified major gaps, which relate to a remaining need for training on basic digital skills, which is still not available to many socially or digitally excluded groups of society. In addition, there is a need to raise awareness about the impact of emerging technologies and their applications in daily lives of citizens and employees in SMEs. For SMEs, there should be more specific targeted training that takes into account their specific job roles and profiles, structured along sectors and digital maturity levels of the companies. The gap analysis also points to a need to target different societal groups with tailored and introductory courses using real-life examples.
**Part 2: Course delivery and design**

<table>
<thead>
<tr>
<th>Topic</th>
<th>Supply side: State of play in terms of available training offer</th>
<th>Demand side: Desired future defined by scenario development and expert interview results</th>
<th>Gaps between supply and demand side</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Frequency and duration</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>• <strong>Self-paced</strong> training courses prevail, but they might have set deadlines to structure the learning process and motivate learners to finish.</td>
<td>• Experts in the majority expressed a preference for <strong>self-paced courses</strong>.</td>
<td>• A comparison of the available frequencies and durations of courses and the preferences indicated by the experts pointed to many similarities: <strong>self-paced and rather short content is favoured</strong>, while learners should be engaged <strong>on a regular basis</strong> (at least once per week).</td>
</tr>
<tr>
<td></td>
<td>• Meanwhile, duration of the trainings greatly differs, although most of the trainings last <strong>no longer than 4-6 weeks</strong> and require <strong>between 2 and 5 hours of work per week</strong>.</td>
<td>• Experts <strong>overall favoured courses that would be rather short</strong> (max. 45 minutes) and where learners would be engaged <strong>at least once or more than once per week</strong>.</td>
<td></td>
</tr>
<tr>
<td><strong>Key elements of the online trainings</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Most of the online trainings are delivered in a <strong>format of videos with the main presenter/teacher</strong> introducing the topic or as guided presentations with a voice-over.</td>
<td>• According to the expert interviews, the elements to be included should be <strong>short video tutorials, quizzes, testimonials and other interactive elements</strong> that fit the specific course.</td>
<td>• A comparison of the available online trainings and the desired elements identified by the experts indicates that these recommended elements are <strong>widely used</strong>. At the same time, there may be a need to adapt those elements to the specific course content.</td>
</tr>
<tr>
<td></td>
<td>• Other common elements are similar to the ones used in offline learning: <strong>simple reading materials and supporting visuals</strong> (e.g., schemes or infographics). ** Provision of online discussion spaces** (forums, community chats, etc.) is also frequent, which might also be used to imitate the real learning process with the community of learners and teachers.</td>
<td>• The use of <strong>collaborative learning tools</strong>, <strong>self-learning, problem or challenge-based learning</strong> was seen as important as well as the role of communities, <strong>peer groups</strong> to increase informal learning and accountability.</td>
<td>• <strong>Collaborative learning tools, self-learning, problem or challenge-based learning as well as the role of communities, peer groups</strong> was seen as important and perhaps lacking in some online training formats.</td>
</tr>
<tr>
<td></td>
<td>• Other elements found in the online training initiatives include (rather rarely, though): <strong>guest interviews, testimonials and practical examples, quizzes and exercises, short games</strong>, links to the external sources for additional information, etc.</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Costs</strong></td>
<td>• The biggest MOOC platforms usually allow to attend MOOCs for free but require <strong>paying in order to obtain the certificate</strong>.</td>
<td>• <strong>Costs were not necessarily considered the major factor</strong> that would be decisive for taking the course by the majority of experts.</td>
<td>• Some experts indicated that publicly funded courses should be available for free, while at the same time, the price may not be the decisive factor to take a course for many individuals (i.e. if they see benefits for professional development, etc.).</td>
</tr>
<tr>
<td></td>
<td>• Trainings offered outside the main platforms are often free, if offered by NGOs or public bodies, while the paid ones come in different pricing levels from a couple hundred to a few thousand Euros.</td>
<td>• Other elements, such as the <strong>content, incentives such as certificates, networking opportunities and personal and professional goals</strong> seemed to be more important than the price.</td>
<td></td>
</tr>
</tbody>
</table>
### Languages
- An absolute majority of the online trainings is provided in **English**, both MOOCs and other types of trainings.
- A few courses can be found in Spanish, French and German and Italian.
- Language was highlighted by some experts as a decisive factor to reach citizens and SMEs in certain geographic areas that do not necessarily speak good English.
- More importantly, it was stressed to use simple and understandable language.
- For some regions in the EU, there may be a need to provide courses in their native language to reach a broader group of society.
- There is a need for simple, accessible language to communicate the content.

### Assessment and certification
- MOOCs usually offer a **possibility to obtain a certificate** (very often it is a paid option). Other providers outside of the biggest MOOC platforms also tend to issue some proofs of successful completion (certificates, diplomas, badges). Certificates are normally received upon successful competition of all training modules and some tests (quizzes, writing assignments, peer reviews).
- It’s important to mention that MOOC providers (especially the most recognized ones) are evolving their business models to include professional programs, MicroDegrees, Nano Degrees and, even, in many case to provide full degrees (especially Masters).
- Certification and credits were in the majority seen as **important elements to incentivize learners** to take and to finish a course.
- A certification process – for instance, within the scope of competence self-assessment – was seen as necessary for individuals and for companies.
- Experts recommended to explore ways to allow for certification of modules and thus let learners follow modular learning paths.
- There may be a need to align online training with certification and credits in the framework of university or higher education as well as existing competence frameworks.
- There seems to be a need to support modular learning paths and/or a customised learning experience. Self-assessment tools can support this.

### Learning platform
- There is no large European-based platform that **focuses on training tailored to SMEs and targets a broad base of citizens** with introductory learning content.
- Experts were missing a platform that can **help people to select which courses** they should enroll in to achieve a specific set of competences, e.g. building on self-assessment tools, and a way of assessing the quality of a course to provide an overview of quality courses.
- A European platform for quality courses would be recommendable.

The second part of the gap analysis focused on the more practical course design aspects of the available online training offer. Here, self-paced learning appears as a dominant approach to online learning because of the flexibility it gives to learners. The gap analysis identifies further some key elements which could be explored in order to better tailor trainings to learners needs, such as availability in local languages, collaborative learning as well as the benefits of receiving certification for a course. To conclude, the gap analysis led to the identification of significant gaps between the available offer of online trainings on traditional online training platforms and the needs identified via the desk research and interviews. Conclusions based on these gaps will be drawn further below.
4.2: Lessons learnt from the gap analysis

The gap analysis provided insights on existing gaps between the training offer and the needs identified to inform future efforts in providing opportunities for citizens and SMEs to acquire skills in emerging technologies. The conclusions will be summarised below, first focusing on the general training needs, the course design, and closing with general conclusions about skills needs and the training landscape in Europe.

4.2.1 Lessons learnt for the training focus

There is a need to increase the understanding of the impact of emerging technologies on society and everyday life. Furthermore, experts stated the necessity to increase awareness of cyber risks (including data protection and privacy related risks) and issues related to disinformation, such as fake news.

For the specific technologies tackled in this report, a need was identified to focus notably on AI, data-related issues, and cybersecurity. At the same time, these advanced skills in emerging technologies require a basic understanding of technology and basic ICT skills, while courses on the main platforms do not seem to cover such basic topics to a wide extent. Nonetheless, some courses outside the big online training platforms focus on basic digital literacy, usage of popular software, access to online services, communication tools, online security and privacy basics. This may point to the fact that alternative providers have identified a need for more training in basic digital skills.

In the context of the COVID-19 health crisis, a need was identified to ensure further support and training to users in handling basic online tools for remote working and working safely online (e.g. raise awareness of cybersecurity, privacy and data protection risks online).

More efforts should be focused on designing courses explaining emerging technologies in a simple and accessible way, aiming at the introductory or intermediary level. Advanced courses prevail (e.g., existing MOOC platforms seem to target mostly ICT professionals with advance skills), while the gap analysis indicates a need for more introductory or intermediate courses delivered using less technical and friendly language. The latter should employ practical and real-life examples to allow learners with no technical background to attend and complete the course. There is a need to focus on real-life cases and to tailor courses to different groups in society.

There is a general need for a more systematic approach to addressing skills needs by tackling both basic digital skills and awareness and skills in emerging technology, as suggested in Figure 11. This approach would enable more people to support the uptake of emerging technologies in the EU as well as the management of a sustainable digital transformation, which supports the aim of digital sovereignty. More efforts should focus on enhancing general awareness and providing a general understanding of technology, rather than providing advanced technical training (which is often covered by other providers, e.g. via online training platforms or universities). This would be beneficial both for a large group of citizens, which could benefit from a basic understanding of technology for their daily lives and for SMEs. A greater awareness may have positive effects on businesses who would want to employ new technologies and transform their business models.

When it comes to SMEs, basic, work-related software knowledge, online marketing tools, e-commerce solutions and basics of online security and privacy are the most recurrent topics of online training in the alternative platforms/providers that were identified. However, there seems to be a gap when it comes to making these courses widely available and applicable to different job roles and profiles, structuring them along sectors and taking into account digital maturity levels of the companies.
4.2.2 Lessons learnt for the course design

A comparison of the available frequencies and durations of courses and the preferences indicated by the experts pointed to many similarities: self-paced and rather short content is favoured, while learners should be engaged on a regular basis (at least once per week). A comparison of the available online trainings and the desired elements identified by the experts indicates that these recommended elements are widely used. At the same time, there may be a need to adapt those elements to the specific course content. Collaborative learning tools, problem, or challenge-based learning as well as the role of communities, e.g. peer groups, was seen as important and perhaps lacking in some online training formats.

When it comes to individual motivation and incentives to upskill, there may be a need to explore certification models that allow the certification of modules and modular learning paths. Generally speaking, receiving an official certificate or credits for taking a course seems to be an important motivational factor. Thus, there is a need to set the right framework in terms of recognition of competences and upskilling programmes, and to align online training with competence frameworks to allow for such recognition. Some experts indicated that publicly funded courses should be available for free, while at the same time, cost may not be the decisive factor to take a course for many individuals (i.e. if they see benefits for professional development, etc.).
For some regions in the EU, there may be a need to provide courses in local languages to reach a broader group of society, as the majority of online platforms offer training mainly in English. A European platform for quality courses, which builds on the mentioned elements would be recommendable.

Figure 12: Skills trainings need to be tailored

Online innovations in education, such as massive open online courses (MOOCs), could “potentially be a way forward in helping to leverage the adult learning gap”. However, the results of the interviews with experts, conducted in the scope of this report, point to a more nuanced picture. While MOOCs and the variety of available topics are important, they do not necessarily provide the incentives for people to become engaged and motivated. Formats that orient themselves more on traditional forms of learning (e.g., by relying on fixed times for online classes and personal interactions with tutors and teachers) seem to be important to guarantee engagement and long-term motivation. This may also be related to the issue that not everyone has the digital skills needed to participate in a MOOC. This has been repeatedly brought up during the expert interviews and there is evidence that learners that consult online training and MOOCs are generally well educated and have already acquired a good level of digital competence.

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231 Ibid.
4.3 Conclusion

This stock-taking exercise and investigation of training needs and the training landscape has shown that a lot has already been done and is available, but there are some apparent gaps that still need to be closed. While the digital transformation will impact virtually all aspects of everyday life, citizens and the vast majority of SMEs do not seem to have the right skills to critically engage with technology and to make full use of the opportunities they offer. Courses offered in the framework of the Digital SkillUp portal can help to fill some of these identified gaps by explaining emerging technologies in simple and accessible language, and relating their impacts to real-life examples and use cases (applicable to different groups of society and different types of SMEs operating in different sectors).

Nonetheless, efforts need to go beyond this. Continuous upskilling and lifelong learning require a framework, which offers incentives to both individuals and organisations. For individuals to invest in upskilling, experts point to the need to obtain certification and to provide an overview in terms of quality. These aspects would allow individuals to access learning that best suits their needs, as well as to follow modular individual learning paths, while having their competences and knowledge recognised for their private or professional goals. At the same time, learners need better guidance in navigating among the variety of learning opportunities available online and in selecting a suitable training that is of high quality.

Finally, there is a need to foster an engaging learning environment, both among individuals and SMEs. Companies usually are embedded in business relationships and supply chains with other companies and partners. This wider ecosystem can be used to inform about opportunities related to emerging technologies, e.g. by exchanging best practices, but also by exchanging in an informal manner about available technologies that could improve business processes. For individuals, inspirational digital champions are already identified in the majority of Member States – but local success stories and learning paths should be promoted broadly to create a positive atmosphere for upskilling and learning related to digital and emerging technologies.
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