



Digital Economy and Society Index (DESI) 2021

Integration of digital technology

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1 Integration of digital technology

Digital technologies enable businesses to gain competitive advantage, improve their services and products and expand their markets. Digital transformation of businesses opens up new opportunities and boosts the development of new and trustworthy technologies. The EU's digital sovereignty will depend on the capacity to store, extract and process data while satisfying the requirement of trust, security and fundamental rights¹. This dimension measures the digitalisation of businesses and e-commerce.

Table 1 Integration of digital technology indicators in DESI

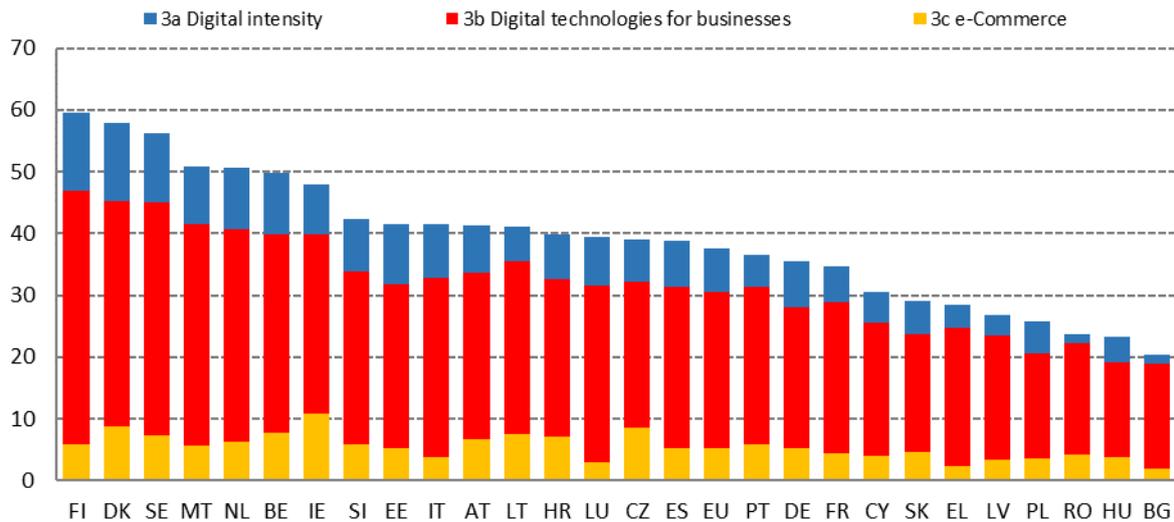
| | EU | |
|---|-------------|-------------|
| | DESI 2019 | DESI 2021 |
| 3a1 SMEs with at least a basic level of digital intensity % SMEs | NA | 60% 2020 |
| 3b1 Electronic information sharing % enterprises | 36% 2017 | 36% 2019 |
| 3b2 Social media % enterprises | 18% 2017 | 23% 2019 |
| 3b3 Big data % enterprises | 12% 2018 | 14% 2020 |
| 3b4 Cloud % enterprises | 16% 2018 | 26% 2020 |
| 3b5 AI % enterprises | NA | 25% 2020 |
| 3b6 ICT for environmental sustainability % enterprises having medium/high intensity of green action through ICT | NA | 66% 2021 |
| 3b7 e-Invoices % enterprises | 25% 2018 | 32% 2020 |
| 3c1 SMEs selling online % SMEs | 16% 2018 | 17% 2020 |
| 3c2 e-Commerce turnover % SME turnover | 10% 2018 | 12% 2020 |
| 3c3 Selling online cross-border % SMEs | 8% 2017 | 8% 2019 |

Source: DESI 2021, European Commission.

The top performers in the integration of digital technologies are Finland, Denmark and Sweden. Bulgaria, Hungary and Romania have the weakest performance.

¹ Strategic Foresight Report 2021, COM (2021)750 final.

Figure 1 Digital Economy and Society Index (DESI) 2021, Integration of digital technology



Source: DESI 2021, European Commission.

1.1 Digital intensity index

The Digital Intensity Index (DII) measures the use of different digital technologies at enterprise level. The DII score of an enterprise is based on counting how many out of 12 selected technologies are used. Figure 2 presents the composition of the DII in 2020. It also shows the degree of penetration and speed of adoption of the different technologies monitored by the DII. Large companies are more digitised than SMEs. While some aspects seem to be reaching saturation, at least for large companies, for most aspects there is still room for improvement.

According to the Digital Compass target, by 2030 more than 90% of SMEs should reach at least a basic level of digital intensity.

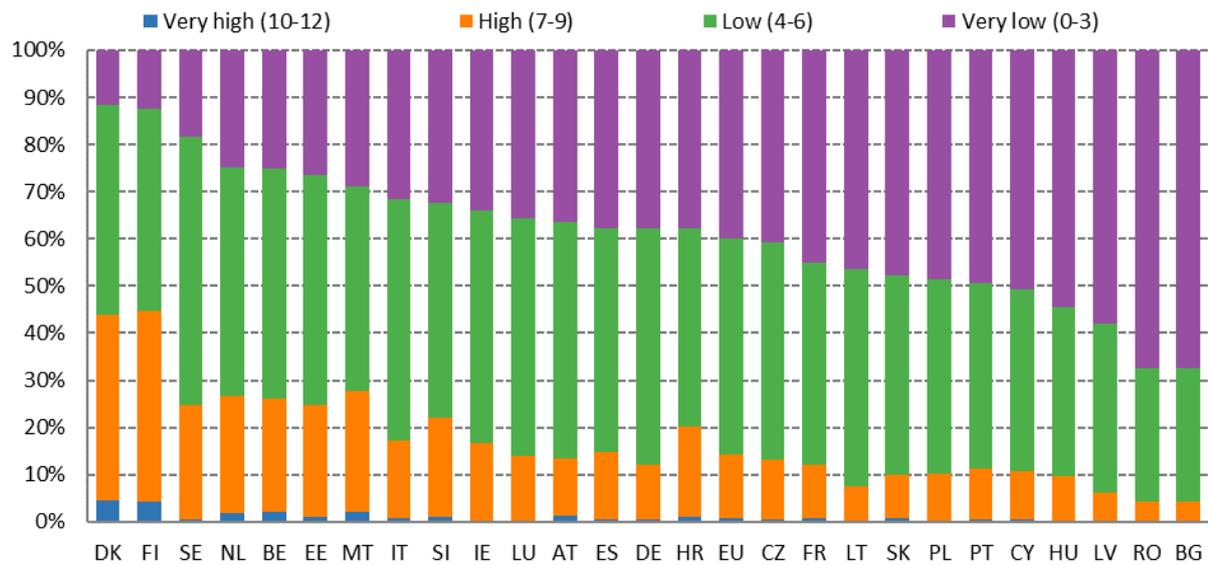
Figure 2 Digital Intensity Index indicators tracking digitisation processes (% enterprises), 2020

| | Large | SMEs |
|---|-------|------|
| Have a website | 94% | 76% |
| The maximum contracted download speed of the fastest fixed line internet connection is at least 30 Mb/s | 92% | 76% |
| Website has at least one of : description of goods or services, price lists; possibility for visitors to customise or design online goods or services; tracking or status of orders placed; personalised content in the website for regular/ recurrent visitors | 78% | 62% |
| Enterprises where more than 50% of the persons employed used computers with access to the internet for business purposes | 56% | 46% |
| Provide more than 20% of the employed persons with a portable device that allows internet connection via mobile telephone networks, for business purposes | 47% | 39% |
| eInvoices sent, suitable for automated processing | 53% | 32% |
| Buy medium-high CC services | 48% | 25% |
| Employ ICT specialists | 76% | 18% |
| Enterprises with e-commerce sales of at least 1% turnover | 39% | 17% |
| Analyse big data internally from any data source or externally | 34% | 14% |
| Use industrial or service robots | 28% | 6% |
| Use 3D printing | 17% | 5% |

Source: Eurostat, European Union survey on ICT usage and e-commerce in enterprises.

Denmark and Finland are the only countries in the EU where the percentage of enterprises with a very high DII (i.e. possessing at least 10 out of the 12 monitored digital technologies) is above 5%, followed by Belgium, Malta and the Netherlands with above 2%. By contrast, in countries such as Bulgaria, Romania, Latvia, Hungary and Cyprus the majority of businesses (over 50%) have made only a small investment in digital technologies (i.e. have a very low DII).

Figure 3 Digital Intensity Index by level (% of enterprises), 2020

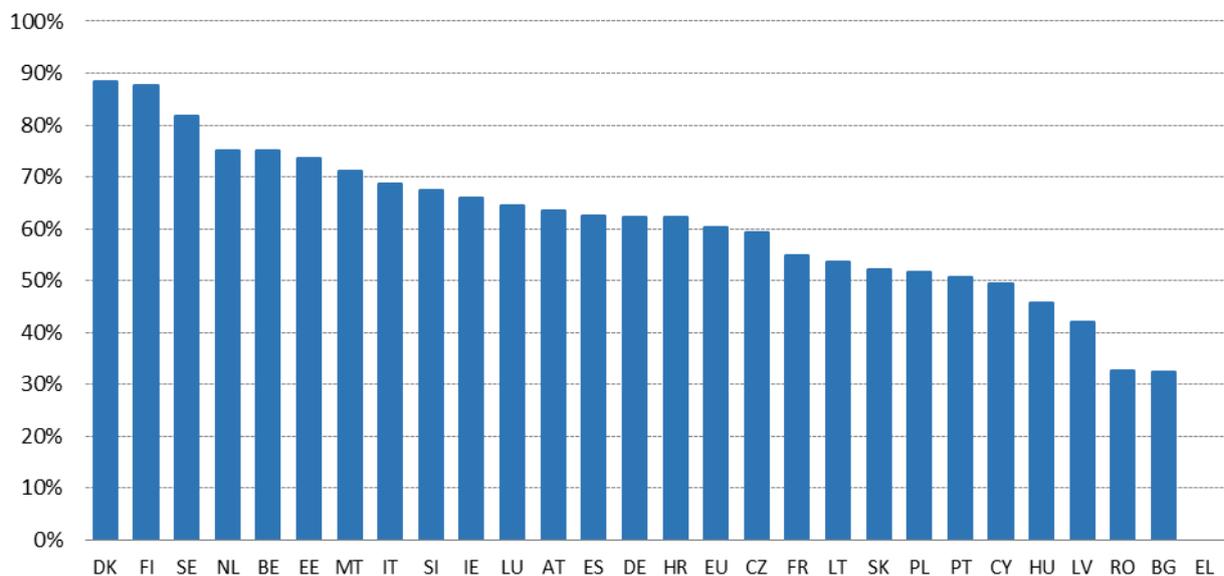


Source: Eurostat, European Union survey on ICT usage and e-commerce in enterprises.

* Data for Greece are available, but unreliable for high and very high DII.

Figure 4 depicts the percentage of SMEs with basic DII score. Basic DII level requires usage of at least four technologies and comprises SMEs with very high, high and low DII. More than 80% of enterprises in the Nordic countries (Denmark, Finland and Sweden) reached at least basic level of digital intensity, while in Romania and Bulgaria it is below 35%.

Figure 4 SMEs with at least basic level of digital intensity, 2020



Source: Eurostat, European Union survey on ICT usage and e-commerce in enterprises.

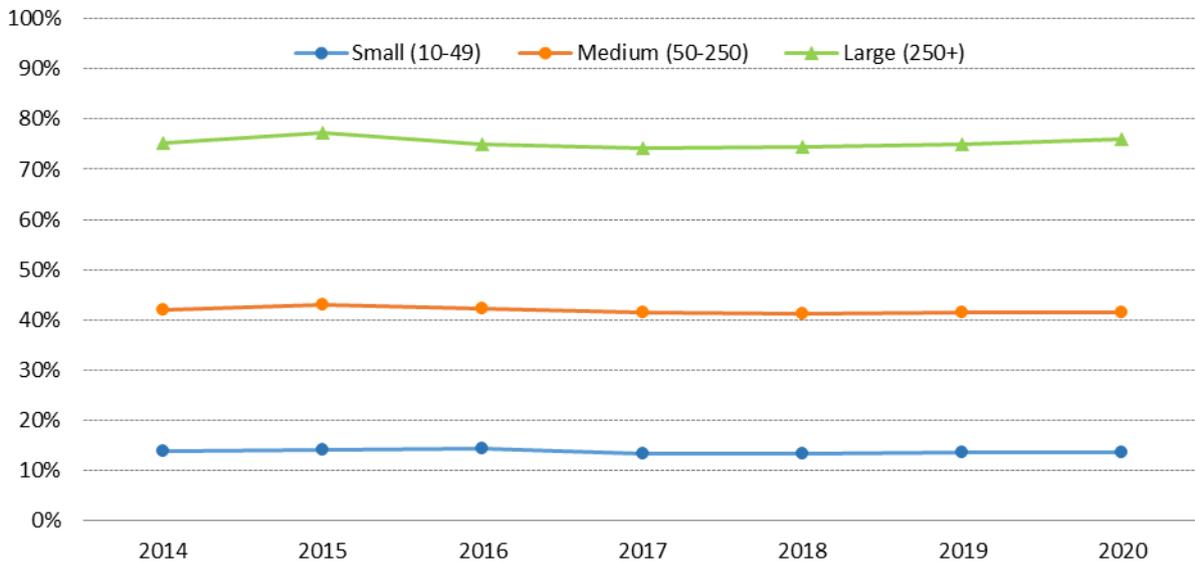
* Data for Greece is available, but unreliable.

1.2 ICT specialists in enterprises

Large enterprises have a scale advantage, and as a result 76% of them employ internal ICT specialists. The share of small enterprises in the EU employing ICT specialists has stayed roughly at the same level (14%) for the last 6 years and similarly for medium-sized ones at 42%. Not surprisingly, in the computer programming and consultancy sectors the share is above 80%, but it is also high in telecommunication (68%) and publishing activities (48%). On the other hand, in

accommodation and food services it is below 7% and in construction below 9%. More than 30% Belgian and Irish enterprises employ ICT specialists, while in Italy the share is below 13%.

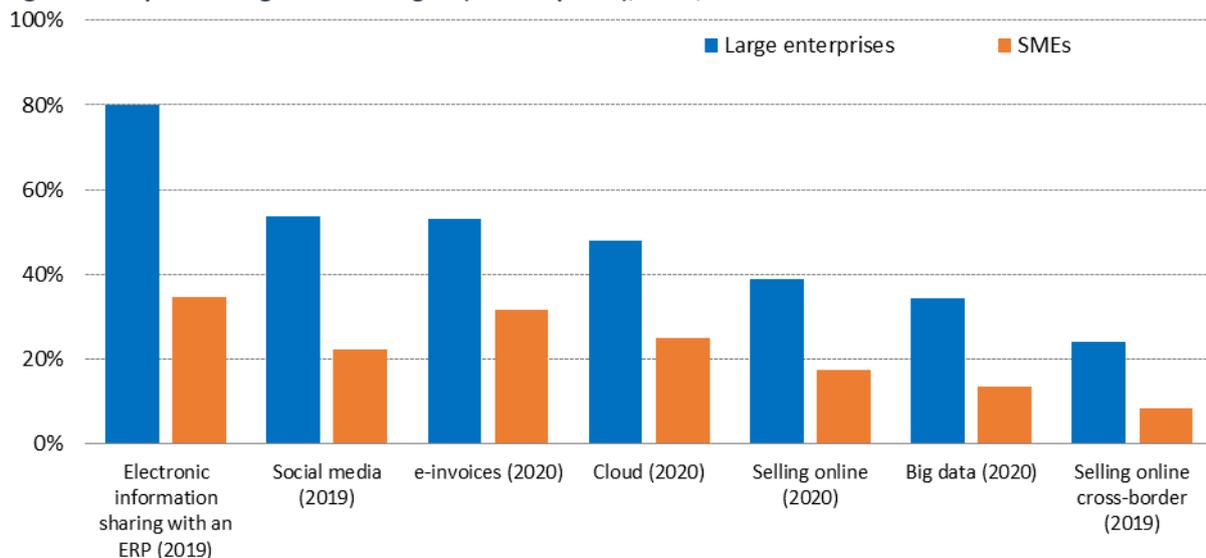
Figure 5 Enterprises employing ICT specialists (% of enterprises), 2014-2020



1.3 Adoption of digital technologies by enterprises

It is evident that large enterprises are more likely to adopt new technologies. For example, electronic information sharing through enterprise resource planning (ERP) software is much more common in large enterprises (80%) than in SMEs (35%). SMEs exploit e-commerce opportunities to a limited extent, as only 17% sell online (versus 39% of large enterprises) and only 8% sell cross-border online (24% for large enterprises). There are many other technological opportunities yet to be exploited by SMEs such as cloud services and big data.

Figure 6 Adoption of digital technologies (% enterprises), 2019, 2020²



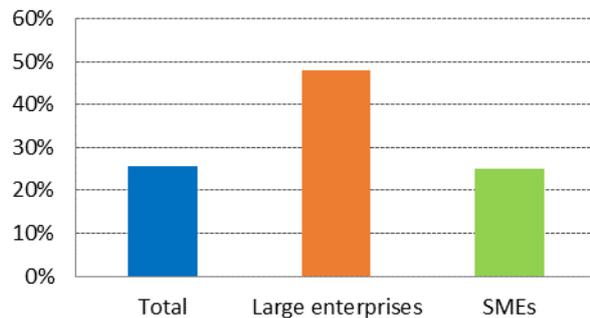
Source: Eurostat, European Union survey on ICT usage and e-commerce in enterprises.

² These are the DESI 2021 indicators under the sub-dimension 3b Digital technologies for businesses. For exact definitions, please see the DESI methodological note.

1.4 Cloud computing

The Digital Compass target requires that more than 75% of EU companies adopt cloud computing by 2030. In 2020, 26% of EU enterprises purchased cloud computing services of medium-high sophistication (i.e. hosting of the enterprise's database, accounting software applications, CRM software and computing power) and incorporated cloud technologies to improve their operations while reducing costs; this was an increase of 15 percentage points since 2014. The cloud uptake of large companies (48%) was higher than for SMEs (25%) in 2020. Cloud adoption is the highest in the computer programming and consultancy (65%) sectors, while in construction, retail trade, transport and storage as well as accommodation and food services the share is about 20%.

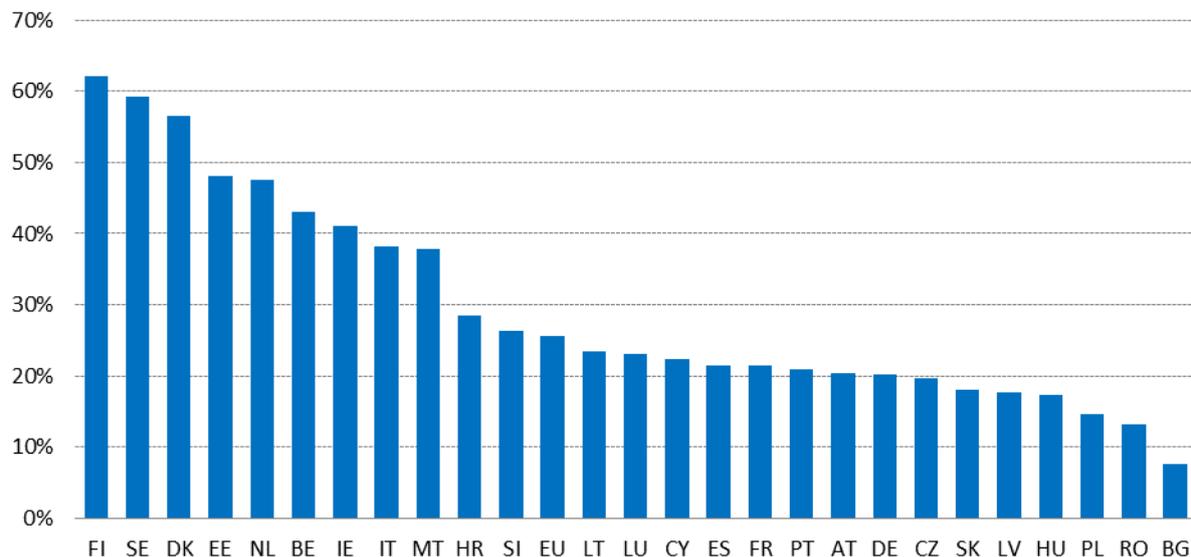
Figure 7 Cloud computing services of medium-high sophistication (% of enterprises), 2020



Source: Eurostat, European Union survey on ICT usage and e-commerce in enterprises.

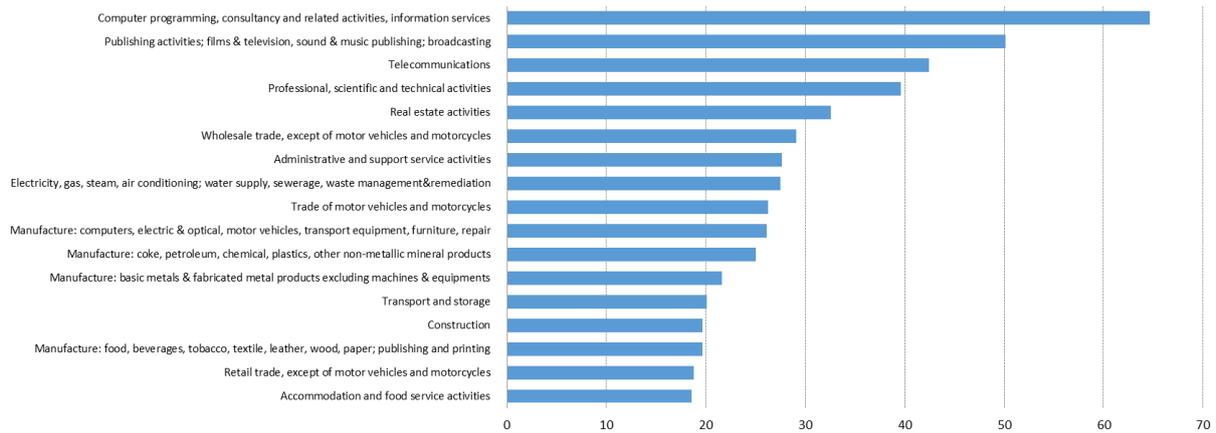
Nordic enterprises are leaders in incorporating cloud services of medium-high sophistication. More than 60% of Finnish enterprises buy such services, an increase of almost 30 percentage points between 2014 and 2020. Sweden and Denmark follow at more than 55%. However, the gap between top and low performers remains large, with Bulgaria scoring below 10%.

Figure 8 Cloud computing services of medium-high sophistication per country (% of enterprises), 2020



Source: Eurostat, European Union survey on ICT usage and e-commerce in enterprises.

When looking at the performance in cloud usage based on sectors, 65% of enterprises in the computer programming sector use cloud computing services of medium-high sophistication, followed by the publishing activities sector with 50% and the telecommunications sector with 42%. The sectors with the least cloud usage of about 19-20% of enterprises are the transport and storage, construction, manufacturing (food, beverages, tobacco, textile, leather, wood, paper; publishing and printing), retail trade (except of motor vehicles and motorcycles), accommodation and food service activities sectors.

Figure 9 Cloud computing services of medium-high sophistication per sector (% of enterprises), 2020

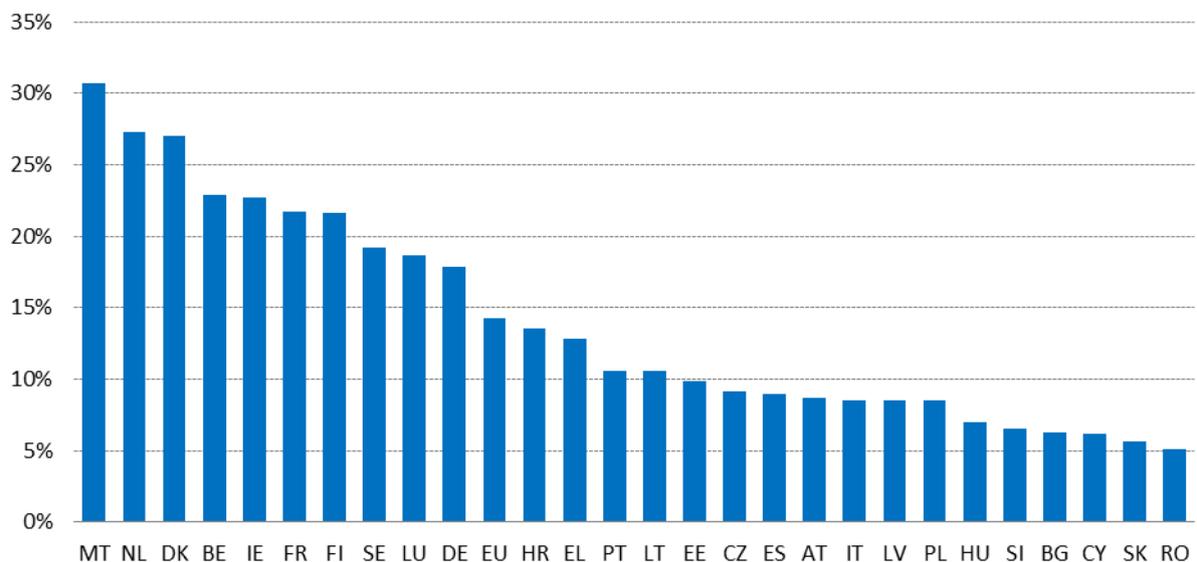
Source: Eurostat, European Union survey on ICT usage and e-commerce in enterprises.

1.5 Big data

The Digital Compass target requires that more than 75% of EU companies adopt Big Data technology by 2030.

Enterprises all over the EU are constantly adapting to new technologies for collecting, storing and analysing data. In 2020, 14% of companies carried out big data analysis. This helped them to produce near time or real time results from data that come in different format types. Large companies have the lion's share in big data processing (with 34% of them using big data), while SMEs have still room for improvement to take advantage of all the benefits of big data (14% use big data).

In Malta, almost a third of enterprises analyse big data. The Netherlands and Denmark follow closely, with 27%. On the other hand, only 5-6% of enterprises in Romania, Slovakia, Cyprus and Bulgaria analyse big data.

Figure 10 Enterprises analysing big data (% of enterprises), 2020

Source: Eurostat, European Union survey on ICT usage and e-commerce in enterprises.

When looking at a sectorial breakdown, enterprises are more likely to analyse big data in the travel agency³ and publishing activities⁴ sectors (both at 28%), followed by the computer programming⁵

³ Travel agency; tour operator reservation service and related activities

and the information and communication sector (both at 27%). Only 14% of enterprises carry out big data analysis in the retail trade⁶ sector, 13% in the construction, 12% in the accommodation and food and beverage service activities and 10% in the manufacturing sector.

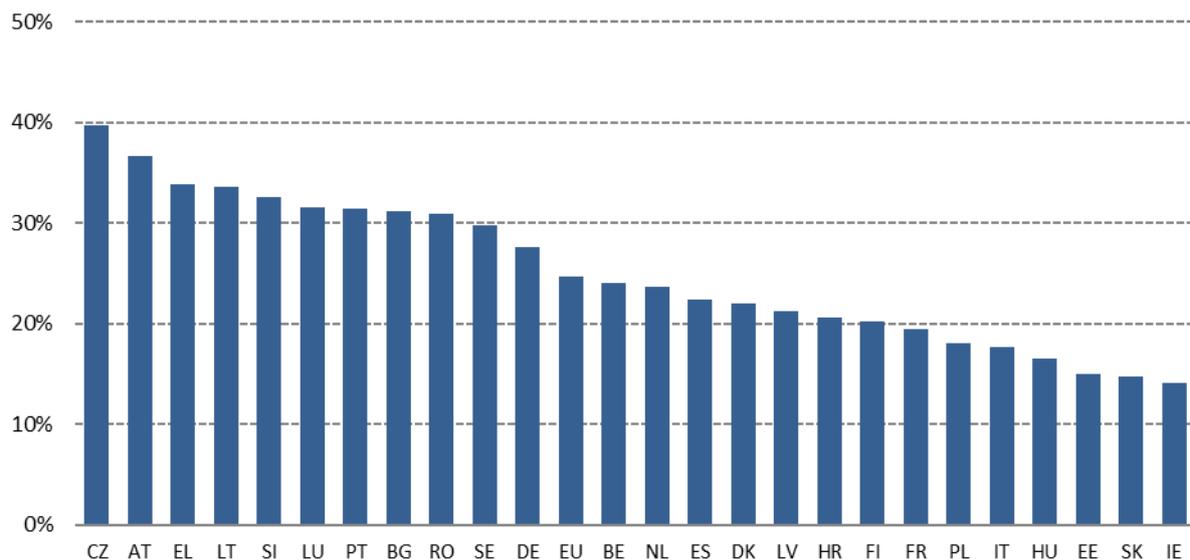
1.6 Artificial intelligence (AI)

Regarding the uptake of AI technologies in the European Union, enterprises can be grouped in three groups: the 'adopters' (42%) who are currently using at least one AI technology, the 'non-adopters' (40%) who do not currently use AI nor intend to use any of the AI technologies (at least in the following two years) and those enterprises, who have plans to adopt AI in the next two years, however they are currently not using AI solutions (18%).

When looking at the intensity of adoption, a quarter (25%) of enterprises use at least two AI technologies. Focusing on enterprises using two or more AI technologies, the following country-level differences can be observed: The adoption of two or more AI technologies is highest in Czechia (40%), followed by Austria (37%), Greece and Lithuania (both at 34%). The uptake of two or more AI technologies is the lowest in Ireland (14%), Slovakia and Estonia (both at 15%).

The Digital Compass target⁷ requires that more than 75% of EU companies adopt AI technology by 2030.

Figure 11 Enterprises using at least two AI technologies (% of enterprises), 2020



Data for Cyprus and Malta are not available.

Source: Ipsos, European enterprise survey on the use of technologies based on artificial intelligence, 2020.

Regarding the overview by sectors, adoption of at least one AI technology is highest in the ICT sector (63%), followed by education (49%), human health, social work, and manufacturing (all 47%). The sectors that have the lowest AI adoption are waste management (31%), construction, transport and food (all 36%).

⁴ Publishing activities; motion picture, video & television programme production, sound recording & music publishing; programming & broadcasting

⁵ Computer programming, consultancy and related activities, information service activities

⁶ Retail trade, except of motor vehicles and motorcycles

⁷ This indicator is based on the share of enterprises using at least two AI technologies.

When looking at adoption of at least two AI technologies, the ICT sector is leading again (43%), followed by human health (29%) and water and electricity supply (28%), whereas the sector with the lowest uptake is oil and gas (19%).

Regarding the plans to use AI technologies in the next two years, the most likely are enterprises in the finance and insurance sector (27%), waste management (27%) and education (21%). The least likely to have plans to use AI in the near future are enterprises in the oil and gas sector (6%), social work (10%) and recreation activities (11%).

Figure 12 Levels of adoption of AI by sector (% of enterprises)

| Sector (Part I) | At least one AI technology | At least two AI technologies | Plans to use | Sector (Part II) | At least one AI technology | At least two AI technologies | Plans to use |
|--------------------------------------|----------------------------|------------------------------|--------------|---|----------------------------|------------------------------|--------------|
| Agriculture, forestry and/or fishing | 39% | 24% | 18% | Accommodation | 42% | 22% | 15% |
| Manufacturing | 47% | 27% | 16% | Recreation activities | 37% | 24% | 11% |
| Construction | 36% | 23% | 16% | IT | 63% | 43% | 12% |
| Oil and gas | 38% | 19% | 6% | Finance, insurance | 40% | 20% | 27% |
| Waste management | 31% | 21% | 27% | Real estate | 42% | 23% | 18% |
| Water and electricity supply | 45% | 28% | 17% | Other technical and/or scientific sectors | 43% | 22% | 18% |
| Trade, retail | 38% | 22% | 20% | Education | 49% | 21% | 21% |
| Transport | 36% | 22% | 20% | Human health | 47% | 29% | 19% |
| Food | 36% | 26% | 20% | Social work | 47% | 26% | 10% |

Base question Q1: What is the current state of adoption in your firm for [AI technologies]?; Base: EU27, N=8661. (Base size represents only EU27 Member States, excluding the UK, Iceland and Norway).

Source: Ipsos, European enterprise survey on the use of technologies based on artificial intelligence, 2020.

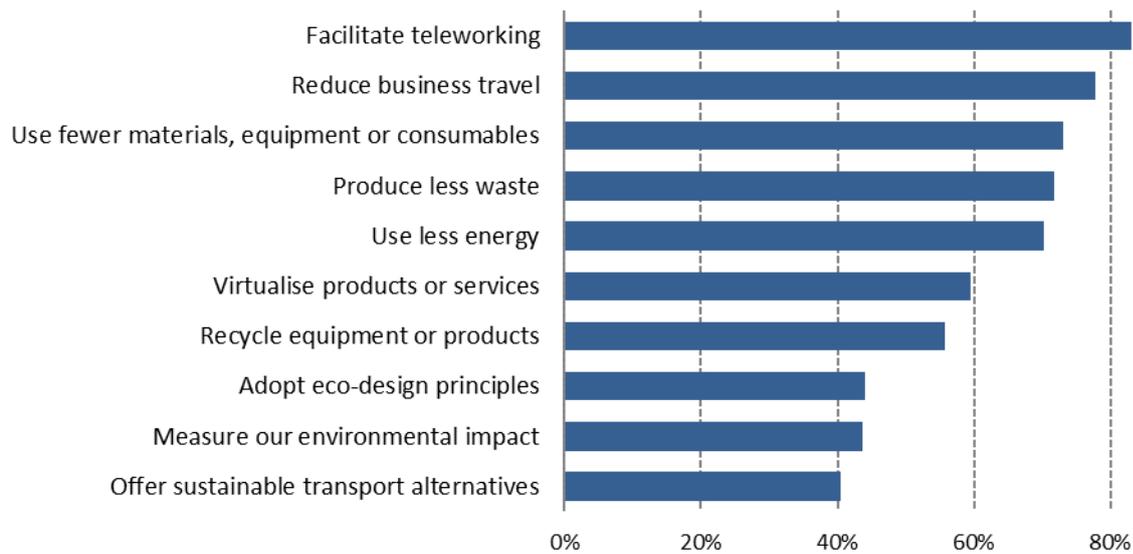
1.7 Sustainability

The green and digital 'twin transitions' spurred the European Commission to look at the relationship between the uptake of Information and Communications Technologies (ICTs) and environmental attitudes and actions of enterprises. A survey⁸ measured the perceived contribution of digital technologies to the environmental sustainability of EU enterprises⁹. Respondents were asked to indicate whether the ICTs used in the company helped them to implement any of the following ten environmental actions: use less energy; use fewer materials, equipment or consumables; virtualise products or services; facilitate teleworking; reduce business travel; offer sustainable transport alternatives; produce less waste; adopt eco-design principles; recycle equipment or products; measure their environmental impact.

Enterprises reported the highest contribution of ICTs to environmental actions such as facilitate teleworking (83%) and reduce business travel (78%). This could be due to the fact that the survey was carried out during the COVID-19 pandemic, when enterprises have supported working online and business travel was reduced to the minimum. Respondents also stated that in their company digital technologies contributed to use fewer materials, equipment or consumables (73%), to produce less waste (72%) or to use less energy (70%). According to respondents, ICT had the lowest contribution to the following environmental actions: adopting eco-design principles and measuring one's environmental impact (44% each) as well as offering sustainable transport alternatives (40%).

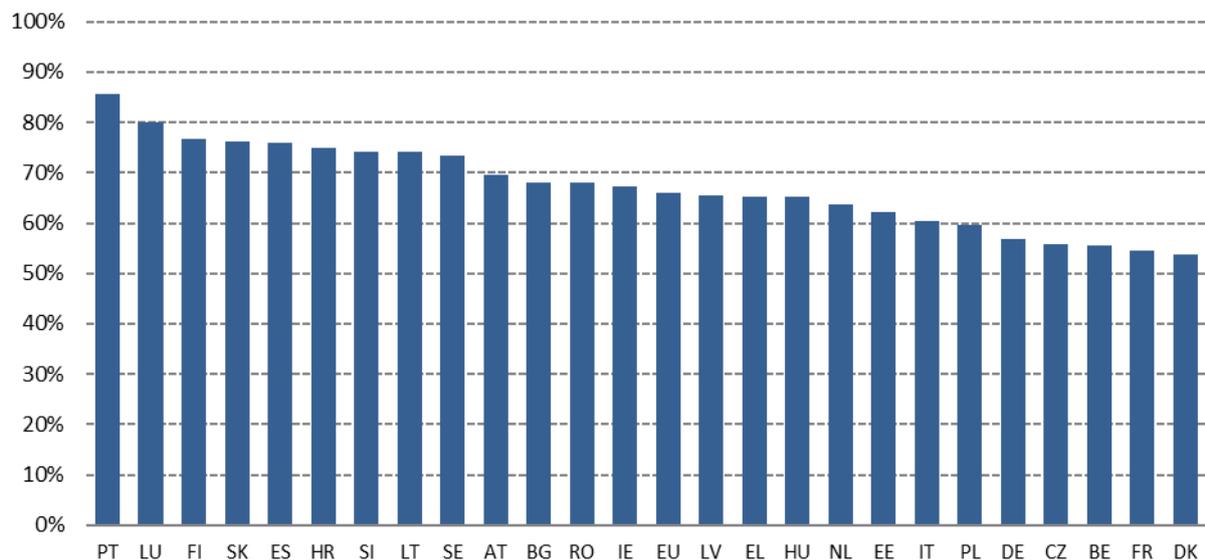
⁸ Ipsos and iCite, Survey on the contribution of ICT to the environmental sustainability actions of EU enterprises, 2021.

⁹ The environmental footprint of ICT has not been assessed in the survey.

Figure 13 Environmental actions taken by enterprises with the help of ICT at EU level (% of enterprises), 2021

Source: Ipsos and iCite, Survey on the contribution of ICT to the environmental sustainability actions of EU enterprises, 2021.

Based on the findings outlined above an indicator has been developed that measures the level of support that adopted ICTs offered to enterprises to engage in more environmentally-friendly actions. The level of intensity is measured based on the number of environmental actions (maximum 10) reported by enterprises to have been facilitated by the use of ICTs. The following categorisation was developed: low intensity (0 to 4 actions), medium intensity (5 to 7 actions) and high intensity (8 to 10 actions). The chart below shows the share of enterprises by country having medium to high intensity of green action through ICT, i.e. having implemented 5 to 10 green actions.

Figure 14 Enterprises having medium/high intensity of green action through ICT (% of enterprises), 2021

Source: Ipsos and iCite, Survey on the contribution of ICT to the environmental sustainability actions of EU enterprises, 2021.

1.8 Unicorns

The Digital Decade sets the target of doubling the current number of EU27 unicorns by 2030 (baseline 122 as of February 2021).

A unicorn is a privately held start-up company valued at over USD 1 billion. This is a stage of the start-up financial development, which proves its maturity and success on the global market. For the current analysis, we include tech companies founded since 1990 that are currently valued at over USD 1 billion, while companies that passed USD 1 billion as a subsidiary are excluded. Companies that may now be worth less than USD 1 billion but exited at more than USD 1 billion are also included.

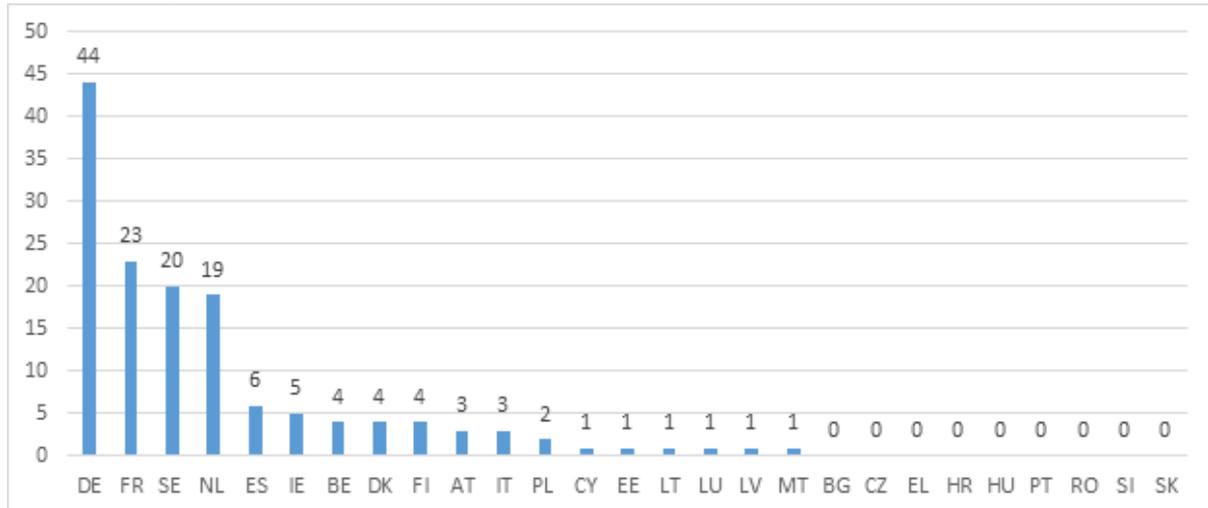
Figure 15 The definition of unicorns included in the analysis



Source: Dealroom

According to Dealroom¹, as of June 2021 there were 1,652 unicorns in the world. The EU has only 143 unicorns, as opposed to 889 in United States, 414 in Asia (out of which 272 in China), 101 in the UK and 105 in the rest of the world. Therefore, there is substantial room for improvement. The leading EU countries are Germany (44), France (23), Sweden (20) and the Netherlands (19). There are nine EU Member States without a single unicorn.

Figure 16 Number of unicorns per EU Member States

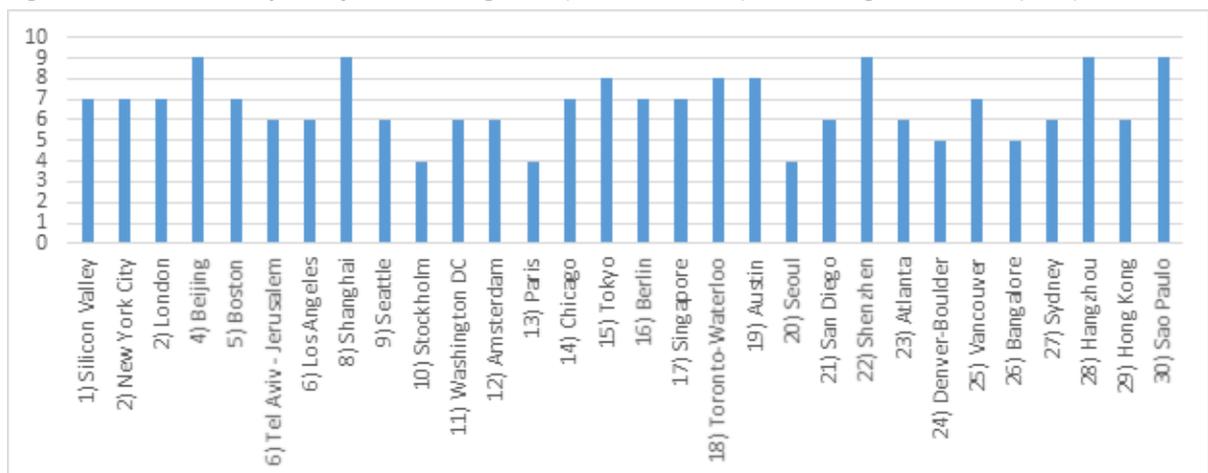


Source: Dealroom, June 2021

In order to reach the stage of a unicorn, a company has to steadily and dynamically grow through all the development phases supported by the start-up ecosystem. According to Startup Genome, the best Global Startup Ecosystems in 2020² were Silicon Valley (1st), London and New York City (tied at 2nd). The best EU ecosystem – Stockholm – was ranked 10th worldwide, followed by Amsterdam-Delta (12th), Paris (13th) and Berlin (16th). Only four EU ecosystems are in the first 20 worldwide. Stockholm and Amsterdam improved their ranking from 2019 by 1 and 3 positions respectively, while Paris and Berlin decreased by 4 and 6.

The most dynamically growing ecosystems are located in Asia (e.g. Tokyo, Seoul, Shenzhen and Hangzhou). In general, Asia-Pacific is the region, with the highest growth in the number of billion-dollar startups. According to Startup Genome³, the region's share increased from 19.5% (2013-2014) to 31.8% in 2018-2019. It grew with a 33.9% compound annual growth rate (CAGR), while North America deals increased with 24.9% CAGR and Europe with 24.1%.

Figure 17 Global start-up ecosystem ranking 2020 (best on the left) and their growth index (bars).



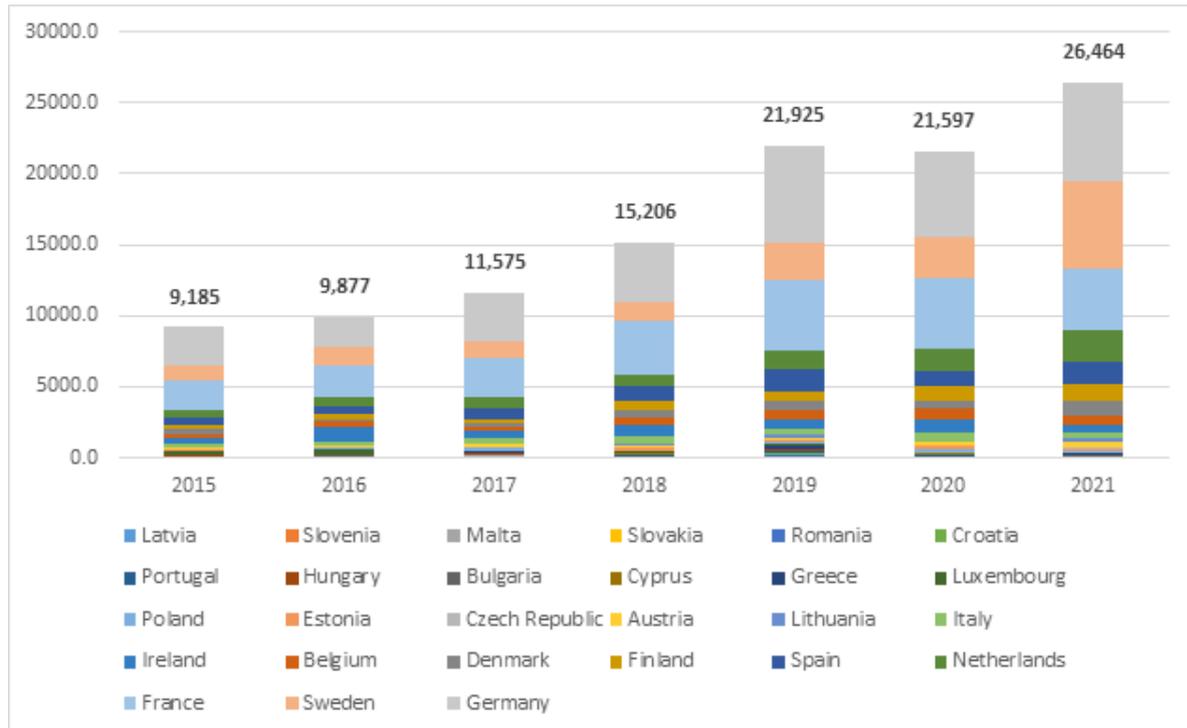
Source: Startup Genome, The Global Startup Ecosystem Report 2020

Out of the ten most valuable unicorns in the world, seven are based in the US and three in China. Amazon, valued at EUR 1.4 trillion, ranks first. In comparison, the most valuable EU unicorn Adyen has a valuation of EUR 52.3 billion (located in Amsterdam), followed by Klarna and Spotify (both

based in Stockholm). Out of the twelve most valuable EU unicorns 5 are located in Germany, 4 in Sweden, 2 in the Netherlands and 1 in Denmark.

Looking at the amount of venture capital invested in EU Member States, it is obvious that larger investment generates more start-ups and better ecosystems, which in return attracts more investment and in the end results in more scale ups and unicorns. Figure 18 shows that Germany, Sweden, France and the Netherlands invested the most in venture capital and had the most thriving start-up environment.

Figure 18 Amount invested by venture capital (not only digital) by Member States in 2021

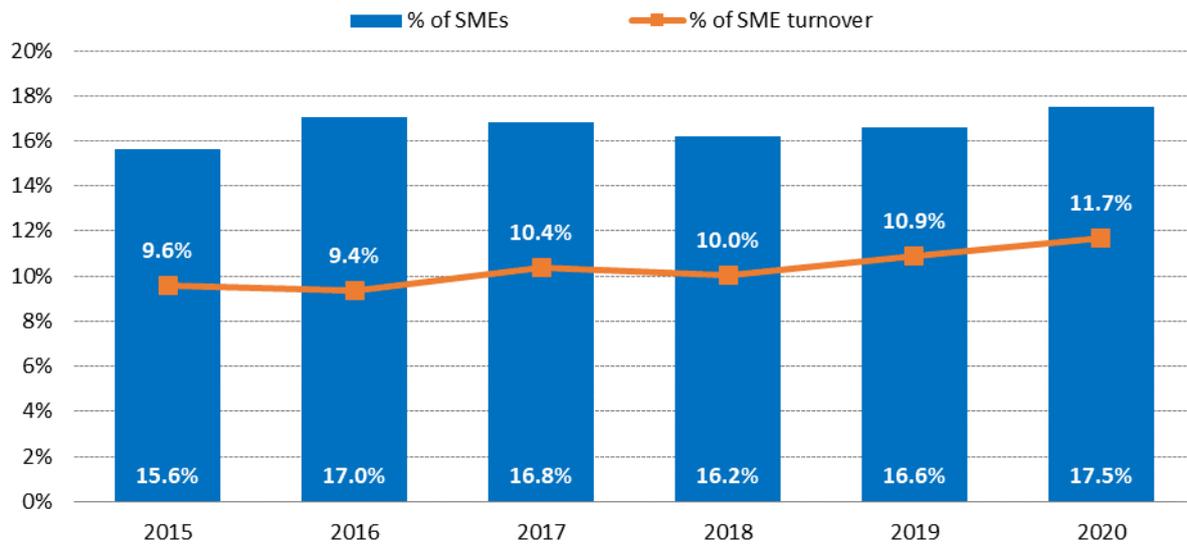


Source: Dealroom

1.9 e-Commerce

One in five EU enterprises made online sales in 2020, amounting to 18% of total turnover of companies that employ 10 or more people. Between 2015 and 2020, the percentage of companies selling online increased by 1.9 percentage points and the turnover of these companies realised from online sales increased by 2.1 percentage points.

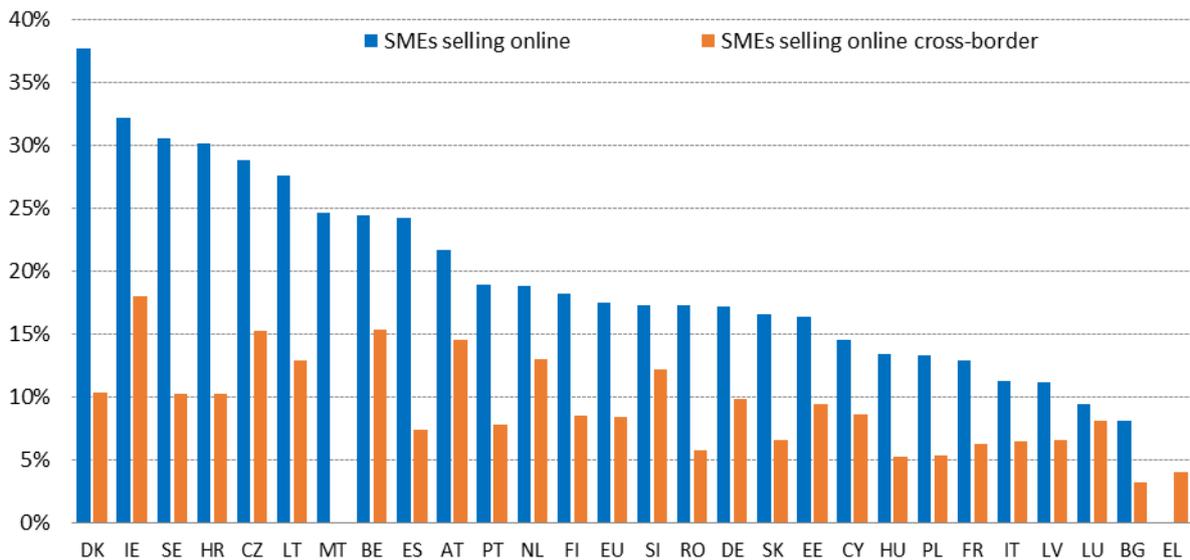
Figure 19 Trends in e-commerce (% of SMEs, % of SME turnover), 2015-2020



Source: Eurostat, European Union survey on ICT usage and e-commerce in enterprises.

Enterprises benefit from cross-border e-commerce by exploiting economies of scale. This helps to reduce costs, increase efficiency, promote competitiveness and improve productivity. Cross-border e-commerce is even more important for enterprises and especially SMEs that are confined to a small home market. Nevertheless, only 8% of SMEs made web sales to customers in other EU countries in 2019. SMEs in Denmark, Ireland, Sweden and Croatia have the largest proportion of online sales (30% or more). Ireland is leader in cross-border online sales (18% of Irish enterprises have web sales across borders), followed by Belgium, Czechia and Austria (all three at 15%).

Figure 20 SMEs selling online (2020), and selling online cross-border (2019) (% of SMEs)



Source: Eurostat, European Union survey on ICT usage and e-commerce in enterprises.

Most of enterprises (63%) with web sales to other EU countries have no difficulties when selling to customers in other EU countries. On the other hand, 37% report at least one obstacle that is mainly related to economic factors (e.g. high costs of delivering or returning products, a problem reported by 27% of enterprises). Other factors such as linguistic and legal problems are also significant. The lack of knowledge of foreign languages and problems related to resolving complaints and disputes are also highlighted as difficulties by 11% of the enterprises selling online to other EU countries.