Chapter 4

DIGITAL UPTAKE, USAGE AND SKILLS

KEY FINDINGS

- Internet usage has significantly increased over the last decade but continues to vary widely across countries. In 2019, the proportion of adults accessing the Internet ranged from over 95% to less than 70% among OECD countries.
- Internet use has become an everyday habit for most people in the OECD area, including seniors. In 2019, 58% of those aged 55-74 used the Internet frequently, up from only 30% in 2010. Yet this remains well below the average share of frequent Internet users aged 16-24, which was close to 95%.
- Smartphones have become the favoured device for Internet use in many countries. For example, 75% of individuals in the European Union used a mobile phone or smartphone to connect to the Internet in 2018, up from 65% just two years earlier.
- Mobile devices are also associated with longer time spent on line. In 2018, the average OECD student aged 15-16 spent 27 hours a week on the Internet outside school. However, time spent on the Internet daily varies significantly across countries.
- The age of first access to the Internet has been decreasing in almost all countries in recent years. In 2018, 24% of 15 year-olds in the OECD area first accessed the Internet at the age of 6 or under compared to only 15% in 2012.
- In 2019, on average 93% of enterprises in OECD countries had a broadband connection, up from 85% in 2010. The gap between large and small firms has narrowed to less than 7 percentage points, on average, compared to 15 percentage points in 2010. Yet the gap remains much larger in some countries.
- Despite being a hallmark of the online age, e-commerce represents a much lower proportion of sales for firms. In 2019, e-commerce generated only 19% of total turnover on average. For those firms using e-commerce, up to 90% of revenue comes from business-to-business transactions. Large firms use e-commerce more than small ones, accounting for an average 24% of their turnover compared with just 9% in small firms.
- By 2017, more than half of businesses in the OECD had a social media presence, up from one-third in 2013. However, this share ranges from nearly 80% to below 30% in individual countries. Fewer than one in three small firms used social media, compared to almost three-quarters of large firms. In 2017, on average, 12% of businesses in the countries for which data are available performed big data analytics, a share exceeding 20% in some countries.
- About 12% of Internet users reported having received on-the-job training on information and communication technologies (ICTs) from co-workers or supervisors in 2018; 9% took part in an ICT-related training course paid for or directly provided by their employer.
- The share of individuals using the Internet to interact with public authorities in OECD countries increased from 43% to 58% over 2010-19. However, this proportion is less than 40% among individuals with low or no formal education compared with 80% among those with tertiary education.
- In 2019, around 14% of Internet users in the OECD area attended an online course. Differences across countries are notable with the share reaching 70% in Mexico and 37% in Brazil but less than 4% in Turkey.

Introduction

This chapter provides an overview of recent developments in the use of digital technologies by individuals and businesses. It examines policies to support digital uptake based on countries' responses to the 2019 OECD Digital Economy Policy Questionnaire. Further, it sheds light on individuals' use of online public services and on the uptake of digital technologies by governments. It provides stylised facts on digital natives and the adult population, examines new facets of the digital divide and sheds light on ICT skills demand in the workplace and possible mismatches. Finally, it reviews policies to develop the skills required to prosper in the digital society.

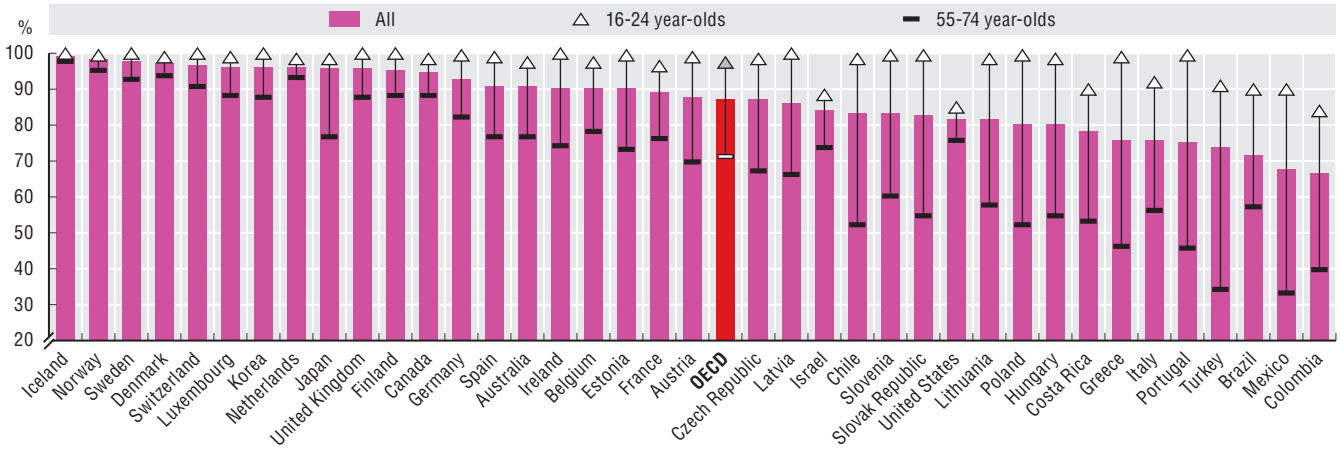
Use of digital technologies by individuals

The Internet underpins a wide range of other digital technologies and applications. Despite increasing significantly over the last decade, Internet usage continues to vary widely across OECD countries and among social groups. In 2019, over 95% of adults accessed the Internet in the Nordic countries, Korea, Luxembourg, the Netherlands, Switzerland and the United Kingdom. The rates of access for adults were 74% in Turkey and under 70% in Colombia and Mexico.

Differences in Internet uptake are linked to age, as well as education and income levels. In most OECD countries, Internet usage is now almost universal among people aged 16-24. Cross-country differences are wider for older generations. Internet usage among those aged 55-74 is above 85% in the Nordic countries, Canada, Korea, Luxembourg, the Netherlands, Switzerland and the United Kingdom. However, it is only 46% in Greece and Portugal, and 33% in Mexico and Turkey (Figure 4.1).

Figure 4.1. Internet users by age, 2019

As a percentage of the population in each age group



Notes: Internet users are those having used the Internet in the last 3 months, except for Colombia and Japan (last 12 months) and the United States (any time). Data refer to 2019 except for Australia (the fiscal year ending 30 June 2017), Brazil, Canada, Colombia, Costa Rica, Japan and Mexico (2018) and Chile, Israel, Switzerland and the United States (2017). Data refer to age groups 16-74, 16-24 and 55-74 except for Israel (20-74 and 20-24), Japan (15-74 and 55-74). OECD data figures are based on a simple average of the available countries.

Source: OECD (2020[1]), *ICT Access and Usage by Households and Individuals Database*, *http://oe.cd/hhind* (accessed in April 2020).

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Internet use has become an everyday habit for most people in the OECD. In 2019, on average, close to 95% of individuals aged 16-24 were frequent Internet users, a significant increase from 80% in 2010. Among those aged 55-74, this share reached 58% in 2019, up from only 30% in 2010 (OECD, 2019[2]).

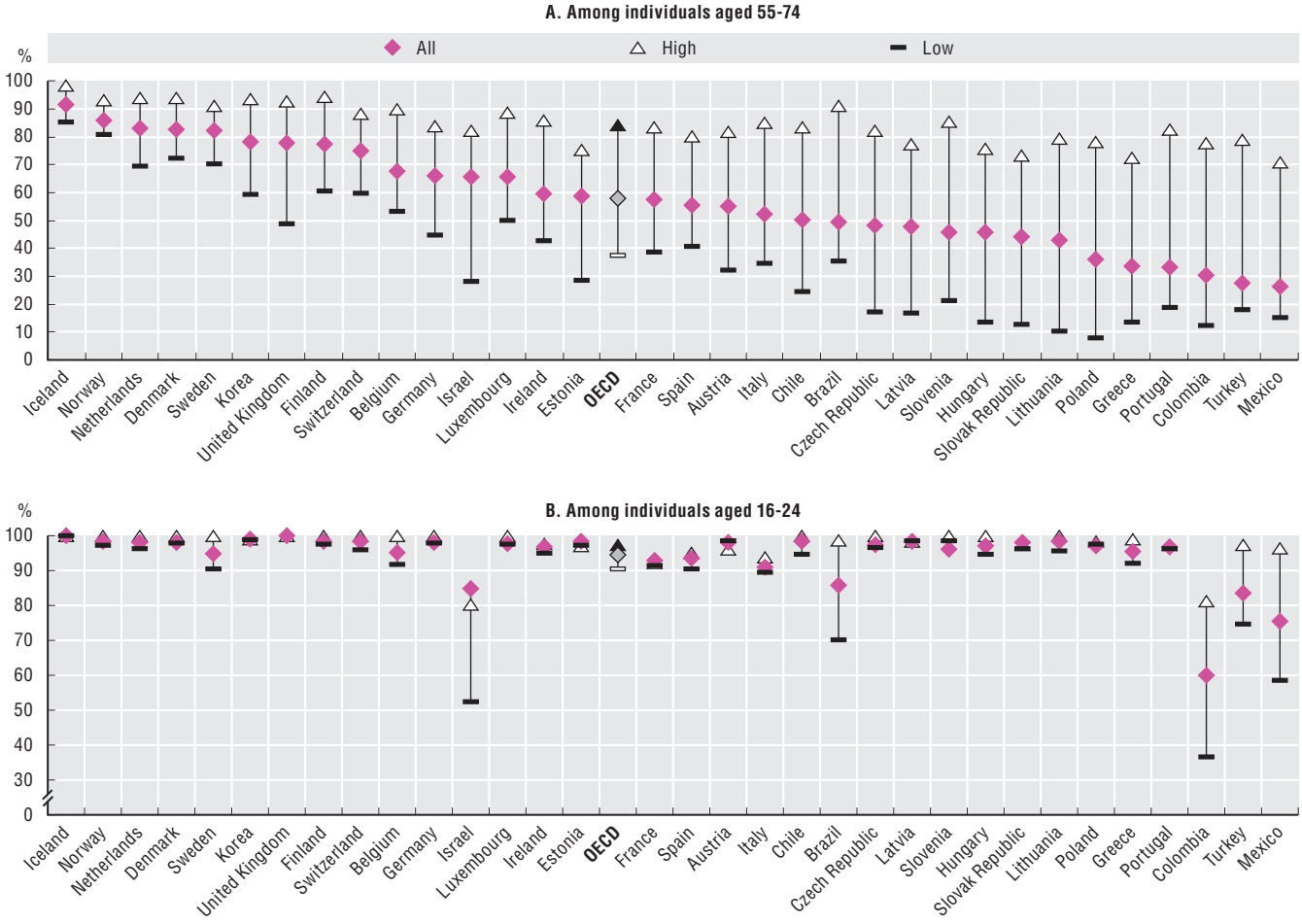
While frequent usage is practically universal among young people in most countries, there are still wide differences for older generations. Among people aged 55-74, regular Internet usage is still heterogeneous across the OECD, with a strong difference according to level of educational attainment. The two countries with the highest share of daily users aged 55-74 (Iceland and Norway) have a relatively small gap between high and low levels of education (close to 10%). In the seven countries where more than 75% of adults aged 55-74 are daily users, there is still a gap of at least 21% between high and low levels. In countries with fewer daily users among the 55-74 age group, the educational gap is generally higher, i.e. above 60% in Poland, Portugal, Mexico or Turkey (Figure 4.2).

Increasing mobility

Smartphones enable ubiquitous and always-on connectivity. In many countries, they are the favoured device for Internet use. In the European Union, for example, 75% of individuals used a mobile phone or smartphone to connect to the Internet in 2018. This was up from 65% just two years earlier and matches the share of individuals using a computer or tablet.

Figure 4.2. Frequent Internet use by age and educational attainment, 2019

As a percentage of the population in each age group



Notes: Frequent Internet use is by individuals using the Internet every day or almost every day. Individuals with medium formal education attainment are not shown in the figure. For Brazil, Colombia and Mexico, data refer to 2018. For Chile and Israel, data refer to 2017. For Israel, data refer to individuals aged 20-24 instead of 16-24. Data for individuals aged 16-24 with high educational attainment are OECD estimates for Denmark, Finland, Iceland Norway, Slovenia and Sweden. OECD data figures are based on a simple average of the available OECD countries.

Sources: OECD (2020[1]), *ICT Access and Usage by Households and Individuals Database*, *http://oe.cd/hhind*; Eurostat (2019[3]), *Digital Economy and Society Statistics*, Comprehensive Database (accessed in April 2020).

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In the United States in 2019, almost four in ten adults said they mostly use a smartphone when accessing the Internet, almost double the share in 2013. In the same year, nearly six in ten younger adults (58%) were likely to reach for their phones when going on line (Anderson, 2019[4]).

In Japan, smartphone diffusion has skyrocketed, surpassing computer ownership in 2016. Only one year later, smartphones became the most widely used device for Internet access in the country (MIAC, 2017[5]; 2018[6]). The same trend occurred in the United Kingdom by 2016 (Ofcom, 2019[7]).

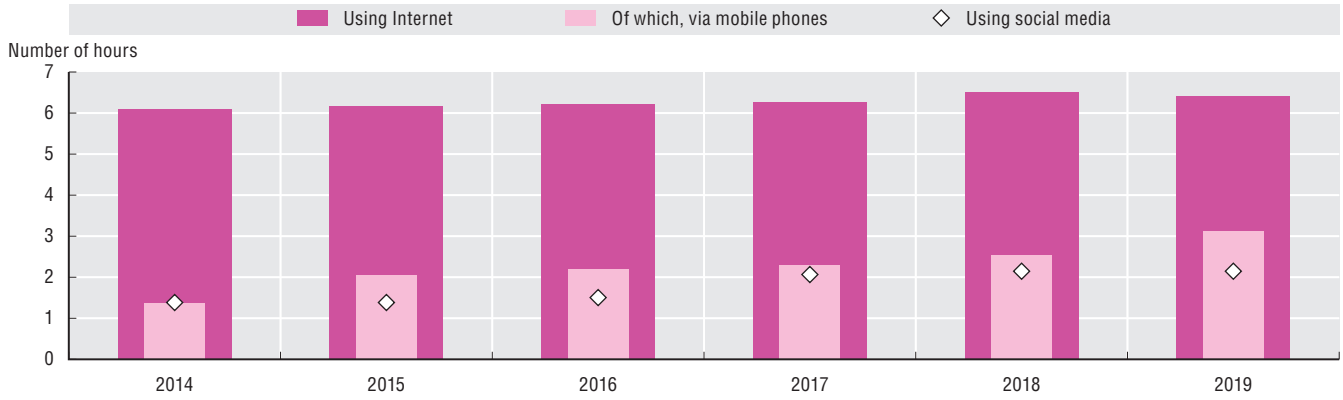
In Brazil, in 2017, half of Internet users could only access the Internet by mobile phone with the figure rising to 72% in rural areas (CETIC, 2018[8]). In France, too, an increasing share of individuals connect to the Internet at home via mobile networks rather than fixed networks (CREDOC, 2019[9]). In Korea, over 90% of Internet users accessed social networks or Internet shopping services using smartphones in 2018, up from under 10% in 2010 (MSIT and KISA, 2019[10]).

Mobile devices are also affecting the amount of time spent on line. In the United States in early 2019, 28% of adults were on line "almost constantly", and one-third of those accessed the Internet using only mobile devices. This latter share reached almost 50% among those aged 18 to 29 but was lower (20%)

among those aged 50-64. Constant connectedness was also greater among those with higher levels of educational attainment, ranging from 23% for individuals with no more than a high school degree to 36% of those with a college degree or above (Perrin and Kumar, 2019[11]).

Between 2014 and 2019, the average daily time spent on the Internet worldwide is estimated to have increased from 6 hours 10 min to 6 hours 42 minutes. Almost half of this was via mobile devices, up from one-quarter in 2014. Social media is a key driver of online time, accounting for one-third on average in 2019. This illustrates the effectiveness of business models for social media platforms (Figure 4.3).

Figure 4.3. Average daily time spent on the Internet worldwide, 2014-19



Source: Datareportal (2019[12]), *Digital 2019: Global Digital Overview*, *https://datareportal.com/reports/digital-2019-global-digital-overview.*

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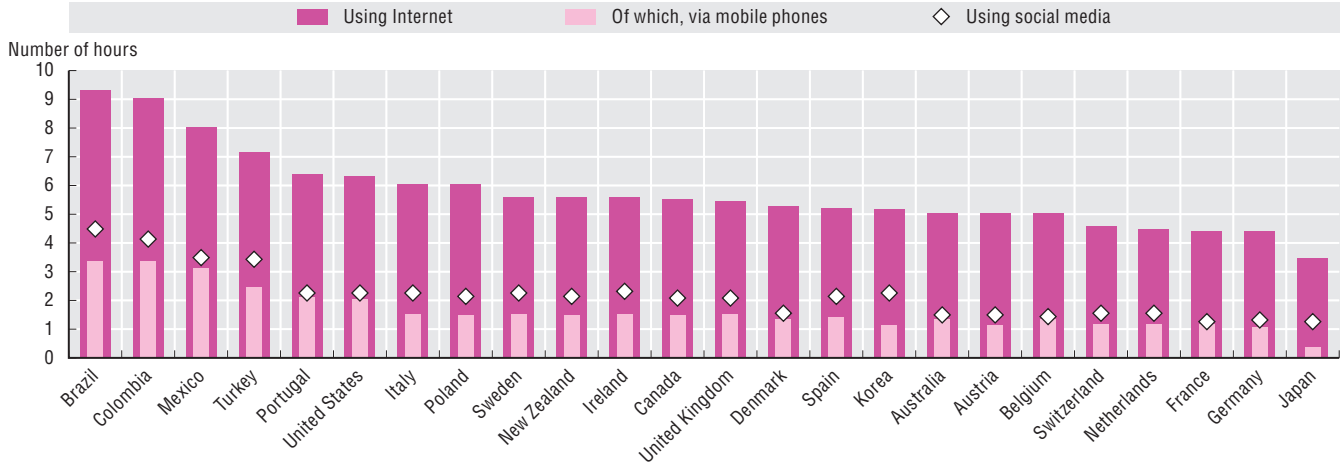
Nevertheless, the amount of time spent on the Internet daily varies significantly across countries – from around nine hours in Brazil and Colombia to below four hours in Japan. Mobile devices account for over half of time spent on line in Brazil and Turkey, but less than one-third in Germany and France. Daily time spent on social media varies from three and a half hours in Brazil to half an hour in Japan – the lowest among the countries presented, at just one-sixth of the daily time on line. By contrast, the highest shares, at near 40% of time on line, can be found in countries such as Mexico, Colombia and Turkey (Figure 4.4).

Figure 4.4. Average daily time spent using Internet, mobile Internet and social media, 2019



Source: Datareportal (2019[12]), *Digital 2019: Global Digital Overview*, *https://datareportal.com/reports/digital-2019-global-digital-overview.*

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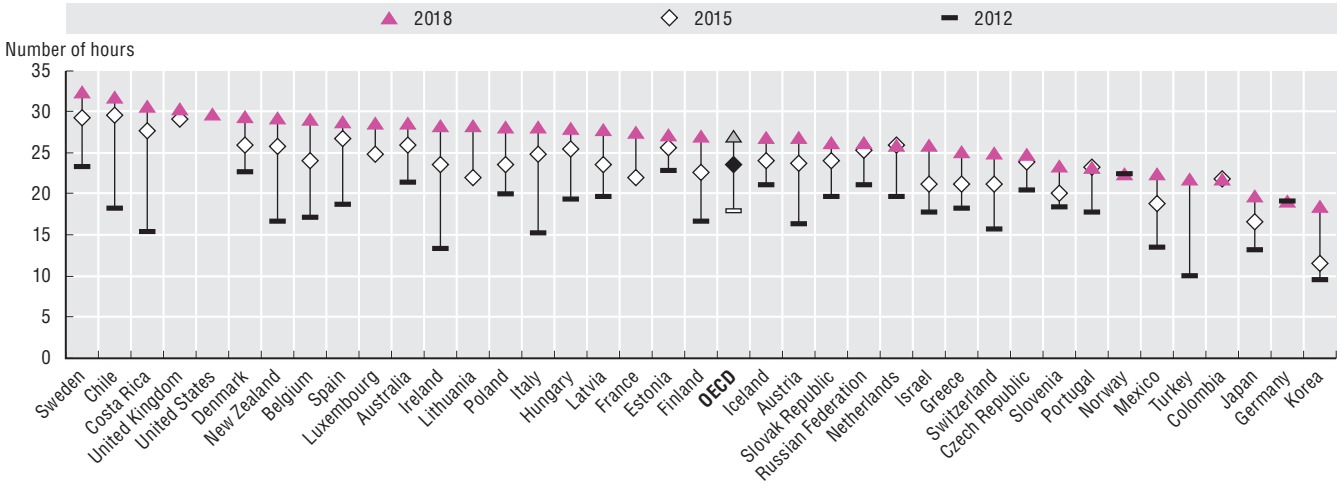
Screen time is now embedded in daily life in many OECD countries. In France, a recent study found that teenagers routinely breach recommended limits. Half of those studied spent more than three hours on screens every day during the week, and more than double that on the weekend (DREES, 2019[13]).

Younger generations are especially likely to spend screen time on line. During the last decade, the amount of time that students aged 15-16 spent on line outside of school has increased considerably (OECD, 2019[14]). On average across the OECD, the time students spend on the Internet outside of school increased from 18 hours per week (including weekends) in 2012 to 23 hours in 2015 and 27 hours in 2018. The weekly time spent on line outside of school ranges from more than 32 hours in Sweden to 18 hours in Korea (Figure 4.5).

Figure 4.5. Weekly hours spent by students aged 15-16 on the Internet outside of school, 2012-18



Note: Based on the cumulated time spent on the Internet on weekdays and weekend days. For the Netherlands, Portugal and the United States, data did not meet technical standards but were accepted as largely comparable. For the United Kingdom, Scotland is not included.

Source: OECD calculations based on OECD (2019[14]), *PISA 2018 Results (Volume III): What School Life Means for Students' Lives*, *https://dx.doi.org/10.1787/acd78851-en*.

StatLink https://doi.org/10.1787/888934191673

On weekdays, students now spend about 3 hours on line outside of school and almost 3.5 hours on weekend days on average across the OECD. In both cases, the time spent has increased by more than one hour per day between 2012 and 2018. Indeed, students in Ireland, Italy and Turkey more than doubled their time spent on line during the same period (OECD, 2019[15]).

Online activities

On average, over 2018-19, 83% of Internet users in the OECD, Brazil and Costa Rica reported sending emails, 78% used the Internet to obtain information on goods and products, 73% used social networks and 72% read online news, and 42% used cloud technologies. While 55% of Internet users ordered products on line, only 20% sold products over the Internet (Figure 4.6).

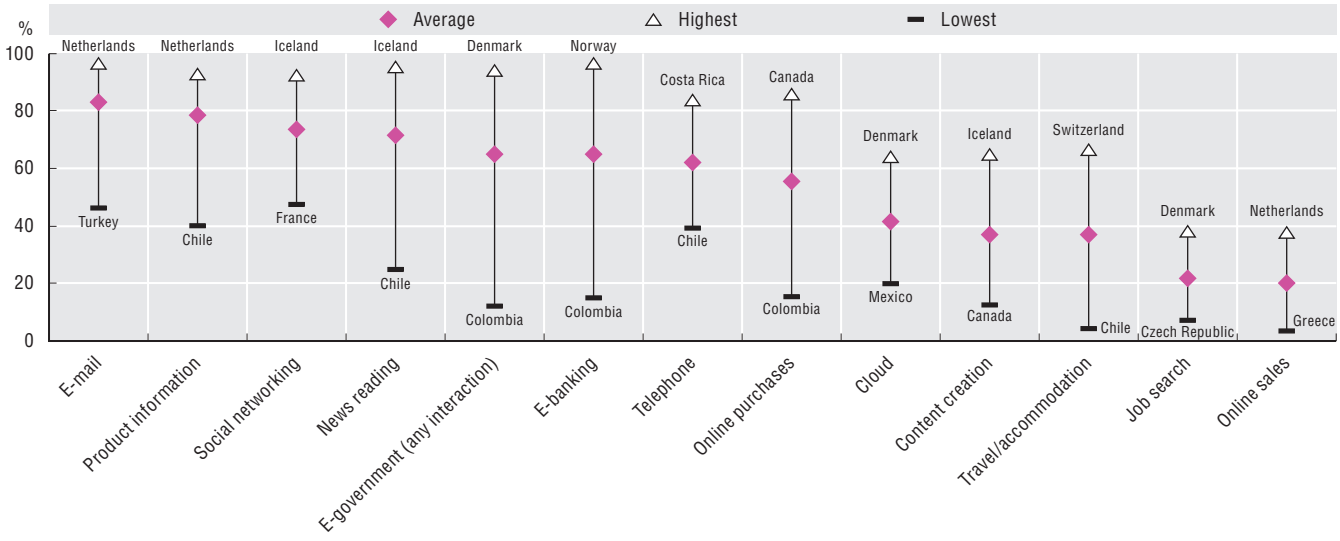
The shares of Internet users performing relatively more complex activities tends to vary markedly across countries. This is the case, for example, for e-banking, online purchases, news reading and use of government services (e-government). On the other hand, activities such as sending emails, social networking or telephoning over the Internet show much less variation across all countries.

People buying and selling on line

Across OECD countries, almost 60% of individuals bought products on line in 2019 on average, up from 38% in 2010 (Figure 4.7). The trend towards online shopping is likely to continue, especially in light of the COVID-19 pandemic. As with Internet use more generally, a growing number of individuals are buying products via mobile devices. The share of people buying on line still varies widely across countries, as well as across different product categories; age, education, income and experience all influence uptake. In Denmark, the Netherlands and the United Kingdom, more than 80% of adults shop on line. In Turkey and Costa Rica, the percentage is only 25%, while in Mexico and Colombia it is under 16% and 7%, respectively.

Figure 4.6. Diffusion of selected online activities among Internet users, 2019

Percentage of Internet users performing each activity



Notes: The data cover OECD countries, Brazil and Costa Rica. Unless otherwise indicated: a recall period of 3 months is used for Internet user; e-government, online purchases and travel/accommodation use a 12-month recall period; data relate to individuals aged 16-74. For countries in the European Statistical System and Korea, data refer to 2019; for Brazil, Canada, Colombia, Costa Rica, Japan and Mexico, data refer to 2018; and for Chile, Israel and the United States, data refer to 2017. For Australia, data refer to fiscal years ending on 30 June. For country exceptions, see endnote 1. StatLink contains more data.

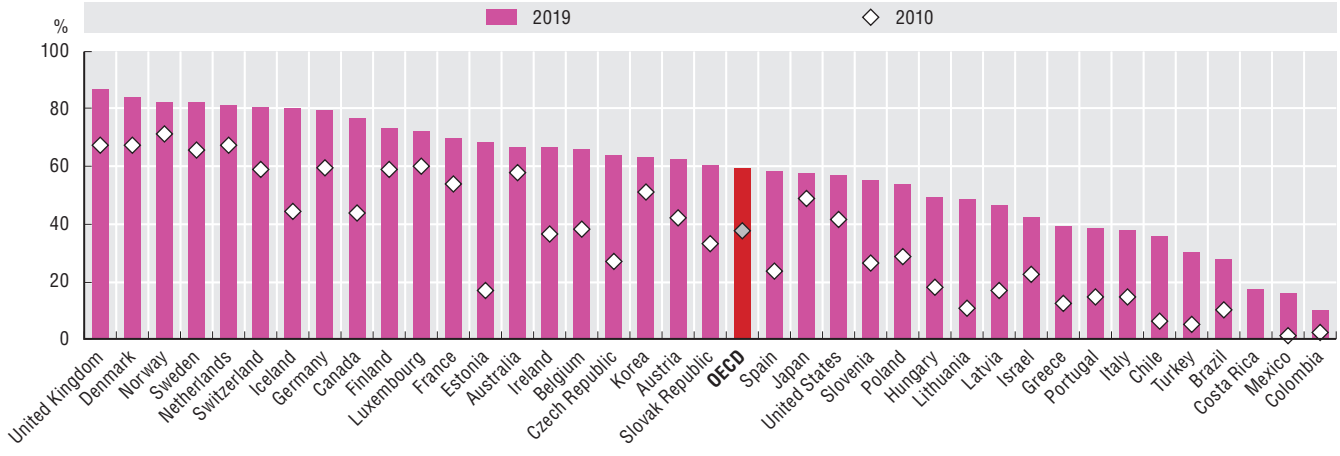
Source: OECD (2020[1]), *ICT Access and Usage by Households and Individuals Database*, *http://oe.cd/hhind* (accessed in April 2020).

StatLink https://doi.org/10.1787/888934191692

E-commerce has already disrupted traditional distribution channels for many categories of products. The most common items purchased on line in 2018 (about 40% each, on average) were clothing, footwear and sporting goods, and travel products. These were followed by tickets for events, reading materials, movies and music, then photographic, telecommunication and optical equipment, and food and grocery products (OECD, 2019[2]).

Figure 4.7. Diffusion of online purchases, 2019

Individuals having ordered goods or services on line as a percentage of all individuals



Notes: For Australia, data refer to fiscal year ending 30 June 2017 instead of 2019 and to fiscal year ending in 30 June 2011 instead of 2010. For Canada, data relate to individuals aged 15-74 instead of 16-74 and to 2012 instead of 2018. For Chile, data refer to 2017 and 2009 instead of 2019 and 2010, respectively. For Brazil, Colombia, Costa Rica, Japan and Mexico, data refer to 2018 instead of 2019. For Chile, Israel and the United States, data refer to 2017 instead of 2019. For Costa Rica, data refer to individuals aged 18-74 and over instead of 16-74. For Israel, data refer to individuals aged 20 and over instead of 16-74. For Japan, data refer to individuals aged 15-74 instead of 16-74. For the United States, the recall period is six months and data refer to 2013 instead of 2010. OECD data figures are based on a simple average of the available OECD countries.

Source: OECD (2020[1]), *ICT Access and Usage by Households and Individuals Database*, *http://oe.cd/hhind* (accessed in April 2020).

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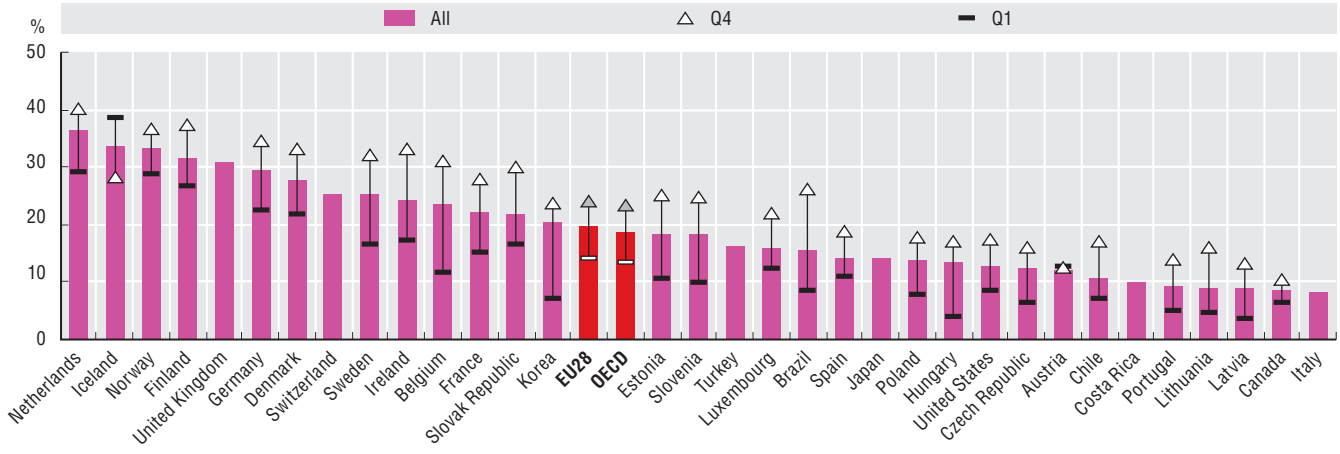
The Internet is also offering individuals opportunities to sell products on line – from homemade items and second-hand goods to furniture assembly services and nights in spare rooms. In 2019, in the European Union, nearly 20% of individuals sold goods or services on line, more than double since 2008. The share reaches more than one-third in the Netherlands, Iceland, Norway and Finland. In most countries, the propensity to sell on line is greater for those in the upper household income quartiles than for people with lower incomes (Figure 4.8).

Online income generation is also significantly increasing. In the United Kingdom, the share of people having sold products on their own website doubled between 2016 and 2019 (9.5% to 18.9%). Similar increases occurred for selling self-made products on line (10% to 20%) and finding paying guests via Airbnb or similar websites (8% to 18%) (HBS, 2019[16]). In the United States, nearly one in five adults (18%) in 2016 earned money in the previous year by selling something on line (Smith, 2016[17]). In 2017, 11% of Internet users aged 15 or more reported selling their own goods on line and 6% offered their own services. Those shares clearly increase with level of income and educational attainment (Robinson and Goldberg, 21 August 2019[18]).

In France, in 2017, one-third of households were selling, buying or renting goods or services on line to individuals, and 26% did so at least once via online ad websites. Half of these received less than EUR 150 over the year, 9% between EUR 800 to EUR 3 000 and 8% more than EUR 3 000. Nine out of ten of the most valuable transactions related to vehicle sales. Only 2% of households offered accommodation rental (Ferret and Demoly, 2019[19]).

Figure 4.8. Individuals who sold goods or services on the Internet, by income, 2019

As a percentage of individuals in each quartile



Notes: Q1 and Q4 refer respectively to the lowest and the highest income quartiles. Data for Canada, Ireland, Japan, Mexico, Sweden, Brazil and Costa Rica refer to 2018, and for Chile, Iceland and the United States to 2017. For Costa Rica and Japan, data refer to individuals aged 18-74 and 15-74, respectively, instead of 16-74. OECD data figures are based on a simple average of the available countries.

Sources: OECD (2020[1]), *ICT Access and Usage by Households and Individuals Database*, *http://oe.cd/hhind*; Eurostat (2019[3]), *Digital Economy and Society Statistics*, Comprehensive Database (accessed in April 2020).

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Policies to promote ICT use in households and by individuals

Countries can support adoption and usage of information and communication technologies (ICTs) in households and by individuals in a wide variety of ways. Out of the 30 countries that responded to the section on Digital Uptake and Use of the OECD Digital Economy Policy Questionnaire, all but four – Italy, Germany, the Netherlands and Spain – reported having policies to promote the use of digital technologies in households and by individuals.

Policy objectives reported in the survey vary greatly. They generally relate to issues such as the digital divide, ICT education, digital skills and literacy, connectivity with network infrastructure and telecommunication plans (broadband, fibre, 5G), cybersecurity and trust, or e-government efficiency. Though not always mentioned explicitly, reduction of digital divides is clearly reflected in the target

groups and policy instruments implemented. This, in turn, reflects the multidimensional nature of this issue. Policy objectives are often set out in broad terms, most often under the umbrella of a digital roadmap or a digital agenda. In such cases, guiding principles or sub-objectives frequently relate to one of the issues previously mentioned.

As digital tools are pervasive, some objectives to promote usage overlap with other broad economic policy areas. In Latvia, for example, the digital agenda coincides with developing an inclusive labour market and improving health care efficiency through e-health. Similarly, objectives for the digital agenda and education overlap in the Czech Republic and the Russian Federation.

For connectivity, countries responding to the survey noted the goals of improving the communication infrastructure, deploying broadband, and enhancing speed and service quality. These belong to the policy toolkit often mentioned by countries to promote digital inclusion and reduce the digital divide.

These policies can be broad when taking the form of national plans. For example, they may seek to reduce the geographical divide between rural and urban areas, to deploy high-speed networks or to improve the quality and speed of communication networks at the country level. Such policies include the National Fiber Optic Project in Chile, the National Telecommunication Development Plan in Costa Rica, Telecom Plan in Iceland, the Next Generation Network in the Country Side in Sweden, Connectivity programmes in Colombia or the Fast Broadband project in Finland.

The coverage can also be more focused in terms of population targeted. Some programmes, for example, refer explicitly to affordability or universal service obligation. These include the ConnectHome Program or the Broadband ReConnect Program in the United States and the Last mile support in Estonia.

Digital security, trust and consumer protection are also ICT policy areas. Some countries have taken various measures to increase awareness, promote more effective data protection, develop knowledge or share experiences among households and individuals. A snapshot of policy instruments is presented below:

- In Austria, efforts are underway to increase awareness of the population as regards the possibilities and dangers of the information society. One key message is that individuals must take some responsibility for risk management. Austria also promotes more effective data protection, cybersecurity and consumer protection.
- In Colombia, the En TIC Confio ("ICT stand out, I trust") programme helps people deal with threats to security and privacy that can occur in the digital environment.
- In Portugal, Safer Internet Centre campaigns target children and teenagers who are socially excluded or outside the influence of a school. At pedagogical centres, at-risk children and teenagers are invited to participate in activities about the benefits of safer use of the Internet. They are made aware of both potential risks of online use and of their right to protect personal data.
- In Singapore, the Media Literacy Council works in partnership with industry, the community and government to promote an astute and responsible digital citizenship. The Council seeks to cultivate and encourage the public to become discerning consumers who can evaluate content effectively, and use, create and share content safely and responsibly. It also advises the government on issues relating to the Internet and media content.

Most OECD countries implement ICT policies dedicated to specific groups and targeted populations. These are concerned with either connectivity and access, or content (use), digital skills and competences.

Targeted population groups can include both younger and older consumers. With respect to children, Chile has the I Chose My Personal Computer programme for children in vulnerable conditions; Japan has the Child Rearing One-stop Service; the Czech Republic has the Strategy of Digital Literacy to develop pupils' computational thinking; and Portugal has the aforementioned Safer Internet Centres for at-risk children and teenagers. With respect to elderly people, Austria has the Be Connected programme, while Israel offers a Senior Citizens' Digital Skills Course.

Programmes can also relate to specific population groups. These include disabled residents in the United States; persons at an economic disadvantage in Costa Rica, or with disabilities in Costa Rica

or Singapore; and women and immigrants in Norway. They may also target occupations or sectors (e.g. medical practitioners in Latvia, or media and journalists in Denmark).

Countries have adopted a range of policy instruments to promote ICT usage in households and by individuals. Non-financial support measures are most widely used, followed by regulation and statutory guidance. Direct and indirect financial support are less often the instruments of choice (Table 4.1).

Direct financial support may go through lead agencies to manage programme implementation, or take the form of loans, grants, vouchers or training oriented to generate specific results. Various types of programmes benefit from this kind of support. Several countries aim to reduce the digital divide in its many dimensions, including network speed and availability (Australia, Colombia, Estonia, Finland, Singapore, Sweden, United States). Others focus on increasing digital skills and competence of individuals (Portugal, Russian Federation). In still others (Costa Rica, Estonia, United States), such programmes (related to the digital divide or networks) also benefit from indirect financial support.

Table 4.1. Policy instruments to promote digital uptake by households and individuals

By type of instrument

Countries	Financial support		Non-financial support	Regulations and statutory guidance	Total
	Direct	Indirect			
Australia	1	..	2	1	4
Austria	..	1	1	1	3
Chile	..	1	..	..	1
Colombia	1	..	1	..	2
Czech Republic	..	1	..	..	1
Denmark	..	1	2	1	4
Estonia	..	1	1	..	2
Finland	..	1	1	1	3
Israel	..	..	1	..	1
Japan	1	..	2	1	4
Korea	..	..	..	1	1
Latvia	1	..	3	1	5
Lithuania	..	..	1	..	1
Mexico	..	..	2	2	4
Norway	..	..	1	..	1
Portugal	1	1	1	1	4
Slovenia	..	..	1	..	1
Sweden	1	..	..	..	1
Turkey	..	..	1	1	2
United Kingdom	..	..	1	..	1
United States	1	1	..	..	2
Costa Rica	..	1	1	1	3
Russian Federation	3	2	3	2	10
Singapore	1	..	1	1	3
Total	**11**	**11**	**27**	**15**	**64**

Note: .. = not available.

Source: OECD, based on countries' response to the 2019 OECD Digital Economy Policy Questionnaire.

Indirect financial support is also provided in the area of education. On the one hand, governments aim to improve the educational system (Czech Republic, Portugal). On the other, they favour development of advanced educational technologies (Russian Federation) and digital skills for students and teachers (Denmark). In Austria, this instrument contributes to reduce federal fees for public services. Specifically, the application costs less if it is submitted by citizen card or mobile phone signature.

Non-financial support instruments are the most widely used. Most commonly they include measures to increase skills, digital competences, and awareness of digital technologies and their opportunities and risks. They are often focusing on targeted groups to reduce the digital divide, and take the form of digital inclusion or training programmes, courses, awareness campaigns and implementation of portals or hubs by the public authorities. Japan and Singapore, for example, have community ICT clubs or learning hubs to share knowledge and experiences. Latvia has a portal and training activities programme, while Australia and Israel offer digital skills courses. Meanwhile, Australia and Colombia offer face-to-face personalised coaching, while Denmark and Portugal promote safe behaviour on the Internet through awareness campaigns.

Regulations and statutory guidance lay legal foundations in a wide range of areas. They aim at improving trust in digital technologies, e-government services and the e-commerce environment. To that end, they promote more effective data protection, digital security and consumer protection.

Implementation includes various legal instruments (laws, regulations, acts, frameworks). For example, a consumer protection law in Turkey aims at establishing trust in the consumer virtual environment through both legal regulations and measures by e-commerce companies. In Mexico, an e-commerce regulation on privacy and electronic security aims to guarantee consumer rights in electronic transactions. In Singapore, the Personal Data Protection Act comprises various rules governing the collection, use, disclosure and care of personal data. In Portugal, a regulation protects natural persons with regard to the processing of personal data and rules for the free movement of such data.

Information portals are also used in the context of regulation and statutory guidance. They aim to improve trust in the digital economy and to provide specific tools and information on cybersecurity and data protection. For example, in Mexico, public authorities provide online tools related to quality and certification for consumers and e-commerce. Denmark implemented a National Awareness Drive on Safe Behaviour on the Internet, while Austria has an ICT security portal.

Some countries specifically mention e-government services. In Australia, the Trusted Digital Identity Framework aims at providing people a single, secure way to use government services on line. In Japan, legislation is establishing the basic principles regarding digital government and administrative procedures.

In some countries, the legal instrument focuses on telecommunication and infrastructure deployment. Costa Rica, for example, developed the National Frequency Allocation Plan, while Mexico implemented the Guidelines for Telecommunications and Broadcasting infrastructure deployment. Latvia targets regulation of the e-health system via the Unified Electronic Information System of the Health Sector.

Overall, almost all OECD and other responding countries have policies to promote use of digital technologies in households and by individuals. Most include various ways to reduce the digital divide with targeted groups of population. Education, training and skills are also significant policy strands. In addition, governments implement a wide range of policy instruments to promote cybersecurity, trust and consumer protection.

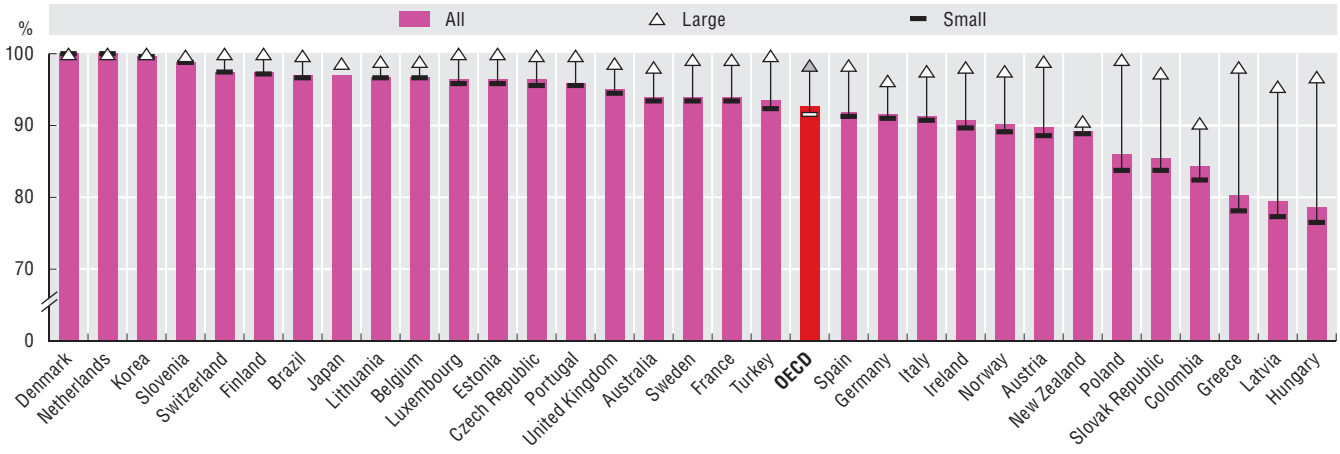
ICT usage by businesses

There are innumerable ways in which the digital revolution is transforming business models, production and competitiveness. The large majority of businesses use at least some ICTs. In 2019, on average 93% of enterprises in OECD countries had a broadband connection (Figure 4.9), up from 85% in 2010. The increase in connectivity was particularly high in Lithuania and Poland (19 percentage points). Higher uptake has also narrowed the gap between large and small firms to less than 7 percentage points, on average, compared to 15 percentage points in 2010. Virtually all large firms (98% on average in the OECD) and more than 91% of small firms are now connected to broadband. Nonetheless, the gap between large and small firms remains significant in Poland, Latvia, Greece and Hungary, at 15 to 20 percentage points.

While broadband connectivity appears to be approaching saturation, a different picture emerges when considering high-speed broadband (100 Mbps or greater). Only 20% of businesses, and 50% of large firms, in OECD countries benefited from high-speed broadband in 2018.

Figure 4.9. Broadband connectivity by size, 2019

As a percentage of enterprises in each employment size class



Notes: Except where otherwise stated, only enterprises with ten or more employees in manufacturing and non-financial market services industries are considered. Size classes are defined as: small (10-49 employees), medium (50-249 employees) and large (250 employees or more). Fixed broadband only except Canada, Japan, Korea and Switzerland, which include mobile broadband. For Australia, data refer to, respectively, the fiscal years ending on 30 June 2011 instead of 2010 and to the fiscal year ending on 30 June 2017 instead of 2019. For New Zealand, data refer to 2016 instead of 2018. For Japan and Korea, data refer to 2018 instead of 2019. For Brazil, Colombia and Switzerland, data refer to 2017 instead of 2018. For Japan, data refer to businesses with 100 or more employees instead of 10 or more; medium-sized enterprises have 100-299 employees and large ones 300 or more. Data include leased lines and mobile broadband in 2018, but not in 2010. For Switzerland, data refer to 2011 instead of 2010. In 2017, broadband refers to broadband connection of more than 10 Mbit/s. In 2017, total businesses with 5 or more employees instead of 10 or more, and 5-49 employees as opposed to 10-49 employees. In 2011, total businesses with ten or more employees. StatLink contains more data.

Source: OECD (2020[20]), *ICT Access and Usage by Businesses Database*, *http://oe.cd/bus* (accessed in April 2020).

StatLink https://doi.org/10.1787/888934191749

The digitalisation of business will continue apace. This will be facilitated by technological developments such as the rollout of 5G networks and increasing connectivity of objects through the Internet of Things (IoT). However, diffusion is likely to remain uneven across firms (Box 4.1). Beyond simple measures based on counting firms with Internet connections, the share of employees using Internet-connected devices offers a more nuanced indicator of the extent to which ICTs have been embedded throughout the activities of a business. The share of employees using computers with Internet access has significantly increased across the OECD during the last decade. It nevertheless remains slightly lower among small firms compared to large firms (Figure 4.10). In 2019, there remained considerable variation across countries. More than 70% of employees used computers with Internet access in the Nordic countries. However, only 38% did so in Greece and Portugal, and fewer than 25% did in Turkey.

Businesses can choose from a wide range of digital technologies. Websites follow broadband as the most widely diffused tools, with 78% of businesses having a website in 2019. Despite being a hallmark of the online age, a much lower proportion of firms make e-commerce sales. Across OECD countries for which data are available, 24% of firms with at least ten employees received electronic orders in 2019 (Figure 4.11). This share, which has remained stable since 2016, increased only 5 percentage points from 2010. In 2019, e-commerce generated 19% of total turnover on average. Up to 90% of e-commerce revenue comes from business-to-business transactions over electronic data interchange applications. These observed patterns are dominated by the economic weight of large enterprises. In these cases, e-commerce sales represent on average 24% of turnover compared to just 9% for small firms.

Digitalisation allows greater business integration, beyond the information flows management within companies, for a variety of business functions. Enterprise resource planning (ERP) allows firms to benefit from a higher integration of information and processing across their various business functions. Customer-relationship-management (CRM) tools allow firms, through intensive use of ICTs, to collect, integrate, process and analyse information related to their customers. ERP and CRM are now respectively adopted by 36% and 30% of firms on average across the OECD, an increase of more than 10 percentage points since 2010.

Box 4.1. The heterogeneity of digital adoption among firms

Although most businesses are connected, digital technologies are still primarily seen as communication tools. Adoption rates tend to decrease as technologies become more sophisticated (OECD, 2019[21]).

In addition, digital adoption patterns tend to differ across firm size and technologies. For instance, small firms are less likely to use enterprise resource planning (ERP) systems than large firms. Businesses adopt ERP systems when they reach a critical size that allows them to deal with the complexity and the significant time, financial resources and reskilling required to implement ERP (Andrews, Nicoletti and Timiliotis, 2018[22]). Consequently, the ERP diffusion gap is significantly larger between medium and small firms than between large and medium-sized firms. The reverse is true for supply-chain-management software, cloud computing or big data analytics, for which the digital gap enlarges between medium and large firms.

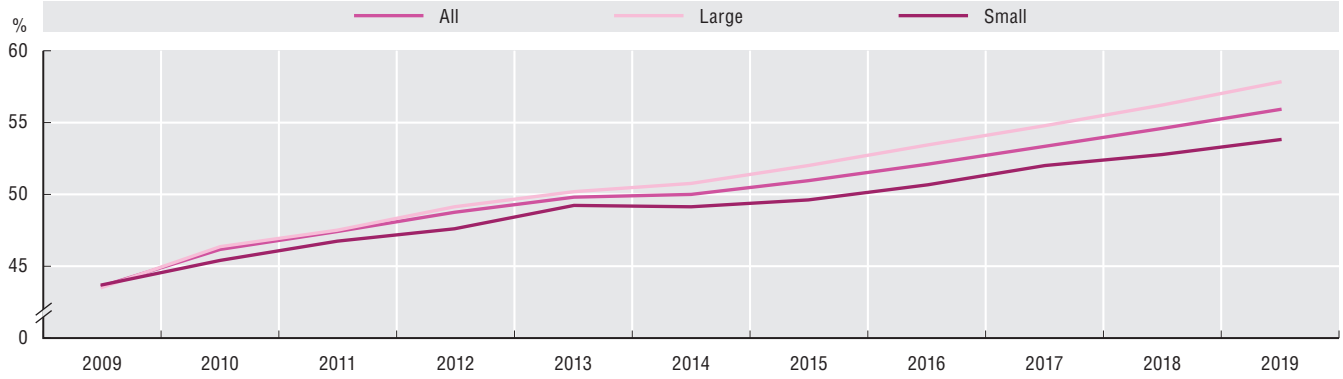
Digital transformation also occurs at different speeds. Small and medium-sized enterprises (SMEs), for example, are catching up to larger enterprises in the use of social media. Conversely, the adoption of business intelligence and supply-chain-management software has progressed little between 2014 and 2018, especially among smaller firms. Similarly, the proportion of small firms providing information and communications technology training to employees has not increased substantially in recent years. It remains comparatively low across the OECD.

SMEs face several size-related barriers in terms of awareness, skills and finance for adopting new digital tools and implementing complementary organisational changes. These barriers are a symptom of imperfections in product, credit and labour markets. They may also reflect the disproportionate impacts of regulatory complexities, administrative burdens and policy inefficiencies on this business population. SMEs account for 99% of all businesses in OECD countries, generating about 60% of employment and 50% to 60% of value added. Consequently, policy makers would increasingly like to see SMEs embrace and benefit from digitalisation.

Source: OECD (2019[21]), *OECD SME and Entrepreneurship Outlook 2019*, *https://dx.doi.org/10.1787/34907e9c-en*.

Figure 4.10. Employed persons using computers with Internet access, by firm size, OECD, 2009-19

As percentage of total persons employed by firms in each size-group



Source: OECD calculations based on OECD (2020[20]), *ICT Access and Usage by Businesses Database*, *http://oe.cd/bus* (accessed in April 2020).

StatLink https://doi.org/10.1787/888934191768

Cloud computing services have risen in popularity with the explosion of network density and speed, and sustained increases in the computing power on offer. One-third of firms across the OECD purchase cloud computing services, an increase of more than 10 percentage points in just five years. In particular, cloud computing allows small and medium-sized enterprises (SMEs) to access extra processing power and storage capacity, as well as databases and software, in quantities that suit their needs (OECD, 2019[21]). In addition to its flexibility and scalability, cloud computing reduces costs of technology upgrading. It exempts firms of up-front investments in hardware, as well as from regular expenses on

maintenance, IT team and certification. It also supports the diffusion of other technologies, as well as new organisational and marketing practices.

More sophisticated and specialist ICT technologies are less widely used. These include big data analytics (BDA) and radio frequency identification (RFID), where uptake is limited to certain types of businesses.

Figure 4.11. Diffusion of selected ICT tools and activities in enterprises, 2019

As a percentage of enterprises with ten or more persons employed

Notes: CRM = customer-relationship management. Enterprise resource planning (ERP) systems are software-based tools that can integrate the management of internal and external information flows, from material and human resources to finance, accounting and customer relations. Here, only sharing of information within the firm is considered. Cloud computing refers to ICT services used over the Internet as a set of computing resources to access software, computing power, storage capacity and so on. Supply-chain management refers to the use of automated data exchange applications. Big data refers to the use of techniques, technologies and software tools for analysing big data. This, in turn, relates to the huge amount of data generated from activities that are carried out electronically and from machine-to-machine communications. Social media refer to applications based on Internet technology or communication platforms for connecting, creating and exchanging content on line with customers, suppliers or partners, or within the enterprise. Radio frequency identification (RFID) is a technology that enables contactless transmission of information via radio waves. For country exceptions, see endnote 2. StatLink contains more data.

Sources: OECD (2020[20]), *ICT Access and Usage by Businesses Database, http://oe.cd/bus*; Eurostat (2019[3]), *Digital Economy and Society Statistics*, Comprehensive Database (accessed in April 2020).

StatLink https://doi.org/10.1787/888934191787

Social media: A growing digital tool for businesses

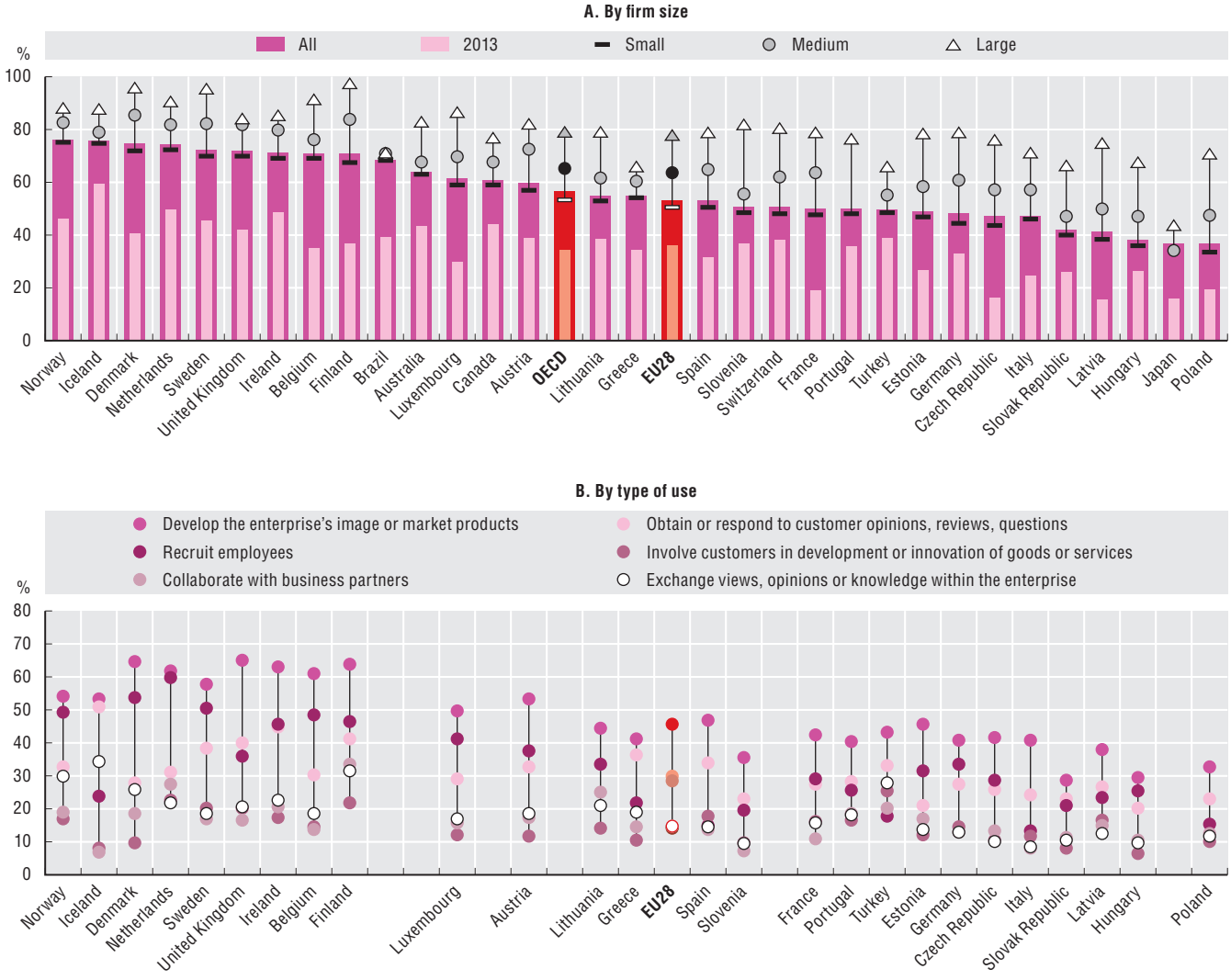
With skyrocketing pervasiveness in society, social media have become a multidimensional vector of information diffusion. Social networks are the most popular online activity in most countries, used by nearly three-quarters of Internet users in the OECD in 2019. Businesses and other organisations are also increasingly using social networks to communicate with individuals (e.g. potential customers). By 2017, more than half of businesses in the OECD had a social media presence, up from one-third in 2013. Even so, there is still a marked contrast between countries. Usage ranges from nearly 80% in Iceland and above 66% in Norway, Brazil, the Netherlands, Ireland and Denmark to below 30% in Japan, Poland and Mexico. Medium and large enterprises are more likely to use social media. In 2017, fewer than one in three small firms in the OECD used social media compared to almost three-quarters of large firms.

Businesses primarily use social media for external interactions. These uses include developing the enterprise's image and marketing products, as well as to obtain or respond to customer opinions, reviews or questions. Much less frequently, they use social media to involve customers in the development or innovation of goods or services. Social media are also used as a channel to collaborate with business partners, although there are other tools for this kind of interaction. Social media have also become an important tool to recruit employees. Within the European Union, more than half of large firms used it for recruitment in 2017.

Within enterprises, social media are seen as potentially enabling an exchange of views, opinions or knowledge within the work place. This use is still relatively poorly spread among small firms (about 12% in the European Union in 2017). However, it has a significant presence within large firms (near 30% in the European Union in 2017). For large firms, the uptake of social media is also closely associated with the uptake of BDA. This illustrates how some firms are undergoing an integrated digital transformation based on synergies between complementary digital technologies.

Figure 4.12. Enterprises using social media, 2019

As a percentage of enterprises in each group



Notes: For Australia, Brazil, Canada and Switzerland, data relate to 2017 instead of 2019, and for Japan to 2018. For the European Union, data relate to 2014 instead of 2013, and for Switzerland and Turkey, to 2015 instead of 2013. For Australia, Brazil, Canada, Japan and Switzerland, data by type of use are not available. OECD data figures are based on a simple average of the available OECD countries.

Sources: OECD (2020[20]), *ICT Access and Usage by Businesses Database, http://oe.cd/bus*; Eurostat (2019[3]), *Digital Economy and Society Statistics*, Comprehensive Database (accessed in April 2020).

StatLink https://doi.org/10.1787/888934191806

Big data analytics

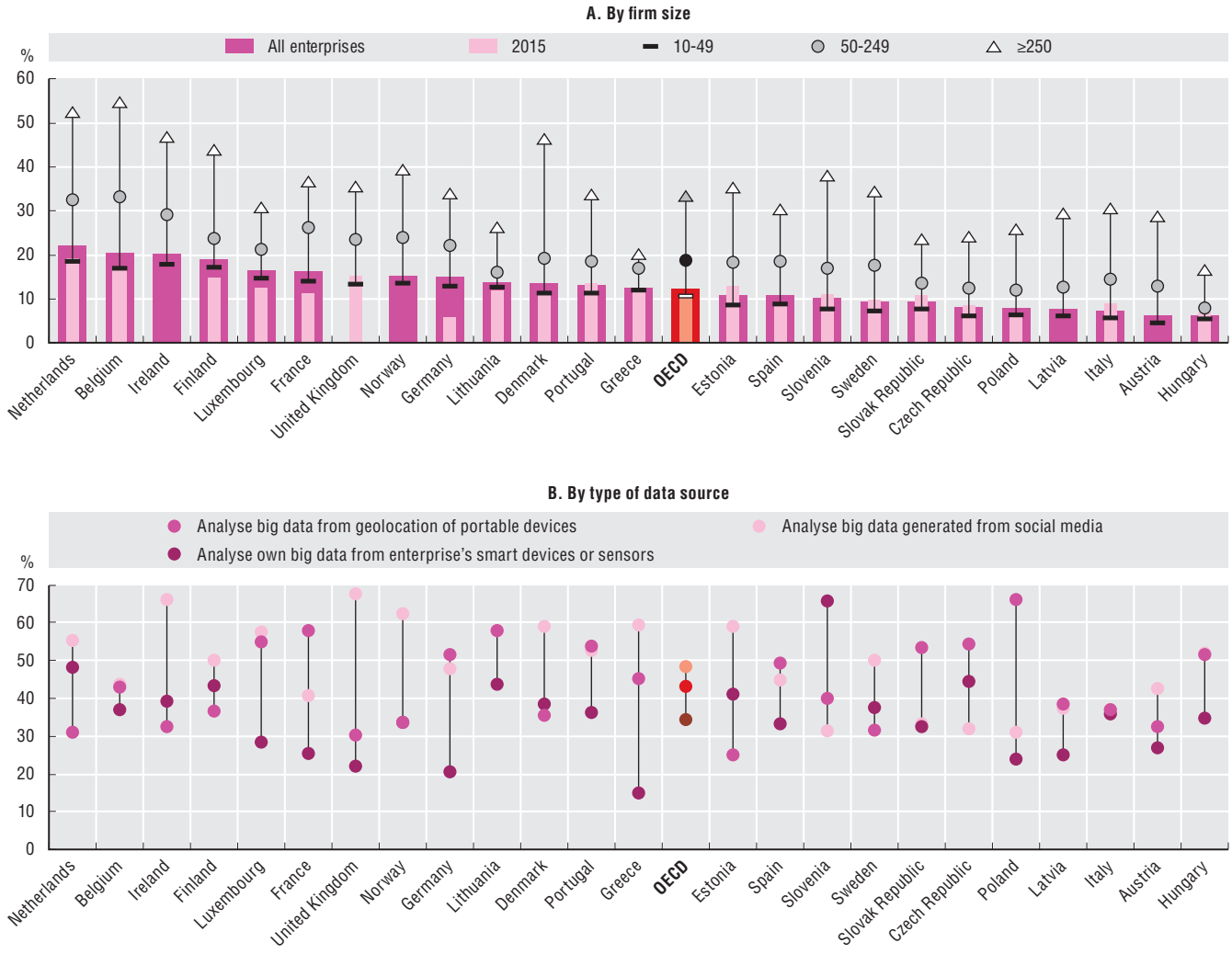
BDA refers to the use of techniques, technologies and software tools for analysing the huge amount of data generated from electronic activities and from machine-to-machine communications (e.g. data produced from social media activities, from production processes, etc.). The declining cost of data storage and processing have facilitated the collection of large volumes of data and the adoption of BDA. Meanwhile, the expansion of cloud computing combined with the advent of easier-to-use analytical

tools have made BDA more accessible to SMEs. Still, large firms remain by far the biggest and fastest growing category of users.

In 2017, on average, 12% of businesses in the countries for which data are available performed BDA. This share reached 22% in the Netherlands and over 20% in Belgium and Ireland (Figure 4.13). Among large firms, in over half the 25 countries for which data are available, more than one-third analysed big data. Further, in Belgium and the Netherlands, more than half of large firms performed BDA. Between 2015 and 2017, the share of enterprises performing BDA increased in most countries. The growth was significant among large firms and to a lesser extent medium-sized firms. It was particularly vigorous among large firms in Germany, France, Finland and Portugal.

Figure 4.13. Enterprises performing big data analytics, 2017

By firm size and by type of data source



Notes: For panel A, data are provided as a percentage of all enterprises (by firm size). For panel B, data are provided as a percentage of all enterprises analysing big data from any data source. For the United Kingdom, data relate to the year 2015. OECD data figures are based on a simple average of the available OECD countries.

Sources: OECD (2020[20]), *ICT Access and Usage by Businesses Database*, *http://oe.cd/bus*; Eurostat (2019[3]), *Digital Economy and Society Statistics*, Comprehensive Database (accessed in April 2020).

StatLink https://doi.org/10.1787/888934191825

The most intensive users of data originating from geolocation of portable devices tend to be in the transportation and storage industry, and to a lesser extent in the construction industry. Businesses in industries such as electricity, gas, steam, air conditioning and water supply, and manufacturing, are the most intensive users of data originating from smart devices or sensors. Social media data are mainly used in the accommodation and food and beverage service activities industry. The real estate

activities industry uses social media data to a lesser extent. Data from other sources are most used in three industries: information and communication; professional, scientific and technical activities; and real estate activities.

Policies to promote ICT usage in businesses

ICT adoption and usage by business can be supported in a wide variety of ways. Out of the 30 countries that responded to the section on Digital Uptake and Use of the OECD Digital Economy Policy Questionnaire, all but three – Italy, the United Kingdom and the United States – reported having policies to promote the use of digital technologies by businesses.

Policy objectives reported in the survey vary greatly and are often set out in broad terms. Most often policies are directed at firms with aims relating implicitly or explicitly to enhancing firms' profitability. These touch areas such as increasing sales, boosting competitiveness, lowering operating costs, reducing compliance costs and improving productivity. Policy objectives are also articulated at the more macro level in terms of driving growth and employment.

The uptake of digital tools and technologies is a stated means for achieving these aims. E-commerce, business tools and software, social media and online marketing, and security and privacy tools are all frequently noted. As such, policies tend to articulate intermediate objectives or targets around two outcomes. First, they want to ensure firms have access to the knowledge and skills needed to choose and use the tools that will most benefit them. Second, they want to help businesses adopt digital tools, which may include the need to fund investment expenditures.

Several countries support development and deployment of innovative products, especially digital services, to enhance competitiveness and thereby drive growth. The development and adoption of specific "frontier" technologies are a popular frame for policies. Artificial intelligence is most commonly mentioned, as well as 5G, IoT, blockchain, robotics, quantum technologies and others. Data generation, collation and analysis are also highlighted as important underpinning factors. Alongside this, several countries highlight the need to encourage efficient markets for technologies and for data.

Reducing digital divides is also a stated policy objective in some cases and can often be linked to high-level aims around well-being. Meanwhile, a number of countries highlighted policy strands around increasing government uptake of digital technologies to improve efficiency, including in modernising and automating tax systems. Several countries have targeted actions in "social sectors" where government is generally active, such as the promotion of e-health.

As they lag in terms of technology adoption, SMEs are the most common target for policies aiming to increase general digital skills, as well as technology awareness and adoption. The same is true of awareness campaigns around issues such as digital security and privacy, which many countries highlight as key areas of policy action. Policies related to developing specific technologies tend to be more narrowly targeted, focusing on specific companies or sectors, as well as on network operators and relevant researchers. Similarly, policies ultimately targeting wider social issues such as access to health care tend to focus on specific relevant sectors. Meanwhile, some policies are framed as being for the business community at large. However, SMEs may often be the most likely to benefit from the support offered.

Countries adopt a range of policy instruments to promote ICT usage in business (Table 4.2). Direct financial support measures are most widely used, followed by non-financial support. Indirect financial support, along with regulation and statutory guidance, are less often the instruments of choice.

Direct financial support includes grants to help targeted companies cover the costs of accessing digital technologies and tools. Korea, for example, offered grants for cloud services. For its part, Portugal offered direct financial support for website development and maintenance, e-commerce, online marketing and big data. In countries such as Denmark, Slovenia and Germany, direct financial support may also help businesses devise digitalisation strategies or augment digital capabilities and skills. While they do not directly promote the use of digital technologies by businesses, a considerable number of countries note the availability of grants or vouchers to support research and development (R&D) and other innovation activities. This support can contribute to technological advances and the development of innovative products for commercialisation. For example, in Germany, grant funding supports pre-commercial R&D projects in areas including big data, autonomous systems, IT security and service platforms.

Table 4.2. Policy instruments to promote digital uptake by businesses

By type of instrument

Countries	Financial support		Non-financial support	Regulations and statutory guidance	Total
	Direct	Indirect			
Australia	2	2	2	1	7
Austria	1	1	1	1	4
Chile	..	..	1	1	2
Colombia	1	1	1	1	4
Czech Republic	..	..	1	2	3
Denmark	2	..	3	2	7
Estonia	2	..	2	..	4
Finland	1	..	..	..	1
Germany	2	..	3	3	8
Israel	1	1	..	..	2
Japan	1	2	..	..	3
Korea	3	..	..	..	3
Latvia	2	1	1	3	7
Lithuania	1	1	1	1	4
Mexico	..	..	..	1	1
Netherlands	..	1	..	..	1
Norway	1	..	1	1	3
Portugal	1	1	1	..	3
Slovenia	1	..	1	..	2
Spain	1	..	..	..	1
Sweden	2	0	2	1	5
Turkey	1	..	..	..	1
Brazil	..	2	..	..	2
Costa Rica	..	..	1	..	1
Russian Federation	3	1	1	1	6
Singapore	..	..	1	1	2
Total	**29**	**14**	**24**	**20**	**87**

Note: .. = not available.

Source: OECD based on countries' response to the 2019 OECD Digital Economy Policy Questionnaire.

Indirect financial support includes tax credits or other relief for ICT investment (as seen in Brazil and Japan, for example). It also includes broader schemes of tax support for R&D, including for digital technologies. Many OECD countries have such generic R&D supports, including some that stated they had no policies to promote use of digital technologies by businesses. The Russian Federation, for example, provides indirect support through subsidies to credit institutions. This enables them to provide loans at preferential rates to help priority sectors introduce digital products, services and platform solutions.

Competence Centres offer measures to increase knowledge and awareness of digital technologies and their accompanying opportunities and risks. Australia, Lithuania, Sweden and Singapore, for example, provide tailored business advice and counselling services. Turkey provides tailored advice on regulations relevant to new business models with responses co-ordinated across government, while Latvia and Norway offer training. Countries such as Portugal and Slovenia enable firms to share experiences through showcasing "digital champions", group workshops, mentoring schemes and similar initiatives.

Regulations and statutory guidance are employed to lay legal foundations in a wide range of areas. The Czech Republic is co-ordinating efforts to enhance cybersecurity, including regulatory changes to codify the role of the National Cyber and Information Security Agency. Mexico focuses on financial technology, including creating regulations relating to financial technology institutions, crowdfunding

and e-money institutions. In Chile, regulations will make it easier and more common for businesses to accept electronic signatures (e.g. authorities, standards setting, education curricula, etc.). Meanwhile, Austria and Norway have mandated public sector suppliers to use e-invoices. Action in this area also includes establishing guiding principles and assessments to ensure regulation support and promote digitalisation. For example, in Denmark, authorities must assess regulation in accordance with stated principles. One such principle is to facilitate the integration of new business models in a technology-neutral manner to ensure user-friendly digitalisation.

Almost all OECD and other responding countries have policies to promote the use of digital technologies by businesses. In addition, many highlight policies that support technological advances and the development of innovative products, as well as their adoption. Policies are most commonly targeted towards SMEs. However, some policies are more inclusive in scope, while others are more narrowly targeted depending on the policy aims. Furthermore, countries use a wide range of policy instruments, even if different countries have similar intermediate and ultimate policy aims.

Digital government

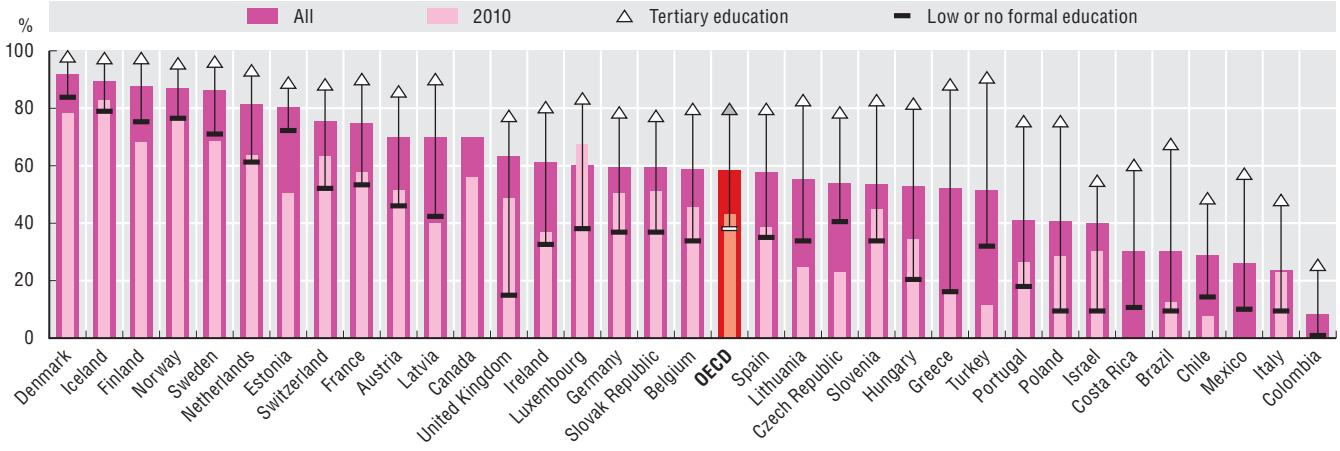
Over the past decades, large-scale reforms enabled greater efficiency and effectiveness of public services through digital transformation. As part of these efforts, governments made large investments to adopt new practices and modernise services to better respond to citizens' needs. Online service platforms common to several public sector organisations have been established to simplify administrative processes and improve interaction with citizens.

Governments are embracing digital technologies to enhance access to services and information

The share of individuals using the Internet to interact with public authorities in OECD countries has increased from 43% to 58% over 2010-19. Differences among countries remain large, however, ranging from over 80% in the Nordic countries to 8% in Colombia (Figure 4.14). The proportion of users with low or no formal education is about half that of individuals with tertiary education. Cross-country variations may reflect differences in various factors. These include Internet usage rates, the availability of e-government services, the propensity of users to perform administrative procedures on line, and data comparability.

Figure 4.14. Individuals who used the Internet to interact with public authorities, by educational attainment, 2019

As a percentage of individuals in each group



Notes: Unless otherwise stated, data refer to the respective online activities in the last 12 months. For Brazil and Colombia, data refer to 2018 instead of 2019. For Canada, data refer to 2018 instead of 2019 and to individuals aged 15-74 instead of 16-74, and 15-24 instead of 16-24. For Chile, data refer to 2009 and 2017. For Israel, data refer to 2017 instead of 2019 and to individuals aged 20 and more instead of 16-74, and 20-24 instead of 16-24. Data relate to Internet use for obtaining services online from government offices, including downloading or filling in official forms in the last three months. For Mexico, data refer to 2018 instead of 2019 and the interaction with public authorities includes the following categories: Communicate with the government, consult government information, download government formats, perform government procedures, and comment on government consultations. For Costa Rica, data refer to 2018 instead of 2018 and to individuals aged 18-74. OECD data figures are based on a simple average of the available countries. StatLink contains more data.

Source: OECD (2020[1]), *ICT Access and Usage by Households and Individuals Database*, *http://oe.cd/hhind* (accessed in April 2020).

StatLink https://doi.org/10.1787/888934191844

Online tax filing is one important way that users have embraced digital government services. All OECD and BRIICS countries (Brazil, Russian Federation, India, Indonesia, the People's Republic of China, South Africa) offer online tax filing for at least some types of tax. These range from personal and corporate income taxes to value-added tax filings by businesses. Taxpayers in Brazil, Costa Rica, Denmark, Italy, Mexico and Portugal must use online filing for both personal and corporate income taxes (Figure 4.15). In most countries, the share of corporate income tax returns filed on line is also above 80%. This trend is driven by a shift towards compulsory online filing. However, the share of businesses and especially of individuals required to file tax returns varies considerably between countries. In Estonia, online filing of personal income tax returns is not mandatory, but 96% of personal returns are filed via this channel.

Figure 4.15. Personal and corporate income tax returns filed on line, 2017

As a percentage of all tax filings

Note: For Iceland, the corporate tax return data refer to 2014.

Source: OECD (2019[23]), *Tax Administration 2019: Comparative Information on OECD and other Advanced and Emerging Economies*, https://dx.doi.org/10.1787/74d162b6-en.

StatLink https://doi.org/10.1787/888934191863

In 2019, the share of individuals citing unavailability of online submission channels as a reason for not submitting online forms to public authorities was generally low. The share was around 2% or under in most countries with such data (Figure 4.16). Unavailability of online submission channels appears to have increased in several countries. However, this most likely reflects greater awareness of survey respondents about unavailability (as a result of being more likely to seek how to submit forms on line), rather than the closure of online submission channels.

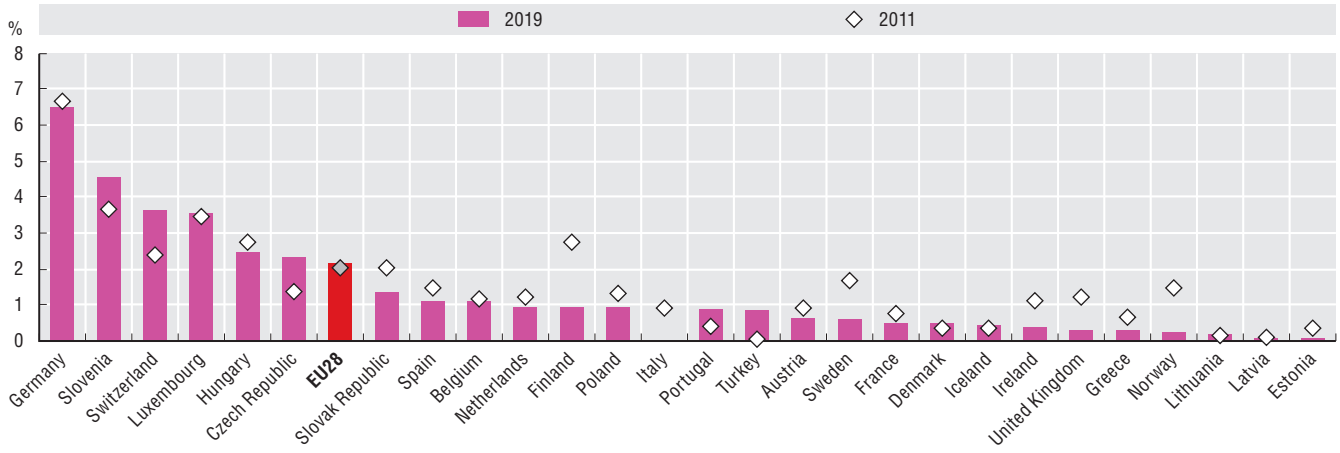
Co-ordination is a key factor for digital government

Becoming fully digital requires further coherence and integration of decisions and activities within and among public sector organisations (OECD, 2019[24]). This entails a shift from e-government (e.g. online tax payments systems) to digital government. The latter term refers to the use of digital technologies as an integrated part of governments' modernisation strategies to create public value. It relies on a digital ecosystem comprised of government actors, non-governmental organisations, businesses, citizens' associations and individuals. This ecosystem supports the production of and access to data, services and content through interactions with the government. For example, several governmental institutions might share an open data platform.

In 2014, OECD countries adopted the OECD *Recommendation of the Council on Digital Government Strategies* (OECD, 2014[25]). This aimed to support the development and implementation of digital government strategies that bring governments closer to citizens and businesses. Shortly after, the OECD Survey on Digital Government 1.0 was designed to monitor implementation of this Recommendation. It aims to assess progress of governments in their evolution from e-government to digital government.

Figure 4.16. Individuals who did not submit forms to public authorities on line due to service availability, 2019

As a percentage of all individuals



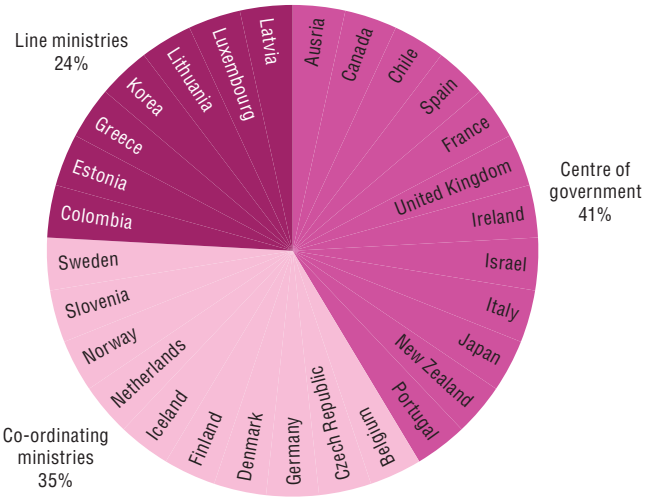
Note: For Switzerland, data refer to 2014 and 2017. For Turkey, data refer to 2012 instead of 2011.

Source: OECD (2020[1]), *ICT Access and Usage by Households and Individuals Database*, *http://oe.cd/hhind* (accessed in April 2020).

StatLink https://doi.org/10.1787/888934191882

According to the results of the aforementioned survey, 29 OECD countries have assigned the role of leading and co-ordinating digital government strategies at the central and/or federal levels to one or several bodies (OECD, 2019[24]). In 44% of these countries, the office/unit responsible for digitalisation strategies was located in the centre of government. In another 33%, the co-ordinating ministry was responsible, and a line-ministry was in charge in the remaining 23% (Figure 4.17). The management of these bodies/units is assigned to an appointed official, often referred to as the chief information officer.

Figure 4.17. Location of the body responsible for the digital government strategy, 2019



Source: OECD (2019[24]), *Government at a Glance 2019*, *https://dx.doi.org/10.1787/8ccf5c38-en*.

StatLink https://doi.org/10.1787/888934191901

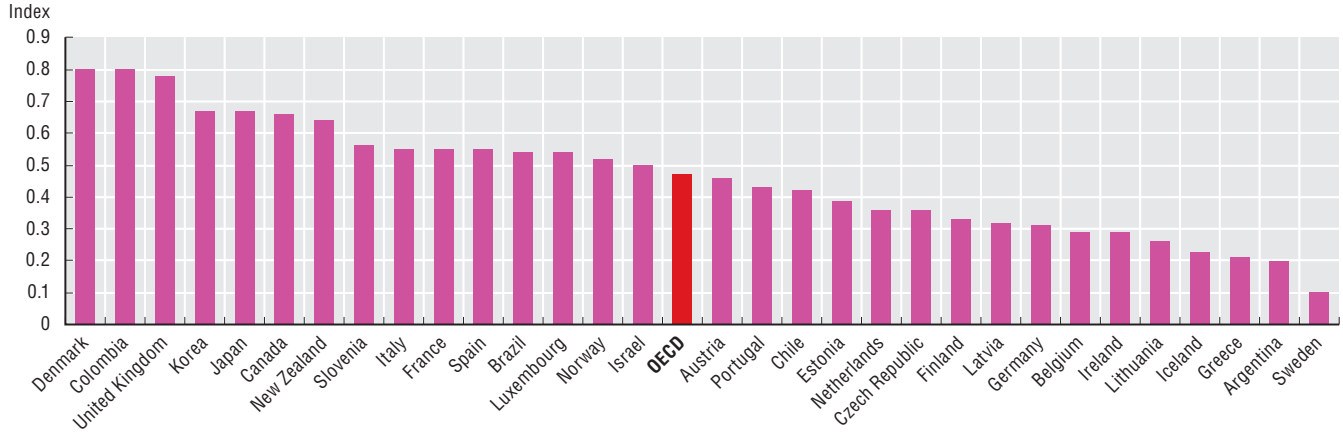
The body in charge of digital government can have both advisory and decision-making responsibilities. In its advisory role, it can co-ordinate development of the national digital government strategy (NDGS) and monitor its implementation. In its decision-making role, it can prioritise ICT project investment across the government and provide financial support for its development and implementation. On average, across the OECD, these bodies have six of the seven advisory responsibilities and three of five decision-making responsibilities enquired about in the survey. In Canada, the Czech Republic, Iceland, Israel, Korea and Luxembourg, these bodies have the widest range of responsibilities. Conversely, they have only an advisory role in Belgium and Sweden.

A fully digital government is user-driven and features government as a platform

When designing and delivering policies and public services, the governments of OECD countries are increasingly placing the needs of citizens and businesses at the core of design. The "user-driven" approach implies a profound shift from the traditional e-government model based on governments' assumptions or understanding of users' preferences. The OECD Survey on Digital Government 1.0 assesses the extent to which a government has adopted an open, inclusive, accessible, transparent and accountable process in the formulation of the NDGS. Questions focus on user engagement strategies, means to evaluate these strategies and initiatives to increase digital skills, notably for vulnerable segments (OECD, 2019[26]).

The user-driven index (Figure 4.18) shows large differences among countries, with the user-driven approach being the more advanced in Denmark, Colombia and the United Kingdom.

Figure 4.18. Governments with a user-driven approach, 2019



Source: OECD calculations based on *OECD Survey on Digital Government 1.0* (accessed in June 2020).

StatLink https://doi.org/10.1787/888934191920

As part of their digital government strategies, OECD countries have been developing an ecosystem to support and equip public servants to make policy and deliver services. This approach to "government as a platform" further allows government to explore opportunities to collaborate with citizens, businesses, civil society and others. In this way, they can co-create services, solutions and public value more broadly.

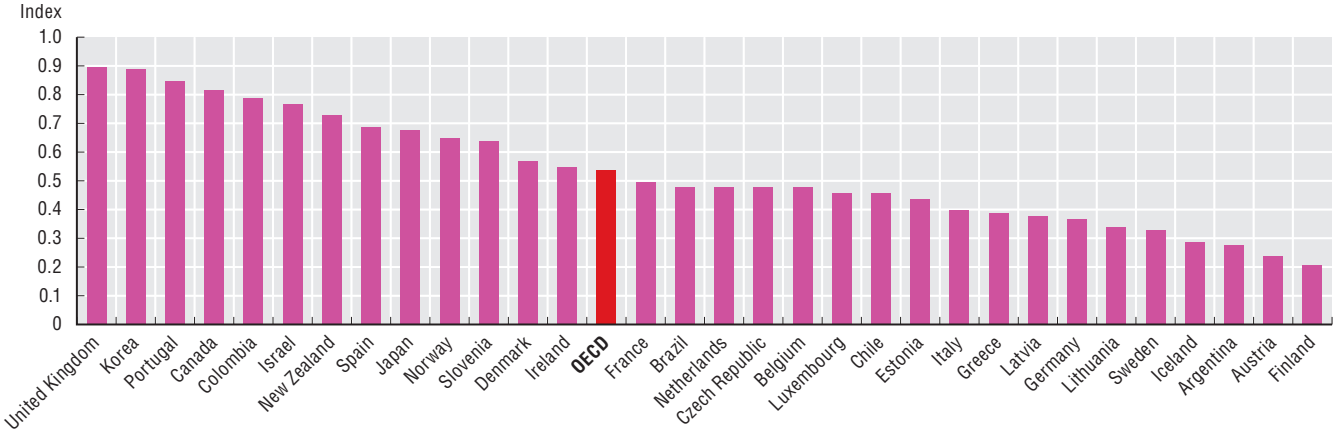
The OECD Survey on Digital Government 1.0 assesses the extent to which a government uses technologies and data to harness the creativity and knowledge of people and facilitate collaborations to jointly address policy challenges. In particular, it involves measuring stakeholder engagement in various governmental policy processes with the use of digital technologies. Countries report offering, most commonly, a range of non-financial support, as well as data as an enabler for greater collaboration (OECD, 2019[26]).

The degree to which OECD countries have embraced the government as a platform approach vary significantly (Figure 4.19). The United Kingdom, Korea and Portugal seem to be leading in this area, while the approach seems less developed in Finland, Austria and Argentina.

Over the recent period, rapid technological progress has significantly increased the amount of data generated in societies, including by government organisations. Open government data (OGD) can be used to strengthen public governance in various ways. It can improve the design of public services with a citizen-driven approach. It can enhance public sector efficiency and responsiveness. Finally, it can spur public sector integrity and accountability. Similarly, ensuring OGD availability, accessibility and use by public, private and civic actors provides many benefits. Governments can design more evidence-based and inclusive policies. They can stimulate innovation inside and outside the public sector, and motivate data-driven civic engagement. They can also better inform citizens' personal decisions and enhance public trust. Making data and evidence available across government departments

and ministries contributes to better policy making and greater co-ordination, and empowers businesses and civil society to also contribute (Chapter 5).

Figure 4.19. Countries with a government as a platform approach, 2019



Source: OECD calculations based on *OECD Survey on Digital Government 1.0* (accessed in June 2020).

StatLink https://doi.org/10.1787/888934191939

Skills for the digital transformation

Solid cognitive skills coupled with problem-solving skills and other competencies necessary to carry out tasks in online environments are key for enabling effective use of digital technologies and prospering in the digital society. This section provides some stylised facts on digital natives and the adult population. It examines new facets of the digital divide, shedding light on ICT skills demand in the workplace and possible mismatches. Finally, it reviews policies to develop the skills required to prosper in the digital society.

Connectivity at an early age does not always lead to higher skills

An increasing number of online activities related to education are undertaken both at school and at home. Connectivity for younger generations gains additional importance when children cannot attend school for various reasons such as long-term hospital care or the containment measures applied in many countries during the COVID-19 pandemic. In such circumstances, governments foster the use of digital solutions for education. Beyond the effectiveness of such teaching methods, helping children stay connected with regular academic and social activities has been shown to reduce difficulties during school re-entry (Ratnapalan, Rayar and Crawley, 2009[27]).

According to results from the ICT familiarity module of the OECD Programme for International Student Assessment (PISA), the age of first access to the Internet has been decreasing in almost all countries over the recent period (Figure 4.20). In 2018, 24% of 15 year-olds in the OECD area first accessed the Internet at the age of 6 or under as opposed to 18% in 2015 and 15% in 2012. The share of such students was around 40% in Israel, Estonia and Denmark. Only 0.3% of students in OECD countries reported never having accessed the Internet.

Top performers (i.e. academic all-rounders) have the highest level of proficiency in PISA as they achieved Level 5 or 6 in science, reading and mathematics concomitantly. They can draw on and use information from multiple direct and indirect sources to solve complex problems, and can integrate knowledge from across different areas. Such exceptional skills can provide a significant advantage in a competitive, knowledge-based global economy as they allow adapting to the scale, speed and scope of digital transformations. Between 2012 and 2018, the share of top performers in science, mathematics and reading decreased in most countries with available data (Figure 4.21). Despite a drop of about 2 percentage points in 2018, Singapore remained the country with the highest share of top performers (15%), followed by Estonia, Korea and Japan.

Figure 4.20. Students who first accessed the Internet at age 6 or under, 2018

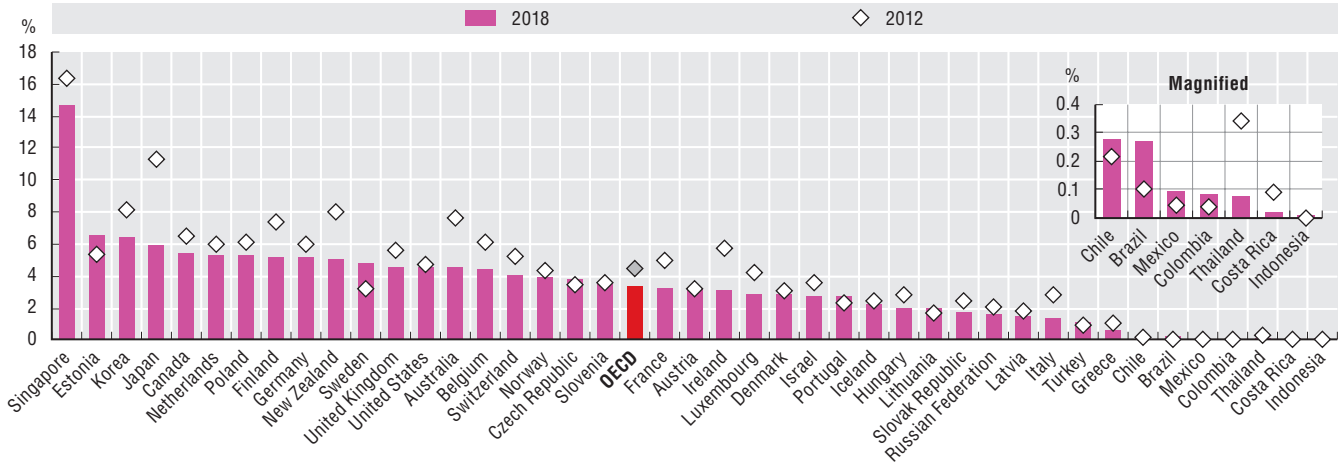
As a percentage of 15 year-old students

Source: OECD calculations based on *Programme for International Student Assessment (PISA)* (database), *www.oecd.org/pisa/data* (accessed in February 2020).

StatLink https://doi.org/10.1787/888934191958

Figure 4.21. Top performers in science, mathematics and reading, 2018

As a percentage of 15 year-old students



Source: OECD calculations based on *Programme for International Student Assessment (PISA)* (database), *www.oecd.org/pisa/data* (accessed in February 2020).

StatLink https://doi.org/10.1787/888934191977

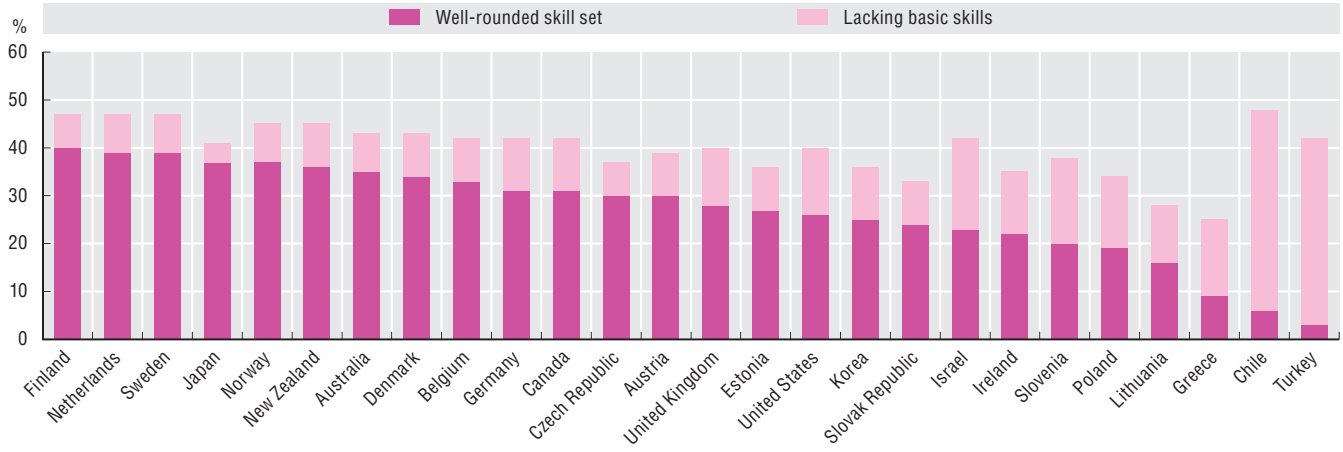
Evidence from the OECD Programme for International Assessment of Adult Competencies (PIAAC) enables a similar view to be drawn for adults. Individuals with a well-rounded skill set in terms of literacy, numeracy and problem solving in technology-rich environments gain an advantage. They can be expected to use digital tools more efficiently, carry out more sophisticated activities on line and better adapt to digital transformations. Countries with higher shares of top-performing students also exhibit higher shares of adults with well-rounded skills (the same is true for lower performance). This underlines the importance of formal education. Furthermore, the share of individuals lacking basic skills in Chile and Turkey is comparable to that of individuals with a well-rounded skill set in Finland, Norway and Sweden, pointing to a skills gap among OECD countries (Figure 4.22).

Training is one crucial way to upskill and reskill individuals to meet their personal digital skills needs. With the widespread use of digital technologies, alternative training channels such as massive open online courses (MOOCs) have become popular, especially among younger people. MOOCs can

help reduce the skills gap that has emerged as the digital transformation has changed skills needs (Music, 2016[28]). In 2019, around 14% of Internet users in the OECD area attended an online course with notable cross-country differences (Figure 4.23). Their share reached 70% in Mexico and 37% in Brazil but remained under 4% in Turkey.

Figure 4.22. Individuals' skill mix, 2012 or 2015

Percentage of 16-65 year-olds with a well-rounded cognitive skill set or lacking basic cognitive skills



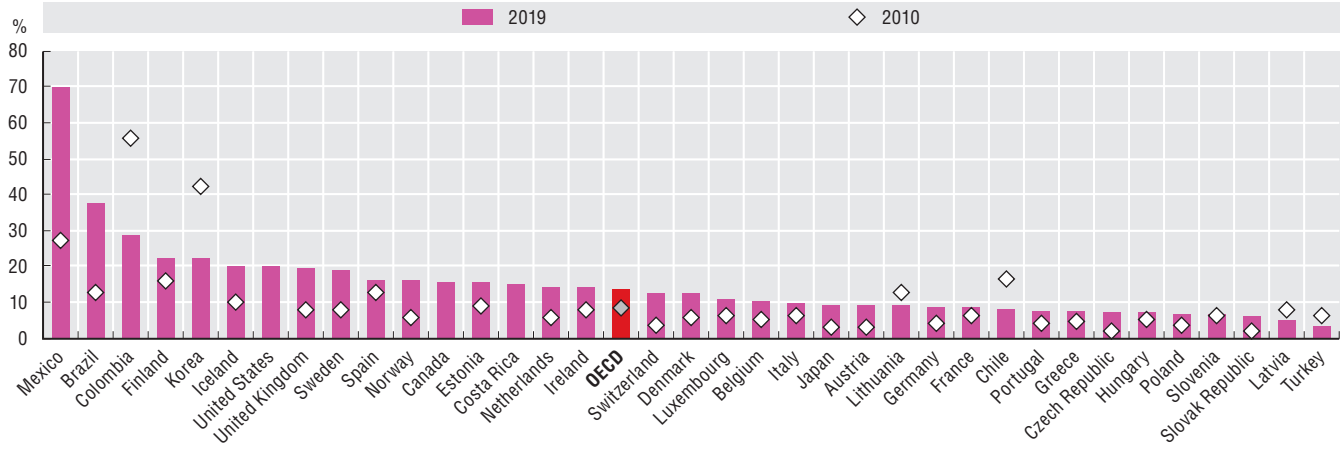
Notes: On the basis of the OECD's PIAAC assessment, individuals lacking basic cognitive skills score at Level 1 or below in literacy and numeracy and at most Below Level 1 in problem-solving in technology-rich environments (including those failing at the ICT core assessment and those who have no computer experience). Individuals with a well-rounded cognitive skill set score at Level 3 or above in literacy and numeracy and at Level 2 or above in problem solving in technology-rich environments. Data refer to 2012 for all countries except Chile, Greece, Israel, New Zealand, Slovenia and Turkey (2015). For Belgium, data refer to Flanders only. For the United Kingdom, data refer to England only.

Source: OECD calculations based on OECD (2019[26]), *OECD Skills Outlook 2019: Thriving in a Digital World*, *https://dx.doi.org/10.1787/df80bc12-en*.

StatLink https://doi.org/10.1787/888934191996

Figure 4.23. Individuals who attended an online course, 2019

As a percentage of individuals who used the Internet in the last three months



Notes: Data refer to 2017 for Chile and the United States, and to 2018 for Brazil, Canada, Colombia, Costa Rica, Japan and Mexico. For Chile, Colombia, Japan and Korea, the recall period is 12 months and data are as a percentage of individuals who used the Internet in the last 12 months. For Mexico, data refer to the category "To support education and learning". For Costa Rica and Japan, data refer to individuals aged 18-74 instead of 16-74. OECD data are based on a simple average of the available OECD countries.

Source: OECD (2020[1]), *ICT Access and Usage by Households and Individuals Database*, *http://oe.cd/hhind* (accessed in January 2020).

StatLink https://doi.org/10.1787/888934192015

According to 2018 data from the European Community Survey on ICT Usage in Households and by Individuals, 11% of Internet users undertook free online training courses or self-studied to improve their skills related to the use of computers, software or applications; only 3% undertook self-paid training courses. About 12% of Internet users reported having received on-the-job training from co-workers or supervisors and 9% took part in a training course paid for or directly provided by their employer. Over the recent period, the participation of Internet users in online courses has been generally lower in European countries compared to Canada, Korea, Mexico or the United States.

The digital divide tends to strengthen socio-economic disparities

As the Internet permeates every aspect of the economy and society, the digital divide has been evolving from one of Internet access to one of effective Internet use. Differences in people's digital activities may not matter if they have no effect on other outcomes. There is significant evidence, however, that most types of digital uses reproduce and even amplify non-digital inequalities (van Deursen et al., 2017[29]).

Skills play a key role in the emergence and evolution of digital divides. People with higher skills can make better use of the Internet and online activities. By using the Internet to expand their knowledge, find better jobs more easily, follow online courses or secure faster access to health care, the highly skilled can obtain more opportunities. Conversely, if low-skilled people use the Internet more for chatting and entertainment, they risk amplifying existing inequalities and undermining their well-being. To design policies that bridge the digital divide, policy makers must understand what types of skills help people get the most out of the Internet, and how important those skills are in relation to other determinants.

OECD (2019[26]) investigates the relationship between skills and digital divides, based on individual-based data from the European Community Survey on ICT Usage in Households and by Individuals (2016) and the OECD Survey of Adult Skills, a product of PIAAC.

The analysis profiles four types of Internet use:

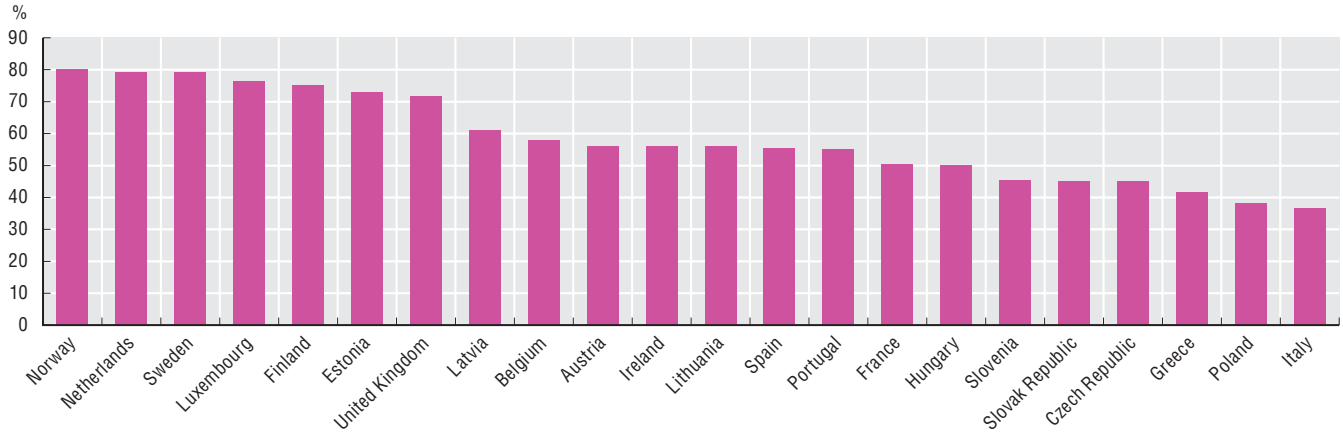
1. **Diversified and complex use**. Individuals in this profile perform on average the largest number and greatest variety of activities. They carry out the biggest share of online tasks linked to e-finance, learning and creativity, as well as activities performed by the smallest range of individuals and that can also be considered more complex.
2. **Diversified and simple use**. Individuals in this profile perform a range of activities, like those in profile 1, but fewer linked to finance, creativity and learning. Their main online activities revolve around communication, social networks, access to information and entertainment.
3. **Use for practical reasons**. Individuals in this profile use the Internet in diverse ways, albeit less so than individuals in profiles 1 and 2. They use the Internet mostly for communication, looking for information, e-health and Internet banking.
4. **Use for communication and information**. Individuals in this profile make the most specialised use of the Internet, mainly using communication tools and accessing the Internet to obtain information. These latter two activities combined make up for 70% of all activities performed on line by individuals in this user profile.

In 2016, in a majority of countries included in the sample, over half of individuals made "diversified and complex use" of the Internet (Figure 4.24). In Norway, the Netherlands and Sweden, about 80% of individuals engage in such activities, as opposed to less than 40% in Poland and Italy.

Socio-demographic characteristics appear to be related to the type of Internet uses. Individuals with diverse and complex Internet use are the most educated in the sample considered in the analysis: 39% have tertiary education and 41% have completed the upper-secondary education. Employed persons are also over-represented in this profile. They represent 70% of all individuals with a diverse and complex use. Finally, three out of four individuals in this Internet user profile are aged between 25 and 55, showing that young people (aged 16 to 24) and those aged 55 to 64 are less likely to make diverse and complex use of Internet (OECD, 2019[26]).

Figure 4.24. Individuals with diversified and complex use of the Internet, 2016

As a percentage of all individuals



Notes: The European Community Survey on ICT Usage in Households and by Individuals provides information on what actions individuals perform online grouped into 11 major activities: communication, social networks, access to information, entertainment, creativity, learning, e-health, e-banking, e-finance, e-government and e-commerce. The identification of individuals with diversified and complex use of Internet is based on a clustering algorithm (k-means) that groups individuals according to the similarity of their online activities. Individuals with diversified and complex use are individuals who perform, on average, the largest number (more than 8 out of the 11 types of major online activities) and variety of activities. They are also those who perform the bigger share of activities linked to e-finance, learning and creativity – activities performed by the smallest range of individuals which can also be considered more complex activities. The clustering algorithm is run on the entire sample of OECD countries with available data in the European Community Survey on ICT Usage in Households and by Individuals (2016).

Source: OECD (2019[26]), *OECD Skills Outlook 2019: Thriving in a Digital World*, *https://dx.doi.org/10.1787/df80bc12-en*.

StatLink https://doi.org/10.1787/888934192034

Figure 4.25 shows that around 40% of individuals with diversified and complex use of the Internet also have a good level of both literacy and numeracy skills. The share of highly skilled individuals is substantially lower in the other profiles. Less than 10% of those who use the Internet mainly for information and communication have good literacy and numeracy skills. The share of those lacking basic skills is more evenly distributed across the different profiles at a rather lower level. When literacy and numeracy skills are considered separately, more than 9% of people in profiles 2, 3 and 4 appear to lack basic numeracy skills. This suggests that a lack of such skills is not a barrier to participation in Internet activities. However, the lack of both literacy and numeracy skills does seem to be a barrier.

Based on a more restricted sample of available data on individuals who can use ICT tools and applications, the skills mix of individuals includes literacy, numeracy and problem solving in technology-rich environments. The problem-solving skills assessed in the OECD Survey of Adult Skills (PIAAC) are not digital skills per se, but basic computer literacy skills (i.e. the capacity to use ICT tools and applications).

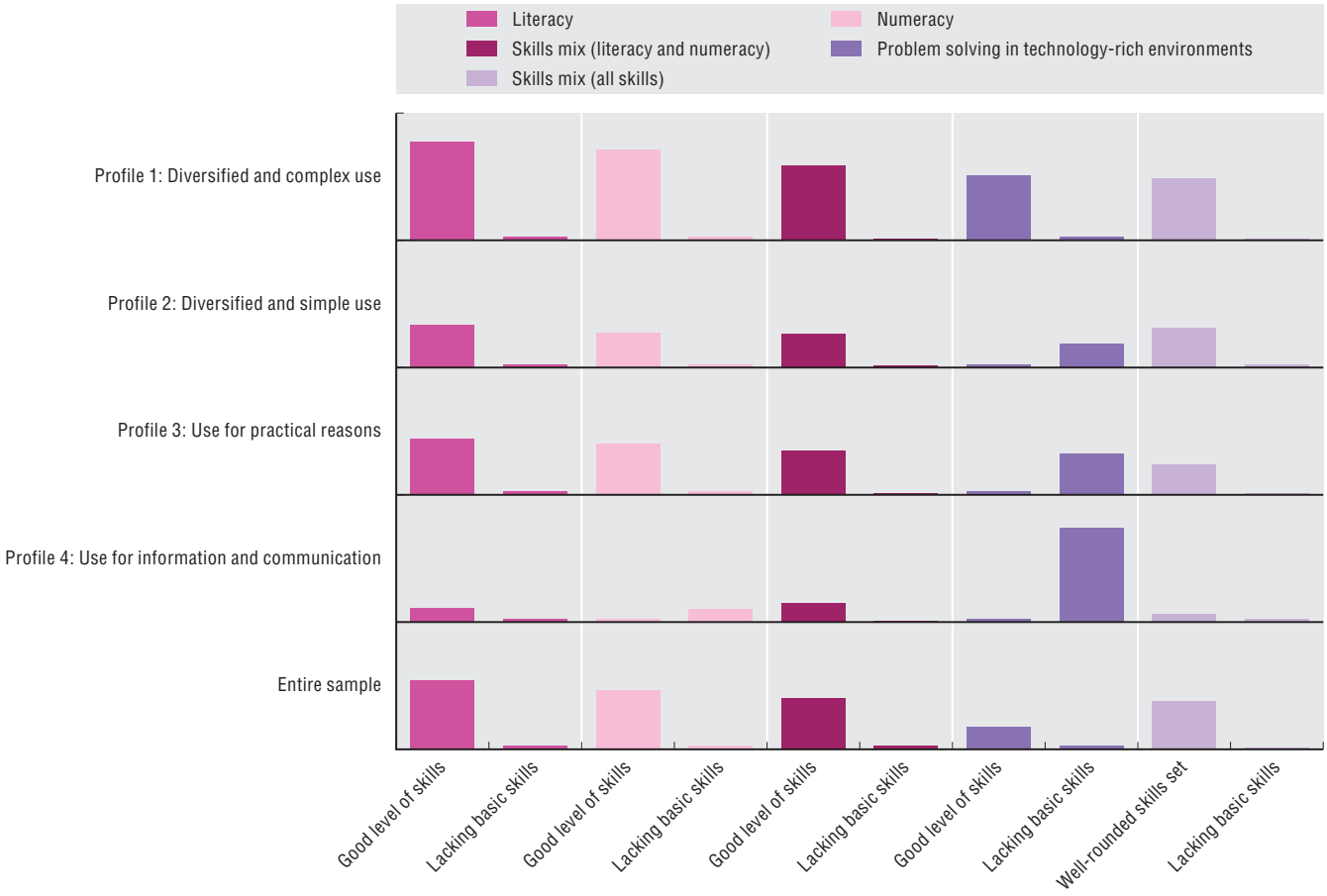
Individuals with a well-rounded skills set are over-represented in the diversified and complex use profile. However, fewer individuals are proficient in all three skills (34%) than those who are proficient in literacy and numeracy only (40%) (Figure 4.25). In general, the share of individuals with a good level of problem-solving skills in technology-rich environments is low across user profiles. Even among individuals with diversified and complex Internet use, almost one in five lacks basic skills to solve problems in a digital environment.

These results suggest that lacking problem-solving skills in technology-rich environments on its own might not be a barrier to participation in online activities, while lacking a mix of skills may be a strong barrier. Having a good level of cognitive skills seems to enable more diverse and complex Internet uses.

Therefore, digital inclusion policies should consider the acquisition of basic literacy and numeracy skills as they impact individuals' use of Internet in addition to factors such as age or employment status.

Figure 4.25. Skills of Internet users by profile, 2016

Share of individuals in each skill level category, by online user profile



Notes: The bars display the share of individuals in each skill level category. The maximum value of each share is 60%. For literacy and numeracy: individuals lacking basic skills score at most Level 1 (inclusive); individuals with a good level of skills score at least Level 3. For skills mix (literacy and numeracy): individuals lacking basic skills score at most Level 1 (inclusive) in literacy and numeracy; individuals with a good level of skills score at least Level 3 in literacy and numeracy. For problem solving in technology-rich environments: individuals lacking basic skills score at most Below Level 1 (inclusive) in problem solving (including failing ICT core and having no computer experience); individuals with a good level of skills score at least Level 2 (inclusive) in problem solving. For the skills mix (all skills): individuals lacking basic skills score at most Level 1 (inclusive) in literacy and numeracy and at most Below Level 1 (inclusive) in problem solving (including failing ICT core and having no computer experience); individuals with a well-rounded skill set score at least Level 3 (inclusive) in literacy and numeracy and at least Level 2 (inclusive) in problem solving. The analysis was performed on the file in which data from PIAAC was matched with that of the European Community Survey on ICT Usage in Households and by Individuals for seven countries (Czech Republic, Finland, France, Ireland, Italy, Lithuania and Spain). The sample for the analysis on the effect of good problem-solving skills includes individuals from the Czech Republic, Finland, Ireland and Lithuania. France, Italy and Spain did not participate in the problem-solving skills in technology-rich environments assessment. In the OECD Survey of Adult Skills (PIAAC): for Lithuania, data refer to 2015; for all other countries included in the analysis, data refer to 2012. For the European Community Survey on ICT Usage in Households and by Individuals, data refer to 2016. StatLink contains more data.

Source: OECD (2019[26]), *OECD Skills Outlook 2019: Thriving in a Digital World*, *https://dx.doi.org/10.1787/df80bc12-en*.

StatLink https://doi.org/10.1787/888934192053

Jobs are increasingly ICT-task intensive but there are signals of a skill mismatch

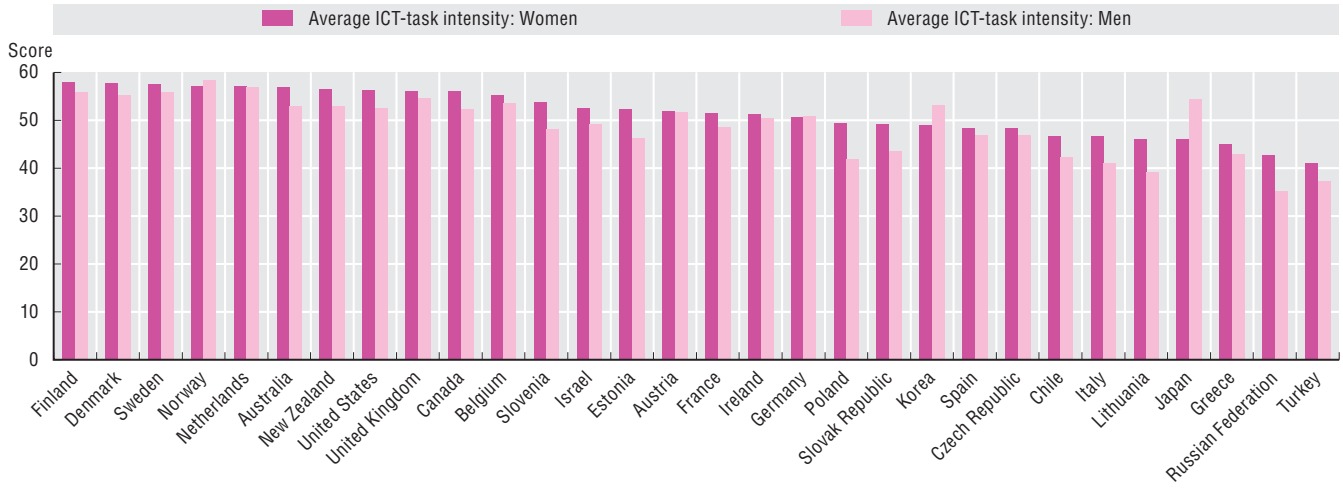
Individuals need the right mix of skills to succeed in technology-rich work environments and to be prepared for new and changing jobs. Evidence shows the importance of cognitive skills such as literacy, numeracy and problem solving for workers in any industry to thrive in a digital and interconnected global economy (Grundke et al., 2017[30]; 2018[31]). There is a growing consensus that transversal skills are critical. These include thinking critically and creatively, solving problems, making informed decisions while using technology and behaving collaboratively (OECD, 2016[32]).

Jobs differ in their ICT-task intensity – the frequency with which these tasks are undertaken. Software, finance, sales and marketing have generally more ICT task-intensive jobs. Conversely, jobs in areas such as accommodation and food, and health and social work tend to have relatively lower ICT-task

intensity. On the basis of the PIAAC data, the average ICT-task intensity of jobs ranges from around 40% in Russian Federation and Turkey to nearly 60% in Scandinavian countries (Figure 4.26). In almost all countries, the average ICT-task intensity of jobs held by women is greater than that of men, with differences being most pronounced in Eastern European countries, as well as in the Russian Federation. Japan and Korea are the only countries where the average ICT-task intensity of jobs held by men markedly exceeds that of women.

Figure 4.26. ICT-task intensity of jobs, by gender, 2012 or 2015

Average scores



Notes: ICT = information and communication technology. The ICT-task intensity of jobs indicator relies on exploratory state-of-the-art factor analysis and captures the use of ICTs on the job. It relies on 11 items from the OECD Survey of Adult Skills (PIAAC) ranging from simple use of the Internet to the use of a word processor, spreadsheet software or a programming language. The detailed methodology can be found in Grundke et al. (2017[30]). The data for the following 23 countries from the first round of PIAAC refer to the year 2012: Australia, Austria, Belgium (Flanders), Canada, Czech Republic, Denmark, Estonia, Finland, France, Germany, Ireland, Italy, Japan, Korea, the Netherlands, Norway, Poland, the Russian Federation (excluding Moscow), Slovak Republic, Spain, Sweden, the United Kingdom (England and Northern Ireland) and the United States. Data for the remaining countries refer to 2015 and are sourced from the second round of the first wave of the PIAAC survey. For the Russian Federation, the PIAAC sample does not include the population of the Moscow municipal area. The data published, therefore, do not represent the entire resident population aged 16-65, but rather the population of the Russian Federation excluding the population residing in the Moscow municipal area.

Source: OECD (2019[2]), *Measuring the Digital Transformation: A Roadmap for the Future*, *https://dx.doi.org/10.1787/9789264311992-en*.

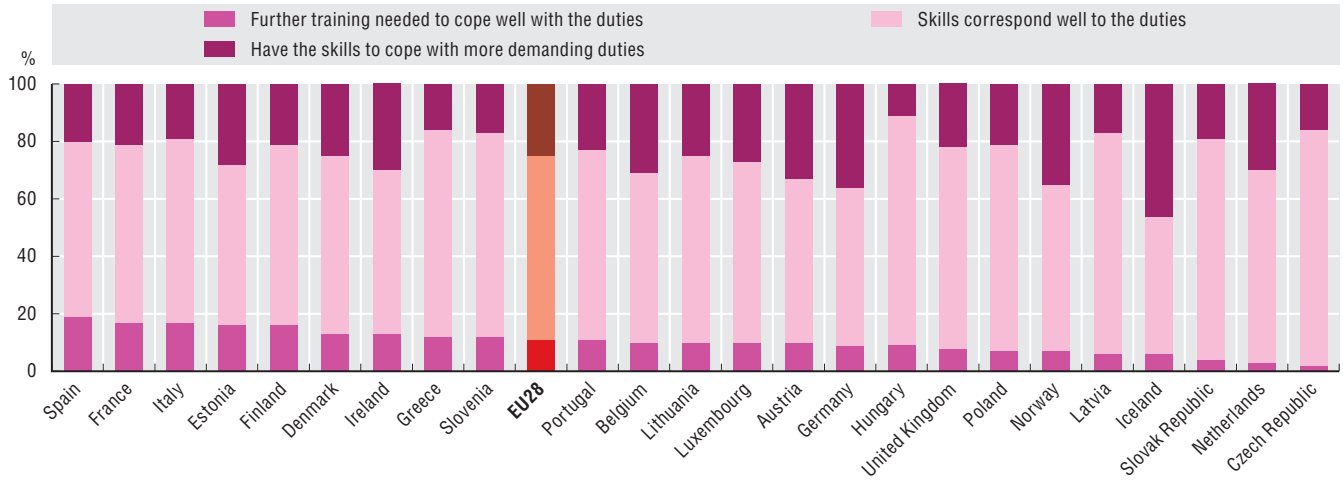
StatLink https://doi.org/10.1787/888934192072

In terms of ICT-related tasks performed at work, data from the 2018 European Community Survey on ICT Usage in Households and by Individuals show that "exchanging e-mails or entering data into databases" is the most common activity - undertaken at least once a week by over 80% of people who use computers or computerised equipment at work (OECD, 2019[2]). "Creating or editing electronic documents" is also commonplace, with over 60% of workers performing these tasks. Almost one-in-four workers in European Union countries use social media for work purposes at least once a week, although the data do not distinguish the active posting of content from more passive uses, such as using social media to follow news. On average, 30% of workers in the European Union use online applications to receive tasks or instructions for work, at least once a week. This includes those finding work through online platforms, as well as a wide range of situations such as workers in e-commerce fulfilment centres or hospital staff who receive instructions via apps on smart devices (e.g. the location of a product in a warehouse or of a patient in a hospital).

Self-assessments offer one perspective on the extent to which workers' skills match the ICT-related tasks needed for their work. In 2018, about 64% of workers using computers or computerised equipment at work in the European Union reported that their skills corresponded well to ICT-related aspects of their work duties (Figure 4.27). Meanwhile, 11% reported needing further training to cope with the ICT-related demands of their job. This figure is lower than the share of people whose ICT skills may be under-used; on average 25% declared that their digital skills exceed the requirements of their jobs. Considerable variation exists between countries, however. In Spain, France and Italy, nearly 20% of workers feel they need further ICT training, while in Germany, Norway and Iceland, over a third report having more advanced ICT skills than those used in their work duties.

Figure 4.27. Digital skills (mis)match at work, 2018

As a percentage of individuals who use computers or computerised equipment at work



Source: OECD (2019[2]), *Measuring the Digital Transformation: A Roadmap for the Future*, *https://dx.doi.org/10.1787/9789264311992-en*.

StatLink https://doi.org/10.1787/888934192091

Education and training policies increasingly focus on equipping individuals from all age groups to thrive in the digital age

The rapid pace of change at work and in society brought about by digitalisation requires flexible learning systems. These systems must be both *lifelong* (accessible to all at any age) and *life-wide* (promote and recognise learning acquired outside of formal education systems) (OECD, 2019[26]). Policies that favour such flexible systems are crucial to meet changing skills needs and manage the uncertainties surrounding these changes.

Policy makers aim to equip younger generations with key skills that form the foundation for learning in a digitalised world. To that end, they foster development of high-quality, equitable primary and secondary education systems. These include well-designed curricula, alongside early and targeted interventions to equip youth, especially those facing barriers, with key cognitive skills. Education systems also need a well-trained teaching workforce that can deal with an increasingly diverse student body and teach new types of skills. Finally, they need to measure quality by focusing on education outcomes rather than on how much spending has increased (OECD, 2018[33]).

A well-designed curriculum enables the acquisition of digital skills through multiple learning areas. However, it also aims to develop a broader range of skills such as creativity, the ability to think critically and openly, and the ability to act ethically.

In this respect, the ICT capability development framework developed by the Australian Curriculum, Assessment and Reporting Authority (ACARA) is an example of a progressive move. ACARA is helping the country shift from developing digital skills as part of stand-alone ICT classes to a more comprehensive approach in which digital skills are also fostered in other learning areas (OECD, 2019[26]).

In Australia, ICT capability development is organised around the following dimensions:

- managing and operating ICT (e.g. managing data, selecting and using software)
- communicating with ICT
- creating with ICT (e.g. using ICT to generate ideas or manage digital solutions for issues arising in learning activities)
- investigating with ICT (e.g. finding and analysing information, verifying sources and reliability of digital data)
- applying social and ethical protocols and practices when using ICT (e.g. recognising intellectual property, applying personal security protocols).

Students' proficiency is assessed in all these dimensions and across all school years as the development of ICT capability is considered to be a learning continuum. At the same time, ICT capability supports student learning in all subjects covered by the curriculum. For instance, students may use digital tools to create artworks, look for and critically analyse online information about historical events, or investigate mathematical concepts using multimodal technologies. A digital technologies learning area is also part of the curriculum, focusing on "understanding the characteristics of data, digital systems, audiences, procedures and computational thinking" (ACARA, n.d.[34]).

Over recent years, other countries have also been adapting the school curricula to changing skills requirements, including digital skills.

In Canada, several provincial governments have adopted a comprehensive approach to digital competence (OECD, 2019[26]). For example, the government of Manitoba has focused on developing "literacy with ICT", which spans all curricular areas. In a similar vein to the ACARA framework, literacy with ICT requires "thinking critically and creatively, about information and about communication, as citizens of the global community, while using ICT safely, responsibly and ethically" (Manitoba Education and Training, n.d.[35]). Students are assessed based on a developmental learning continuum.

In the Czech Republic, the Digital Education Strategy for 2020 aims to i) open education to new methods and ways of learning through digital technologies; ii) improve pupils' competences in information and digital technologies; and iii) develop pupils' computational thinking.

In Denmark, efforts are devoted to development and dissemination of educational material on digital skills, and to improve digital judgement and skills among children.

In France, a mandatory course on computational sciences and technology was introduced in 2019 at the upper secondary level. The objective goes beyond teaching ICT as a science to also discussing the role of digital technologies in society (Ministère de l'Éducation nationale et de la Jeunesse, 2018[36]). The government is also encouraging the creation of coding workshops outside classes. It will progressively introduce a certification of digital skills for students in their last secondary school year.

In Portugal, the curriculum at the primary and secondary education has been broadened since 2017. A guidance document to be followed by all schools sets out the knowledge, competencies and values to be acquired by all students upon completing upper secondary education. The guidance focuses on the ability to navigate a complex world competently through critical thinking, resilience and the ability to learn throughout life (OECD, 2019[26]).

In countries that have incorporated ICT skills in the curriculum, teachers need training in ICTs and often report this need (OECD, 2019[26]). For instance, a review of the ICT curriculum in the United Kingdom highlighted several gaps. First, the teaching profession needed to be more attractive for professionals with ICT skills. Second, current teachers needed more relevant continuous training. Third, there was a need to create qualifications recognising immediate levels of ICT skills (The Royal Society, 2017[37]).

For over a decade, countries across the OECD have been tackling the need for teachers to develop ICT skills through a range of policies. These range from developing national plans promoting this goal to introducing compulsory training, national accreditation standards or national certification for teachers (OECD, 2019[26]). Denmark, for instance, has developed a voluntary Pedagogical ICT Licence that combines pedagogical knowledge of ICTs and basic ICT skills training. It has become a European standard in the provision of ICT skills to teachers. Implemented at first for in-service training, this approach was expanded to initial teacher education and general upper secondary education. While not mandatory, the licence is integrated into the curriculum of student teachers who graduate from teacher education colleges (Rizza, 2011[38]).

Portugal recently implemented a Train the Trainers programme to promote digital skills and a safer and responsible use of the Internet. In so doing, it became another example of a country that recognises how a well-trained teaching workforce is key to increasing quality in education systems.

In parallel, countries also set up policies to enable life-wide acquisition of skills to tackle digital inequalities among adults, especially for the most vulnerable groups.

In Austria, the Pact for Digital Competence aims to foster development of digital competencies for comprehensive inclusion and for a beneficial increase in Internet use for all. Primary target groups are young career starters, off-liners, professionals aged 45 or more and seniors more generally.

In Colombia, the Digital Citizenship Strategy gives certification of digital skills, through face-to-face and virtual training for Colombian citizens, over the age of 13. Victims of armed conflict, persons with disabilities, communities social groups, detainees and Colombians residing abroad can also get this certification. In addition, the Digital Talent Strategy of the ICT ministry aims to design, include and promote programmes for the development of individuals' digital talent. Ultimately, this would achieve digital transformation, improve quality of life and contribute to sustainable development.

In Israel, the National Program for Digital Literacy aims to reduce the digital gap among citizens. In this respect, a Senior Citizens' Digital Skills Course is implemented for the elder generations. The Digital Community Initiative harnesses the power of the community structure to improve digital literacy among specific/targeted segments of the population.

In Latvia, a portal and training activities have been set up as part of the "My Latvia.lv. Do it digitally" programme to improve the skills of citizens and entrepreneurs to use public services digitally. Digital agents advise the public on the use of e-services in different life situations and how to operate safely on the Internet.

In Norway, the Digital Inclusion for All programme provides training to individuals who do not use ICT as part of their everyday life. It helps them acquire the skills needed to master these technologies with the elderly, women and immigrants as specific target groups.

In Portugal, the "National Digital Competences Initiative e.2030" aims to generalise digital access, use and literacy. At the same time, it seeks to stimulate employability and professional training and specialisation in digital technologies and applications. Further, it works to ensure strong participation in international R&D networks and the production of knowledge in digital areas. It assists both households and individuals in supplying digital competences that are essential both for exercising full citizenship and making a person more employable. To that end, it gives special attention to individuals with an identified need of digital competences.

In Sweden, the Digitalisation Strategy spans several social areas and provides a unified vision for a sustainable digitised country, which includes the National Digitalisation Strategy for the School System. The strategy aims at providing all children and pupils, young adults, with the skills they need for life and work life. In the long run, this will provide the basis to meet the future skills needs of the labour market. The curriculum for compulsory school and equivalent forms of education, upper secondary education and adult education have also changed to clarify the schools' mission to strengthen pupils' digital skills.

In the United Kingdom, a national entitlement to basic skills aims to reduce the number of adults who lack the essential digital skills for life and work. The Future Digital Inclusion Programme, funded by the Department for Education, supports adult learners to engage with digital technology and develop their digital skills in community settings. Through a network of 5 000 Online Centres, adults benefit from online courses and/or face-to-face delivery, either delivered in groups or one-to-one. The programme supports adults who are digitally excluded, and often unemployed, low skilled, disabled or with a learning difficulty. It also helps adults to gain the foundation skills needed to progress onto the new and essential digital skills qualifications that the Department for Education offers free to adults from 2020 onwards.

In Singapore, the TechSkills Accelerator (TeSA) offers various programmes to support ICT and non-ICT professionals. TeSA helps people upgrade and acquire new skills and domain knowledge that are in demand, to stay competitive and to meet the challenges of a fast-moving digital landscape. The programme is driven by the Infocomm Media Development Authority in partnership with Workforce Singapore and SkillsFuture Singapore. It also collaborates with industry partners and employers.

Finally, from the business perspective, additional policies to improve the skills for digital transformation include the following:

- technical assistance to SMEs through Business Digital Transformation Centers (Colombia)
- vouchers for raising digital competences (Slovenia)

- competence centres and learning laboratories for cybersecurity (Germany)
- reskilling and upskilling workers (Portugal)
- ICT training for SMEs (Israel)
- promotion of training and support skills for the ICT industry (Latvia)
- business consultations for SMEs (Lithuania).

Box 4.2. Ireland's ICT Skills Action Plan

The development and attraction of high-level ICT skills is crucial to the growth of the Irish economy and job creation. This is especially true given the projected growth of the ICT sector and the digitalisation of the economy. Ireland has formally sought to meet these skill needs through the ICT Skills Action Plan process, introduced in 2012. Technology Skills 2022: Ireland's Third ICT Skills Action Plan seeks to build on the momentum of the first two plans. This plan was devised with industry and the education and training sector. By 2022, planned interventions aim to deliver up to an additional 5 000 graduates annually through indigenous supply, with the remainder serviced by inward migration.

Although significant numbers of high-level ICT graduates are expected to enter the job market, the forecast level of demand for their skills to 2022 requires going beyond mainstream labour sources. The plan identifies priority actions for 2019-22 to meet this demand. It sets out to provide appropriate education and training pathways for people to train, learn and upskill in a variety of high-level ICT skills. These include data analytics, artificial intelligence, robotics, animation and gaming, among others.

Priority areas are as follows:

1. Expansion of provision in higher education – this plan places a strategic focus on fully utilising the range of learning opportunities available across the tertiary education system to deliver a range of pathways to meet skills needs now and into the future.
2. Pathways to ICT – the plan builds on existing partnerships between the further and higher education sectors to deliver a new reskilling pathway. It provides an entry point at the further education level and a defined progression pathway to higher education programmes for learners from diverse professional backgrounds, including those employed in industries at risk from technological advancements.
3. ICT apprenticeships – the continued growth of ICT apprenticeships can play a major role in meeting skills needs and the Irish government aims to expand the apprenticeship model into ICTs.
4. Skillnet Ireland – Ireland's business support agency continues to expand and develop technology-focused business support networks. It has collaborated with the University of Limerick to launch Ireland's first Master's degree in Artificial Intelligence.
5. International talent – there is a continuing requirement to attract international talent, both from within the European Union and the European Economic Community (EEA) and through the Employment Permits System for skilled professionals outside the EEA.

These actions are implemented through a partnership between government, industry and the education and training system. They complement the ongoing upskilling of the country's talent base by the business sector.

Linkages between education, training, but also between industrial and employment policies, are needed to allow individuals to prosper in the digital society. Consequently, countries should opt for a whole-of-government approach (OECD, 2019[39]) and co-ordinate policy "packages" to ensure they are mutually reinforcing. Without co-ordination, policies may not deliver results.

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Notes

1. For Colombia, Korea and Japan, the recall period is 12 months, and for the United States, 6 months.

   For Canada and Japan, data refer to individuals aged 15-74 instead of 16-74, and for Costa Rica, to individuals aged 18-74 instead of 16-74.

   For Canada, data for the Cloud category relate to individuals who used the Internet in the last 12 months.

   For the e-government category, data relate to individuals who used the Internet in the last three months for Costa Rica, Israel and Mexico. For Costa Rica, it refers only to "obtaining information from public authorities". For Mexico, it includes the following categories: "communicate with the government", "consult government information", "download government formats", "fill out or send government forms", "perform government procedures" and "comment on government consultations".

   For online purchases, the recall period is three months for Australia, and data relate to individuals who used the Internet in the last three months for Australia, Costa Rica, Israel, Mexico and the United States.

   For travel and accommodation, data relate to individuals who used the Internet in the last three months for Australia, Mexico and Costa Rica. For Mexico, it refers to the following category: "reservations and tickets".

2. For countries in the European Statistical System, sector coverage consists of all activities in manufacturing and non-financial market services.

   For Australia, data relate to the fiscal year 2016/17, ending on 30 June, instead of 2018. For Broadband, data include "DSL", "fibre-to-the-premises", "cable", "fixed wireless", "satellite" and "other". For e-purchases, orders placed via email are also included. A broad definition of e-commerce transactions is used to include sales or purchases of goods or services via any other computer-mediated networks. For Cloud Computing, data refer to 2016.

   For Canada, the North American Industry Classification System is used instead of ISIC Rev.4, and data relate to 2017 for ERP, Cloud Computing and Social Media, and to 2013 for the other items.

   For Iceland, data relate to 2014 for Broadband, e-purchases and Cloud Computing, and to 2013 for High-Speed Broadband.

   For Japan, JSIC Rev.13 division is used instead of ISIC Rev.4 and data include total businesses with 100 and more persons employed instead of 10 and more. Data for small firms (10-49) are not included. For large firms, data refer to 300 and more employees instead of 250 and more. Data refer to 2018.

   For Korea, data refer to 2018 instead of 2019.

   For Brazil, Colombia and the United States, data relate to 2017 instead of 2019.

   For New Zealand, for industrial classification, ANZSIC06 division is used instead of ISIC Rev.4, and data refer to 2016 instead of 2019.

   For Switzerland, data refer to 2017 and to firms with respectively 5 or more employees instead of 10 or more, 5-49 persons employed instead of 10-49, 50-299 employees instead of 50-249, and 300 and more employees instead of 250 and more. For e-sales, data refer to the proportion of total businesses making sales through the Internet and no recall period has been specified (instead of the last 12 months).