Increasingly Connected Households and Businesses, but Persistent Disparities

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The development of digital technology is reshaping the French economy and society. In 2017, 84% of households had access to the Internet at home, double the number in 2006. Over the past ten years, devices and practices have become more mobile. In 2018, eight out of ten people aged 15 and over reported having used the Internet in the last three months, mostly to send emails and search for information. However, in 2017 one in five people had no digital skills.
Digital platforms and e-commerce are developing rapidly, but remain minor in the sectors concerned. In 2017, electronic sales accounted for 30% of the turnover of companies with 250 or more employees, double the percentage ten years ago.
Among information technology, media and content (ITMC) activities, employment and value added are particularly dynamic in computer programming, consultancy and related activities. However, the digitalisation of the economy and society raises a number of questions. There are variations according to the profile of individuals, but also according to region and company size. For example, Internet access and usage and digital skills vary greatly by generation and, to a lesser extent, by educational level and standard of living. IT tools have ambiguous effects on employment and working conditions (jobs lost to automation, emergence of new professions, telework, etc.). Infrastructure, equipment and uses, including the rise of smartphones and the increase in mobile data traffic, have environmental impacts which, though difficult to quantify, are nonetheless real and growing. Digital technology also generates a considerable amount of data, which is of particular interest to businesses for advertising purposes, thus raising the issue of data protection.

The advent of desktop computers and the Internet in the 1990s, of laptops and mobile Internet in the 2000s and of smartphones in the 2010s have profoundly changed the way people produce, consume and sell, but also how they learn, communicate and entertain themselves. The work sheds light on the radical changes seen in the economy and society as a result of digital technology[1] using data from official statistics. The digital economy is approached from the perspective of the new practices related to the development of **information technologies, content and media** (ITCM) *(Box 1)*, focusing in particular on cultural practices, administrative procedures, trade, tourism, finance and labour. To measure digitalisation, the European Commission (EC) [2019] uses several dimensions: Connectivity (fixed and mobile Internet access), Human Capital and digital skills, Use of Internet Services, Integration of Digital Technology by

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This overview is the result of collaboration between official statistical bodies. It summarises the main findings of the work as well as recent research in official statistics published on the topic.
1. Here, the term "digital" will be used to refer to the widespread use of information technology to produce, store, process and disseminate information, while the term "digitalisation" refers to the transformation of the economy and society through digital technology.

businesses (including e-commerce) and Digital Public Services, as well as the economic activity of the sectors producing and distributing information technologies and providing information technology services. The dimensions defined by the EC will be used to provide a progress report on digitalisation in France before focusing on the challenges of digitalisation for the economy, society and the environment.

The Current Status of the Digital Transformation in France

In 2017, 84% of Households Had Access to the Internet at Home

With the development and democratisation of **information and communication technologies** (ICTs), the equipment owned by French people has changed over the last twenty years. In 2017, 77% of households had a desktop or laptop computer at home, while in 1995 just 13% of households owned a desktop computer. The proportion of households with Internet access (i.e. with network coverage and Internet access equipment) has doubled over the last decade or so, increasing from 42% in 2006 to 84% in 2017. Devices have become more mobile. In 2017, 93% of households owned a mobile phone, 62% a laptop computer and 42% a tablet computer *(Figure 1)*.

Box 1

The Challenge of Measuring the Digital Economy

In 2007, the OECD defined the **information and communication technology** (ICT) and **content and media sectors** as being increasingly produced and disseminated digitally. The OECD's definitions remain a reference today, despite the fact that they do not identify those sectors which have been profoundly transformed by digital technology, especially businesses that have created new natively digital goods and services. The digitalisation of the economy means new products, new business models, new players and major changes in value chains. Households are able to circumvent professionals and to interact directly with other households using digital platforms. By allowing direct and real-time contact between supply and demand, the digital economy generates a process of disintermediation and creates new consumption patterns that are playing an increasingly significant (albeit still limited) role in the economy as a whole.

Official statistics do not have access to all the data and classifications required to fully measure the extent of these changes in the economy. Sectoral approaches tend to classify businesses based on their main activity, regardless of their level of digitalisation. For example, Amazon is classified as a retail business – specifically, Retail sale via home-shopping by general catalogues – and thereby circumvents the information technology activities category. "Traditional" companies that are going digital and "digital" companies with certain traditional functions[1] also coexist within the same sector. Using an extensive definition that takes into account the level of digitalisation of sectors based on how intensively they use ICTs, 80% of the French economy may be described as falling under the influence of digitalisation [Inspection générale des finances, 2012]. Against this backdrop, the OECD is coordinating the implementation of a digital satellite account[2]. For now, however, measuring the economic impact of digital technology remains a "challenge" [Bellégo and Mahieu, 2016] and even a "statistical and intellectual challenge" [Gaglio and Guillou, 2018].

1. Online orders on Amazon's website generate transport, storage and warehousing activities.
2. This account "cannot be based on the definition of products or producers alone, since a focus on digital industries would exclude other industries that nevertheless use digital products, and conversely a focus only on digital products would exclude non-digital product transactions made possible by e-commerce" (Going Digital initiative).

Box1 (continued)

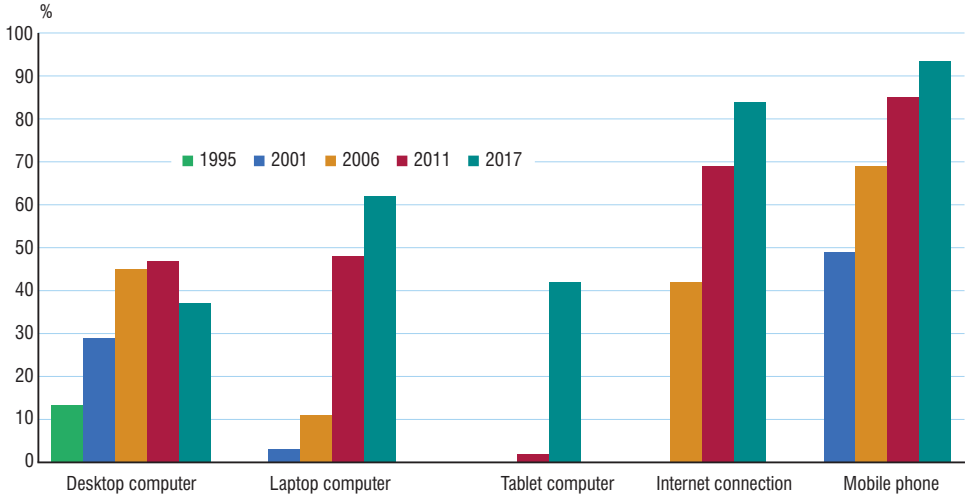
Therefore, this work quantifies the economy of the information technology, content and media (ITCM) sectors, corresponding to the scope of economic activities and products common to the various statistical sources used (national accounts, employment estimates, business statistics). ITCM sectors refer to the economic activities corresponding to the codes of the French Classification of Activities (NAF) and the associated products detailed in *Figure 1*. Companies in the ITCM sectors employ people in "digital" professions (e. g. developers, computer scientists, etc.) and employees in non-digital jobs, including support functions (assistants, accountants, etc.). On the other hand, "digital" jobs are spreading to all sectors of the economy, meaning that, for example, a data scientist might work for a business in the transport sector. The sectoral approach (based on NAF) and the occupational approach (based on professions and socio-professional categories) partially intersect but do not overlap.

1. Definition of Information Technologies, Content and Media (ITCM)

Code		Economic Activity	Definition
CI	**26**	**Manufacture of computer, electronic and optical products**	
	26.1	Manufacture of electronic components and boards	ICTs
	26.2	Manufacture of computers and peripheral equipment	ICTs
	26.3	Manufacture of communication equipment	ICTs
	26.4	Manufacture of consumer electronics	ICTs
	26.5	Manufacture of measuring, testing, navigating and control equipment; watches and clocks	ICT-related technologies
	26.6	Manufacture of irradiation, electromedical and electrotherapeutic equipment	ICT-related technologies
	26.7	Manufacture of optical instruments and photographic equipment	ICT-related technologies
	26.8	Manufacture of magnetic and optical media	ICTs
	46.5	Wholesale of information and communication equipment	ICTs
JA		**Publishing, audiovisual and broadcasting activities**	
	58	**Publishing**	
	58.1	Publishing of books, periodicals and other publishing activities	Content & media
	58.2	Software publishing	ICTs
	59	**Motion picture, video and television programme production; sound recording and music publishing activities**	
	59.1	Motion picture, video and television programme activities	Content & media
	59.2	Sound recording and music publishing activities	Content & media
	60	**Programming and broadcasting activities**	
	60.1	Radio broadcasting	Content & media
	60.2	Television programming and broadcasting activities	Content & media
JB	**61**	**Telecommunications**	
	61.1	Wired telecommunications activities	ICTs
	61.2	Wireless telecommunications activities	ICTs
	61.3	Satellite telecommunications activities	ICTs
	61.9	Other telecommunications activities	ICTs
JC		**IT and information service activities**	
	62	**Computer programming, consultancy and related activities**	ICTs
	63	**Information service activities**	
	63.1	Data processing, hosting and related activities; web portals	ICTs
	63.9	Other information service activities	Content&media

Notes: this field roughly corresponds to "information and communication technologies" (ICTs) and "content and media" as defined by the OECD. In the absence of data available at the NAF subdivision level in the national accounts and employment estimates, the repair of computers and communication equipment (95.1), which, according to the OECD, falls under the ICT category, is excluded. Conversely, ICT-related technologies are included.

1. Rate of Household Ownership of Electronic Goods, 1995-2017



Notes: the term "laptop computer" also includes netbooks and ultraportable laptops.
Coverage: Metropolitan France, ordinary households.
Sources: INSEE, 1995, 2001, 2006, 2011 and 2017 Family Budget Surveys (BDF) and 2006, 2011 and 2017 Statistics on Resources and Living Conditions Surveys (SRCV) (for Internet connection). The 2017 BDF data are provisional.

Ownership rates for these items have increased since 2011, while desktop computer ownership rates have declined (-10 points in six years). Smartphones have been widely and very rapidly adopted: within just seven years, the ownership rate rose from 17% in 2011 to 75% in 2018 [ARCEP, 2018]. This increase is mainly due to the development of high-speed and very high-speed broadband networks (3G, 4G).

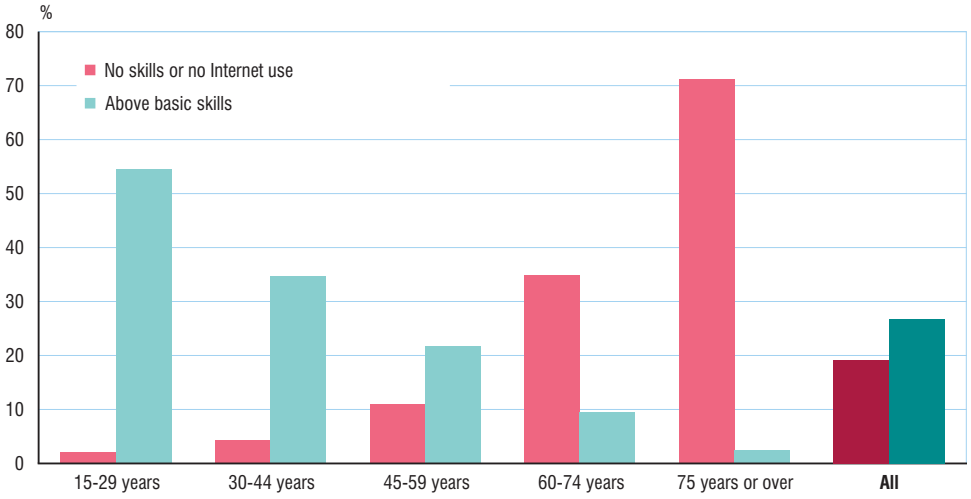
This trend is reflected in household spending patterns. In 2017, households spent 4.2% of their income on ICT and content and media goods and services, compared to 3.2% in 1960. Expenditure in this area increased until the mid-2000s, reaching 6.3% of total expenditure in 2006, as a result of an increase in pre-committed expenditure on telecommunications services (telephone subscriptions, radio and cable or satellite television channels, Internet), before decreasing in terms of household consumption due to a sharp drop in mobile telephone service prices.

In 2017, 19% of People Aged 15 and Over Had no Digital Skills

With the increased presence of digital technology in everyday life, new skills are needed to search for information online, communicate by email or via social media and use software. In 2017, 19% of people aged 15 and over residing in France excluding Mayotte had no **digital skills**, while 27% had above basic digital skills *(Figure 2)*. With significant age differences, the gaps are a reflection of the technological environments in which different generations have grown up: 71% of people aged 75 and over report having no digital skills, compared to less than 5% among those aged under 45. Conversely, 55% of young people aged 15 to 29 have above basic digital skills.

In order to develop these skills among the general population, digital technology is playing an increasingly important role in education and in teaching practices. In public education, the average number of computers increases gradually throughout the school system, from preschool

2. Level of Digital Skills by Age in 2017



Coverage: France excluding Mayotte, people aged 15 and over living in an ordinary household.
Sources: INSEE, 2017 ICT Household survey.

(maternelle) to high school (lycée), reaching 44 computers per 100 students in general and technological high schools and 62 in vocational high schools in 2018-2019. The level of computer access has increased by ten points in high schools (lycées) since 2010 [Chaumeron, 2018]. In 2018, 36% of teachers at middle school (collège) provided students with regular opportunities to use ICT, whether in class or as part of project work (+12 points since 2013). However, the practice is more common in other European countries. The development of digital skills is also a significant issue in the world of work. In 2018, 19% of companies with 10 or more employees provided their staff with ICT training.

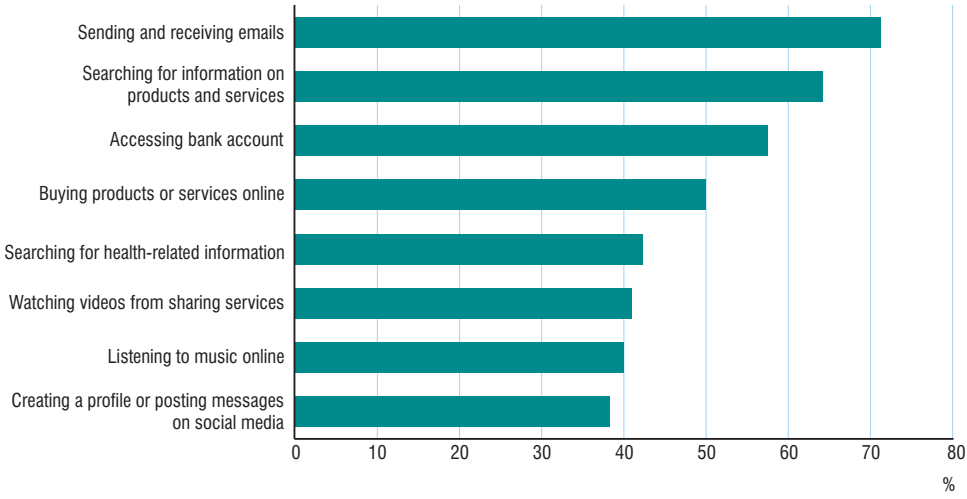
In 2018, 82% of People Aged 15 and Over Reported Having Used the Internet Within the Last Three Months

Internet use practices are developing and changing. Between 2009 and 2018, the proportion of Internet users over the last three months rose from 65% to 82%. With the rapid and widespread adoption of smartphones and the improvement of the 4G network, Internet use has become more mobile: In 2018, 68% of people reported having connected to mobile Internet over the last three months, compared to just 18% in 2009.

In 2018, the most common uses of the Internet were email, information searching and online banking, with more than half of people aged 15 and over having used the Internet for at least one of these reasons over the course of the last three months *(Figure 3)*.

Half of the population made online purchases (clothing, travel tickets, holiday accommodation, etc.), while 7% of individuals aged 15 and over reported having spent 500 euros or more on the Internet in the last three months. In addition, 42% of the population searched for health information. Young people are particularly keen on social and audiovisual uses. In 2018, three quarters of 15-29 years-old communicated via **social media**, watched videos and listened to music online, i.e. twice as many as in the general population.

3. Proportion of the Population that Carried Out the Following Activities Online At Least Once Over the Last Three Months in 2018



Coverage: France excluding Mayotte, people aged 15 and over living in an ordinary household.
Sources: INSEE, 2018 ICT Household survey.

Digital Platforms: A Small but Growing Market Share

Digital platforms generally represent a small share of the market in question. For example, rentals by private individuals on digital platforms such as Airbnb accounted for 14% of all commercial tourist accommodation in 2018, compared with 9% in 2015. In terms of crowdfunding for business, loans collected via digital platforms represent a small share of business financing as a whole (9% of total financing among companies that used crowdfunding in 2018). As regards individuals, in 2017 transactions (whether free of charge or not) between individuals on a platform concerned one third of households. For example, nearly 20% of households bought or sold something to an individual, while 8% reported having rented housing, accommodation, a place in a car or property in the last 12 months [Ferret and Demoly, 2019].

In terms of employment, digital platforms such as Uber, Deliveroo and Hopwork contribute relatively little to job creation. In France, platforms have contributed to an increase in self-employment. However, the increase in self-employment predates the rise of these platforms, having begun around fifteen years ago. The increase is linked in particular to the "auto-entrepreneur" status introduced in France in 2009 [Amar and Viossat, 2016; Montel, 2017]. In 2017, at least 200,000 self-employed people accessed their customer base using a digital platform, representing 6.9% of all self-employed workers. However, just half of them were exclusive users of these platforms. This is most often the case for taxi drivers, consulting engineers, trainers and craftsmen in the building trade [Babet, 2018]. Beyond jobs, microwork on crowdsourcing platforms (Amazon Mechanical Turk, Clickworker, ClixSense, Wirk, etc.) no doubt partly escapes official statistics. In the case of France, based on the number of people who are regularly active on these platforms, this would represent a few thousand full-time equivalent jobs.

However, the weight of platforms can change quickly. In just ten years, the recorded music market has changed radically. The turnover generated by download and streaming platforms exceeds that of the physical market.

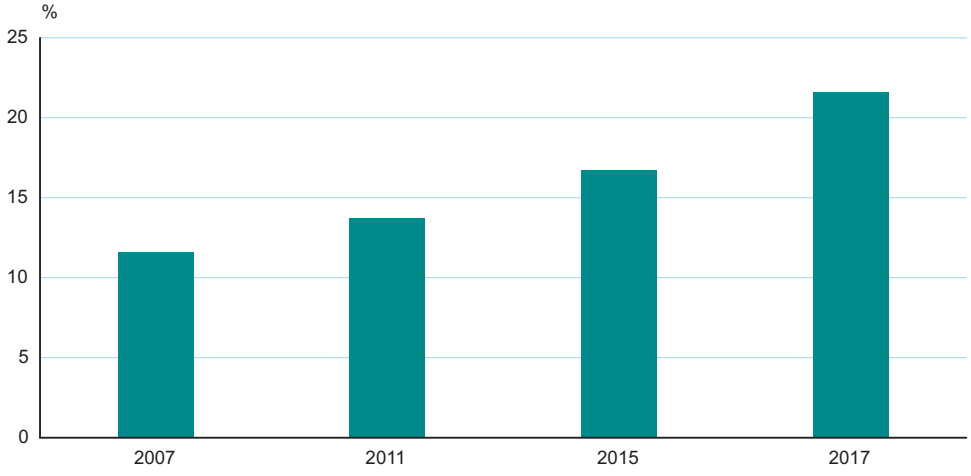
E-commerce is Becoming Increasingly Important in Business Activities

With regard to business digitalisation, in 2017 two thirds of all companies with 10 or more people had a website. This proportion has remained stable since 2013. By contrast, businesses' **social media** presence doubled over the same period (18% of companies with 10 or more employees in 2013 compared to 41% in 2017). Websites are generally used to describe the goods and services provided by companies and, in a quarter of all cases, can be used to place orders or make online bookings.

Against this backdrop, e-commerce is playing an increasingly important part in the business activities of companies based in France. In 2017, electronic sales accounted for 22% of the turnover of businesses with 10 or more employees excluding the agricultural, financial and insurance sectors *(Figure 4)*, representing an increase of 5 points in two years, compared to the same increase between 2007 and 2015. The increase is particularly significant in the case of companies with 250 or more employees, where the ratio of **electronic sales** to total sales has almost doubled in ten years, reaching 30% of total turnover in 2017. Most e-commerce transactions are B2B (86% of e-commerce sales), mainly through **electronic data interchange**. Online purchases by individuals account for just 14% of the e-commerce of businesses.

Businesses are adopting new tools, such as **enterprise resource planning**, **customer relationship management applications** and collaborative work tools. In 2017, more than 60% of companies with 250 or more employees used management and collaborative work tools. Investment in software is rising significantly, especially custom software developed or adapted to businesses' needs [Lavergne and Méot, 2015]. In 2016, software accounted for 75% of business and government investment in ICT and content and media (15% in the case of standard software and 60% in the case of custom software), representing a total of €27 billion. New technologies are becoming more widespread: in France in 2017, 8% of companies with 10 or more employees used **RFID technologies**, while in 2018 4% used 3D printing and 8% used robots.

4. Share of Electronic Sales in Company Turnover, 2007-2017



Coverage: companies with 10 or more employees based in France, in predominantly commercial sectors excluding the agricultural, financial and insurance sectors.
Sources: INSEE, 2008, 2012, 2016 and 2018 ICT Business Surveys.

The dossier entitled "*Cloud Computing and Big Data: Dematerialisation at the Service of European Companies*" [Pradines, 2019] explores two developing practices in business organisations. Cloud computing enables businesses to move away from all or part of their investments in IT infrastructure in favour of online services (software, storage, computing power, etc.). In France in 2018, 19% of companies with 10 or more employees used a paid cloud service, i.e. less often than in the European Union as a whole (26%). On the other hand, the analysis of **big data** from devices, sensors, geolocation and social media is more common in France than in the European Union (16% compared to 12%), particularly among large companies.

Programming and IT Consultancy: Dynamic Economic Activities

In 2016, information technology, content and media activities[2] accounted for 6.0% of the value added (in value terms) of the French economy, in line with the average across the European Union as a whole. Activities in this area are mainly dominated by the computer programming, consultancy and related activities sector (39%) and by the telecommunications sector (21%). Publishing, including the production of standard software (11%), and the manufacture of computer, electronic and optical products (10%) also accounted for a significant proportion of value added *(Figure 5)*. Since 1999, the weight of the industrial sector has declined (-7 points between 1999 and 2016), as has that of the telecommunications sector (-5 points), in favour of the computer programming, consultancy and related activities sector (+10 points). For nearly twenty years, the increase in the value added of ITCM activities in volume terms has been more dynamic than the economy as a whole, particularly in the early 2000s and since 2012.

The external balance of goods and services in the ITCM sector has worsened, falling from -4.2 billion euros in 1999 to -15.9 billion euros in 2016. This decline is mainly due to the increase in imports of computers and telephone and communication equipment and to the decrease in French exports of high-tech computer products for specific businesses.

5. Information Technologies, Content and Media (ITCM)

	Employment in 2016	Employment trends 2000-2016 (%)	Number of legal units as at 31 Dec 2017	Value added in 2016 (in billions of euros)	Distribution of value added (%)	
					1999	2016
Computer programming, consultancy and related activities	350.2	70.1	99 965	46.3	28.2	38.6
Manufacture of computer, electronic and optical products	132.1	-31.8	3 576	11.8	16.6	9.8
Publishing	124.8	-14.0	21 568	13.3	10.8	11.1
Telecommunications	119.3	-34.2	5 259	25.3	25.7	21.1
Motion picture, video and television programme production; sound recording and music publishing activities	56.0	9.0	34 588	7.2	5.7	6.0
Wholesale of information and communication equipment	54.4	-10.3	9 499	5.0	6.1	4.2
Information services	53.8	10.5	15 465	6.6	4.2	5.5
Broadcasting and programming activities	34.4	26.0	1 251	4.4	2.6	3.6
All ITCM	**925.0**	**1.2**	**191 171**	**119.9**	**100.0**	**100.0**
Share of ITCM in the total (%)	**3.7**	///	**4.1**	**6.0**	///	///

////: no result due to the nature of the situation. Notes: sectors of activity for employment and legal units; branches for value added except for "wholesale of information and communication equipment" where the sector was used since the trade account is sector-based.
Coverage: France for value added and legal units (non-agricultural commercial activities); France excluding Mayotte, employees aged 15 and over for employment.
Sources: INSEE, National Accounts, base 2014 and Trade Account; Employment Estimates; Register of Enterprises and Establishments (SIRENE).

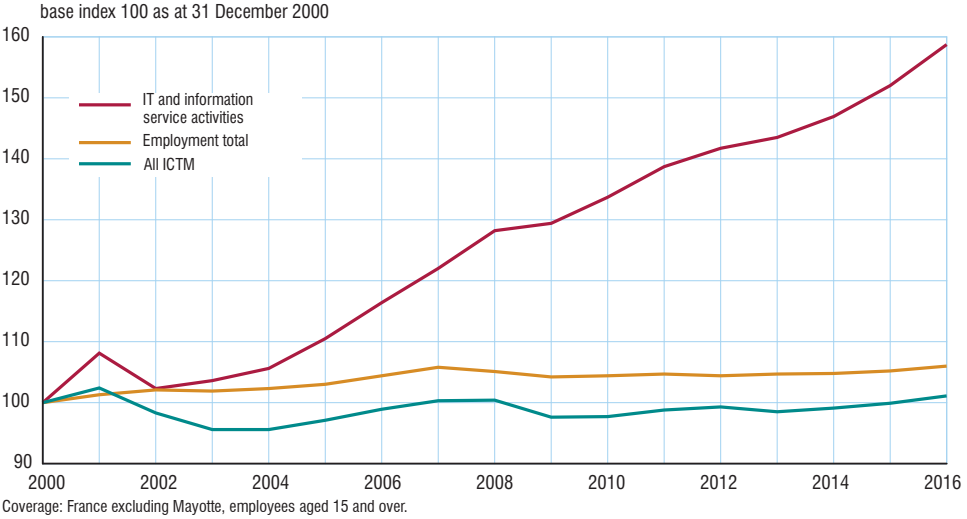
2. Reference to the ITCM sector alone provides only a partial measure of the digital economy *(Box 1)*.

At the end of 2017, the core activity of 191,200 legal units (companies and sole proprietorships) was in the field of ITCM, representing 4.1% of all legal units in the non-agricultural market economy. More than half of these legal units were involved in computer programming, consultancy and related activities. 22% of legal units operating in the ICT and content and media sectors are micro-entrepreneurs. Large corporations and intermediate-sized enterprises generate three quarters of the total turnover within the ITCM sectors, more than in the economy as a whole (excluding the agricultural and financial sectors). In addition, as in many sectors, companies belonging to multinational firms account for a large proportion of the ITCM sectors (79% of turnover).

At the end of 2016, 925,000 employees[3] worked in the ITCM[4] sectors in France excluding Mayotte, representing 3.7% of total paid employment, a slightly lower share than in 2000 before the bursting of the Internet bubble. Between 2000 and 2016, wage employment increased significantly in IT activities and information services (+149,000 jobs between 2000 and 2016; *Figure 6*). By contrast, employment fell sharply in computer manufacturing and telecommunications.

The ITCM sectors are highly innovative. Between 2014 and 2016, three quarters of businesses operating in these sectors innovated, compared to just half of all companies with 10 or more employees. A slightly higher number of ITCM businesses introduced **technological innovations** (62%) rather than **non-technological** innovations (organisational, marketing, etc.; 59%). The opposite applies when looking at businesses as a whole, with 33% introducing technological innovations and 42% making non-technological innovations. ITCM businesses are characterised by a greater proportion of staff dedicated to **research and experimental development** activities compared to businesses involved in R&D work as a whole.

6. Employment Trends in the ITCM sectors, 2000-2016



Coverage: France excluding Mayotte, employees aged 15 and over.
Sources: INSEE, Employment Estimates.

3. Due to the lack of available data, estimates only cover paid employment.
4. The ITCM sectors also employ people in non-digital positions (support functions such as assistants, accountants, etc.). Conversely, the digital professions extend beyond the ITCM sectors. The sector-based and occupation-based approaches partially intersect but do not overlap.

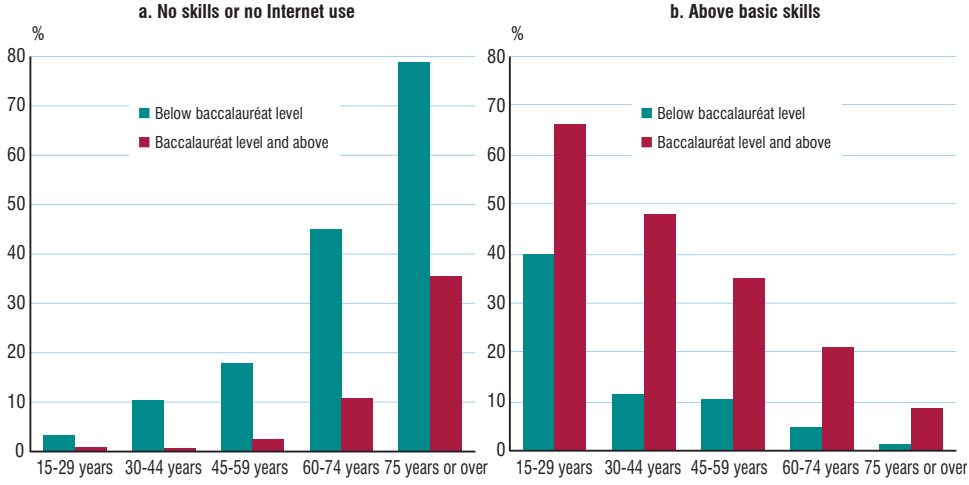
What Are the Challenges of Digitalisation?

Persistent Disparities

Despite the widespread use of devices, the widespread adoption of digital practices and the digitalisation of businesses and public services, significant socio-demographic disparities and disparities between regions and between businesses in mastering these new technologies remain. Although the proportion of non-Internet users in France is decreasing every year, in 2018 14% of French people reported that they had never used the Internet. This is especially true for the elderly and the less educated. Not having basic digital skills is detrimental to consumption and to participation in social and public life and the world of work [Baena and Rachiq, 2018]. In 2017, 35% of people aged 60 to 74 and 71% of people aged 75 and over did not use the Internet or had no digital skills *(Figure 2)*. These proportions also vary by education. The gaps between baccalauréat holders and those who do not hold a baccalauréat are particularly high among the older generations and narrow to the point of disappearing among 15-29 year-olds *(Figure 7a)*. The youngest generations have all already used the Internet. On the other hand, there are disparities in terms of digital literacy: 66% of 15-29 year-olds who hold a baccalauréat have above basic digital skills, compared to 40% of 15-29 year-olds who do not hold a baccalauréat *(Figure 7b)*. Despite being a recent phenomenon, the use of electronic products (mobile phones, computers, Internet access) is increasing rapidly among the elderly but slowing among the younger generations, where ownership rates have reached saturation point. For example, in 2017 83% of people aged 60 to 74 had access to the Internet, compared to just 14% in 2004. There are also disparities in household computer ownership by standard of living, although these have been on the decline over the last decade or so [Gleizes *et al.*, 2019].

The issue of disparities is particularly acute in the context of the dematerialisation of public services[5]. Without support, a part of the population that is not comfortable with digital tools is at risk of being excluded [Défenseur des droits [French Defender of Rights], 2019]. While 72% of higher education graduates filed their income tax returns online, just 20% of those with no qualifications or educated to primary level did so in 2018 *(Figure 8)*, the last year before

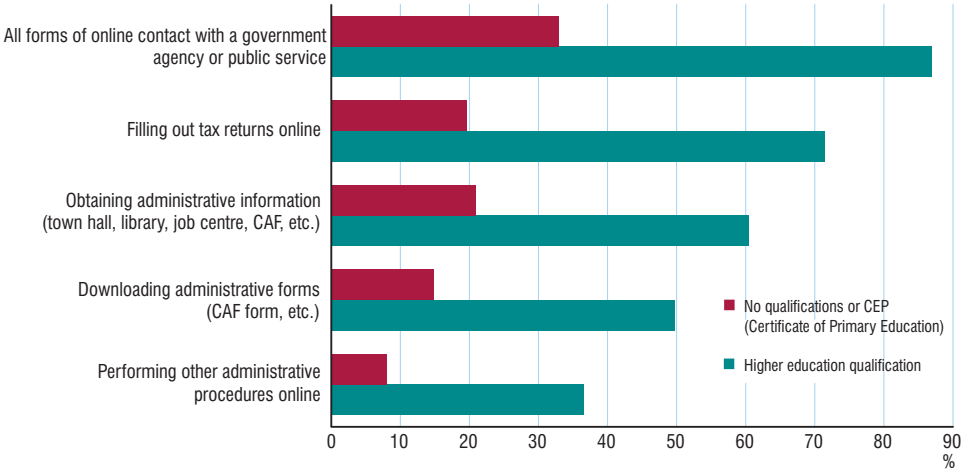
7. Level of Digital Skills by Age and Education in 2017



Coverage: France excluding Mayotte, people aged 15 and over living in an ordinary household.
Sources: INSEE, 2017 Household ICT survey.

5. In October 2017, the government announced the "digital transformation of public services" by making 100% of administrative procedures paperless, including, among others, income tax returns, social housing applications, prime d'activité (work bonus) requests and registration at the Pôle emploi (job centre).

8. Type of Online Administrative Tasks by Education in 2018



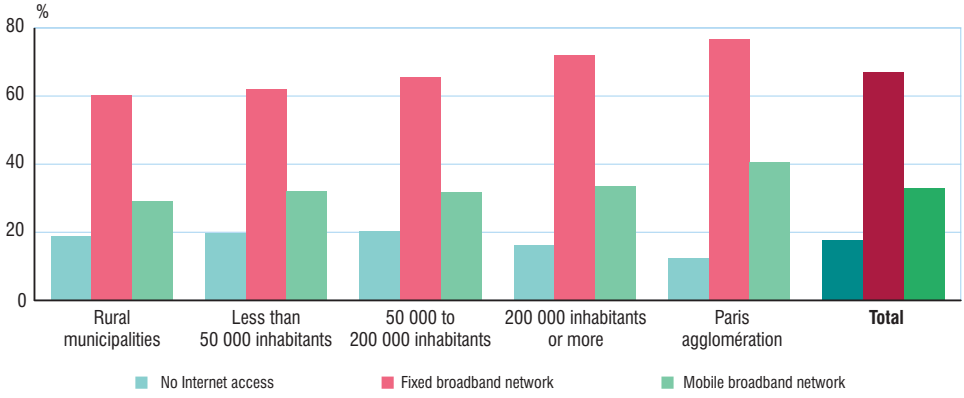
1. Enrolment in higher education, declaration of change of address, etc.
Reading Note: 87% of higher education graduates contacted a government agency or public service via the Internet at least once in 2018.
Coverage: France excluding Mayotte, people aged 15 and over living in an ordinary household.
Sources: INSEE, 2018 ICT Household survey.

online tax returns became mandatory for all. Likewise, the gap between the highest and lowest educated people exceeds 35 points in terms of searching for administrative information and downloading administrative forms.

Digital technology can help to bring people in remote areas closer to public services, employment areas and shops. For example, the dematerialisation of administrative procedures, telemedicine, telework and e-commerce all help to reduce distances, provided that a high-quality Internet connection is available and the new practices develop across France as a whole. However, some rural and mountainous areas are either not connected to fixed and mobile Internet networks or have poor connectivity. These so-called "white areas" create difficulties in terms of access to the Internet and mobile phones for both households and businesses. Agreements between the government and telephone companies include provisions for very high-speed broadband access in order to increase high-speed Internet coverage in sparsely populated areas. In September 2018, the four major telephone companies reported that between 92% and 98% of the population of metropolitan France was connected to their 4G network, compared to between 82% and 92% of the population a year earlier [ARCEP, 2019].

There are regional disparities in terms of household Internet access. These reflect households' choice of equipment, disparities in network coverage and, to a certain extent, resident profiles. The greatest disparities are for access to high-speed Internet connections. In 2018, 60% of residents in urban areas with less than 50,000 inhabitants had access to a fixed broadband network, compared to more than 70% of residents in urban units with 200,000 inhabitants or more. Similarly, 40% of residents in the Paris agglomeration had access to mobile broadband, compared to 30% in urban units with less than 200,000 inhabitants *(Figure 9)*. On the other hand, in 2018, residents of rural municipalities used e-commerce as much as residents of large urban areas (excluding Paris) and more often than residents of medium-sized urban units. E-commerce is therefore assumed to reduce distances to a small extent, at least in metropolitan France. In overseas departments (DOM), the frequency of Internet use remains lower than in metropolitan France, especially in the case of online purchases, despite the computer ownership and Internet access rates being close to those found in metropolitan France [Audoux and Mallemanche, 2019].

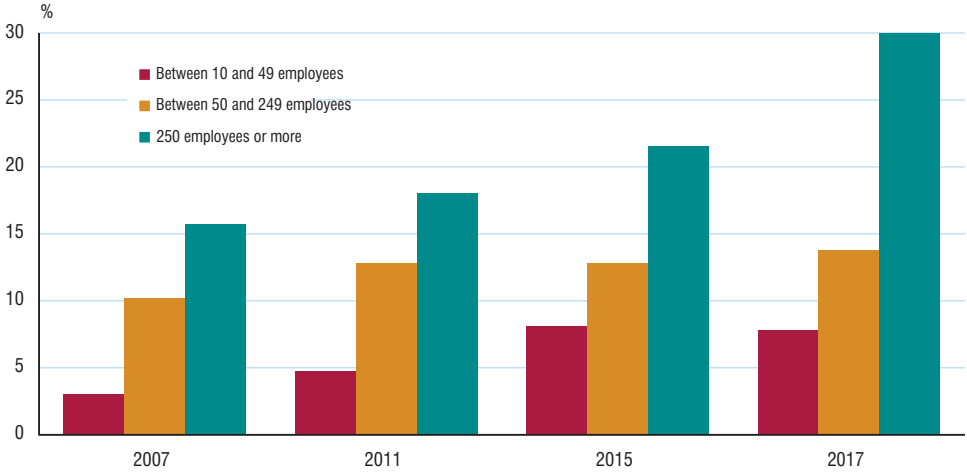
9. Type of Internet Connection by Urban Unit Size in 2018



Notes: this refers to the actual status of household equipment, resulting from both coverage and ownership of access equipment.
Coverage: France excluding Mayotte, ordinary households.
Sources: INSEE, 2018 ICT Household survey.

There are also variations according to the size of companies. In 2016, all companies with 10 or more employees had at least one computer or smartphone with Internet access, while 17% of very small enterprises (VSEs) did not use computers or smartphones and 19% had no Internet access. However, VSEs narrowed the gap between 2012 and 2016. The visibility of VSEs on the Internet remains limited: only one in three has a website, compared to two in three companies with 10 or more employees and almost all companies with 250 or more employees, a fact that partly reflects the different needs of businesses. To increase their online visibility, smaller companies use marketplaces (Amazon, Booking.com, etc.) more frequently than larger businesses. The level of e-commerce adoption is dependent on company size. In 2017, electronic sales accounted for 8% of the turnover of companies with 10 to 49 employees and 30% of the turnover of companies with 250 or more employees *(Figure 10)*.

10. Share of Electronic Sales in Company Turnover by Company Size, 2007-2017



Reading note: in 2017, online sales accounted for 30% of the turnover of companies with 250 or more employees, compared to 22% in 2015.
Coverage: companies with 10 or more employees based in France, in predominantly commercial sectors excluding the agricultural, financial and insurance sectors.
Sources: INSEE, 2008, 2012, 2016 and 2018 ICT Business Surveys.

The gap is also widening, with e-commerce turnover remaining stable in companies with 10 to 49 employees but increasing significantly in companies with 250 employees or more (+9 points in two years).

The Changing Landscape of Work and Employment

The digitalisation of businesses also has an impact on jobs and working conditions. The automation of tasks, driven by the impact of microcomputers and industrial robots in the 1970s, took off with the rise of the Internet in the 1990s. All sectors of the economy are now seeing radical change as a result of digitalisation [Conseil d'orientation pour l'emploi [French Employment Advisory Council], 2017]. Advances in robotics, **artificial intelligence**, big data processing, the development of the **Internet of Things** and 3D printing offer considerable potential for automation. While it is difficult to estimate their impact and strong assumptions are required [Le Ru, 2016], according to the Organisation for Economic Co-operation and Development (OECD) automation is expected to result in 16% of jobs being lost in France over the next twenty years and in 33% of jobs being radically changed [OECD, 2019]. The effects of computerisation on productivity and employment depend on the technological level of industries. For example, in France's low-tech industries, between 1994 and 2007 computerisation went hand in hand with significant increases in productivity and falling employment. By contrast, in medium and high-tech industries, computerisation is not associated with either productivity gains or job losses. However, across all sectors computerisation is known to favour the most skilled workers [Chevalier and Luciani, 2018].

Conversely, new professions are emerging as a result of digital technology, as detailed in the dossier "*Data Scientists, Community Managers... and Computer Scientists: Identifying Digital Workers*" [Desjonquères *et al.*, 2019]. The majority of digital jobs are in the fields of IT support and information systems (38%) and IT programming and development (14%). Digital jobs extend well beyond the IT and telecommunications sectors, with half of them being found in other service industries. These occupations tend to be dominated by men and, in particular, by relatively young and highly qualified male executives.

Digital technology is also changing the recruitment process and working conditions. In 2015, the Internet was used to advertise job vacancies and consult CV databases in more than half of all recruitments. The practice is more common in the case of highly qualified permanent jobs, where recruiters put more effort into finding the right candidates. In 2016, six out of ten unemployed executives used digital social networks to find a job, compared to an average of three out of ten unemployed workers generally [Guillaneuf, 2017].

IT tools have ambiguous effects on working conditions. For example, while some tasks are made easier, the pace of work is determined to a greater extent by the computerised control and supervision of work. Between 1994 and 2017, the pressure to increase the pace of work became widespread and was a key factor in the intensification of work among employees, affecting almost a third of private sector employees in 2017 [Memmi *et al.*, 2019]. Digital tools allow for greater mobility and autonomy, but they are also associated with greater workloads [Mauroux, 2018]. **Telework** is a good example. In 2017, 3% of employees worked remotely at least once a week. Six out of ten teleworkers are executives. The dossier "*Does Teleworking Improve the Working Conditions of Executives ?*" highlights a number of ambiguous effects [Hallépée and Mauroux, 2019]. Teleworkers benefit from a more flexible work environment and shorter travel times, but those who telework at least two days a week report working more than 50 hours a week and in the evening (between 8pm and midnight) twice as often as executives who do not work remotely. Physical distance reduces the potential for cooperation with management and colleagues. Lastly, teleworkers report being as satisfied with their work as non-teleworkers.

Environmental Impacts

At first glance, digital technology appears to be a means of reducing resource and energy consumption, particularly since the miniaturisation of devices, the invisibility of network infrastructures and the dematerialisation of content mean that the material impacts of digital technology are largely imperceptible. There is little data available to measure the environmental impacts of digital technology. The dematerialisation of invoices, books and music, reduced traffic as a result of teleworking and carpooling and the optimisation of energy consumption by Smart technologies all represent potential environmental benefits associated with digital technology. According to the French Environment and Energy Management Agency (ADEME), telework reduces greenhouse gas (GHG) emissions, although the gains at a national level are low. Research on e-commerce also shows a reduction in environmental impacts. However, the environmental benefits are offset by potentially very significant rebound effects [Tinetti *et al.*, 2016]. Digital devices and infrastructure are becoming more efficient as a result of technological progress. By a rebound effect, this increases their use and leads to the development of new uses, resulting in an increase in energy consumption. For example, mobile phones have been largely replaced by smartphones, allowing people to connect to high-speed mobile Internet. The increasingly widespread use of smartphones and the rate at which consumers renew their smartphones raise questions about their mass production, which requires mining rare earths and metals that are not easily recyclable. Another consequence of the new devices is the widespread use of online audio and video practices (streaming, video conferencing, etc.), which are driving an explosion in data traffic. The Shift Project think tank estimates that the electricity consumption of terminals and peripherals, networks and data centers accounted for 7.5% of global electricity consumption in 2017. Between 2013 and 2017, the global energy consumption from digital technology (production and use of equipment and infrastructure) increased from 1.9% to 2.7% of total global energy consumption. The **direct energy footprint of digital technology** is constantly increasing (+9% per year). GHG emissions are following the same trend. The share of digital technology increased from 2.5% of total global GHG emissions in 2013 to 3.7% in 2017, higher than the share of civilian air transport (2%) but lower than the share of light vehicle emissions (8%) [The Shift Project, 2018].

New Data that Can Be Used by Companies

Digital technology generates a considerable amount of data. This includes **personal data** provided by users, Internet usage data (time spent on a website, search engine requests, web page browsing history, content published on social media, etc.). It also increasingly includes machine-generated data (connected objects, sensors, robots, etc.). Big data represents a large proportion of the economic value of digital giants such as Google, Apple, Facebook and Amazon (GAFA). They are of value to companies for advertising purposes and to develop new services. In France in 2017, one third of companies with 10 or more employees providing transportation and warehousing services performed big data analyses, a proportion not seen in any other European country. They make extensive use of geolocation data. Businesses in the hotel and restaurant industry and in the ICT sector use social media data [Pradines, 2019]. For official statistics, digital traces also represent new data sources or sources that complement traditional statistical surveys, for example for price monitoring purposes [Blanchet and Givord, 2017; Leclair *et al.*, 2019].

Personal digital data raise protection issues. The General Data Protection Regulation (GDPR), which came into force in 2018, governs the processing of personal data in the EU. In 2018, 88% of Internet users reported having used an identification procedure over the course of the year to access online services, generally by means of a username and password or by means of a code received by SMS. Similarly, 76% of smartphone users report having

already restricted or denied access to their personal data (to their geographical position or contact list) when using or installing an application. Companies also ensure the security of their information systems. In 2019, 86% of companies with 10 or more employees regularly updated their software, while 70% required a complex password to access their systems.

Finally, opening public data is one of the challenges for the digitalisation of a country. In France, the Law for a Digital Republic, promulgated in 2016, establishes the principle of "open by default". In 2017, France ranked second for open government data among OECD countries. ■

Box 2

Questions for the Measurement of Growth?

Growth has slowed over the past two decades, which may seem paradoxical in a context of large-scale innovation. It is now widely assumed that traditional tools for measuring economic growth are inadequate for measuring the new types of growth made possible by the digital economy. This question has several dimensions [Bellégo and Mahieu, 2016; Blanchet *et al.*, 2018].

First of all, digitalisation and ICTs more generally increase the speed at which market goods and services are renewed. The monetary value of new goods and services continues to be reported in the accounts in value terms: the challenge is to distinguish between the volume effect and the price effect. If price measurement underestimates how digitalisation reduces the cost of accessing goods and services or underestimates the quality gains associated with new goods, then volume growth will be underestimated. However, this is not a new problem: a substantial proportion of economic growth has always been driven by the renewal and diversification of goods and services. Price measurement techniques take this problem into account [Aeberhardt *et al.*, 2019]. They cannot do so perfectly, but various studies estimate the risk of measurement error to be a few tenths of a point, i.e. in the order of the risk that would have existed prior to the digitalisation of the economy [Ahmad *et al.*, 2017]. Therefore, the argument according to which growth slowdown is a pure artefact caused by unsuitable measurement tools is ruled out.

A second problem is that digitalisation has been conducive to the development of free services. By its very nature, this trend goes beyond what national accounts aim to measure. It is possible to estimate the monetary value of free services, a question that has given rise to an active area of research [Brynjolfsson *et al.*, 2019]. However, it may not be necessary to aggregate them within the central framework of national accounts, not only because of their fragility but also because of the main uses to which national accounts are put. The main function of national accounts is to assess how monetary income is generated and distributed. Adding the cash equivalent of services that fall outside the scope of monetary exchange is rather a matter for satellite accounts.

The case of new services that are only partially or not actually free is more complex. The online encyclopaedia Wikipedia, apartment swapping and free temporary accommodation (CouchSurfing) are based on a "collaborative model operating on a broadly non-market basis". However, this is only partly true for the rental of accommodation agreed between individuals (e.g. Airbnb) and car-sharing (e.g. BlaBlaCar), both of which represent "mixed models of collaboration" in which a person pays a monetary consideration to use a good or service [Bellégo and Mahieu, 2016].

Lastly, digital technology promotes the mobility of the intangible assets of large multinational companies and the associated income flows, which may distort the measurement of local production. This problem can be particularly acute in small countries offering attractive tax regimes, where this trend raises questions about how a relevant notion of "domestic" production can be maintained [Blanchet *et al.*, 2018].

Definitions

Customer relationship management application: business software (abbreviated as CRM) enabling all customer relationships to be managed using the same process by grouping together the management of marketing campaigns, computerised sales forces, daily customer relationship management, etc. CRM does not include tools for real-time interaction with consumers (chat, instant messaging, real-time navigation, screen sharing, etc.).

Digital skills: the digital skills indicator, as defined by Eurostat, is based on selected activities related to the use of the Internet or software in four specific areas (information retrieval, online communication, IT problem solving, software use), each rated from 0 to 2. It is assumed that people who report having performed certain activities have the corresponding skills. For the "information" and "communication" fields, non-use of the Internet in the last three months gives a score of 0, while the reference period for the "software" and "problem solving" fields is non-use in the last year. In other words, the scale aggregates inability (non-use of the Internet) and lack of skill. The scale also distinguishes between no skills (four 0 scores), low skills (at least one 0 score), basic skills (no 0 scores) and above basic skills (all scores = 2).

Cloud computing : Cloud computing refers to computer services used on the Internet to access software, computing power, storage capacity, etc. These services must have all of the following characteristics:
– be delivered by service provider servers;
– be easily adjustable upwards or downwards (for example, the number of users and changes in storage capacity);
– once installed, can be used "on demand" without the need for human interaction with the supplier;
– be paid for, either by the user or based on the capacity used, or be prepaid.

Content and media: according to the OECD definition, ICT and content and media activities include the various activities that create and disseminate information and cultural products to the general public and activities that provide the means to disseminate them. Content and media include the following activities: publishing of books, periodicals and other publishing activities; motion picture, video and television programme production activities; sound recording and music publishing activities; and programming and broadcasting activities (radio, television).

Big data: generated by activities performed electronically and between machines (e.g. data from social media, production processes, etc.). Big data has the following characteristics:
– a large volume generated from a large amount of data generated over time;
– a variety of complex data formats, whether structured or unstructured (e.g. text, video, images, voice, documents, sensor data, activity logs, clickstreams, contact details, etc.);
– velocity due to the high speed at which data are generated, become available and evolve over time.
Big data analysis refers to the use of appropriate techniques, technologies, algorithms and software (machine learning, data mining, etc.).

Personal data: any information relating to an identified or identifiable natural person, directly or indirectly, in particular by reference to an identifier or to one or more factors specific to the identity of that natural person (surname, first name, postal address, e-mail address, IP address, photo, etc.).

Electronic Data Interchange (EDI): a technique used to replace the physical communication of documents between businesses (purchase orders, invoices, delivery notes, etc.) using electronic communication in a standardised format between computers connected by dedicated links or by a (private) value-added network (VAN).

Innovation (in the broad sense): innovation includes technological and non-technological innovation, the assumption being that several categories of innovation may be used in combination within

the same business. Technological innovation refers to innovation in products (goods or services) or processes or innovative activities within these areas, whether or not these have led to innovation. Non-technological innovation refers to innovation within an organisation (methods of work organisation, decision-making, etc.) and in marketing (changing the appearance or the method used to sell products, etc.).

Artificial intelligence (AI): artificial intelligence is a scientific discipline that draws on many different theoretical and technical methods to replicate cognitive functions through computer science.

Internet of Things: a global infrastructure for the information society enabling advanced services by interconnecting (physical and virtual) things based on existing and evolving interoperable information and communication technologies.

Social media: the term "social media" refers to three types of Internet applications: social networks (Facebook, LinkedIn, Viadeo, Google+, etc.), corporate blogs and microblogs (Twitter, Present.ly, etc.) and multimedia content sharing websites (YouTube, Flickr, SlideShare, etc.).

Digital platforms: digital environments used to connect suppliers and buyers of goods or services via an online communication interface.

Enterprise resource planning: business management software (ERP) used to manage a company's processes and share information between businesses via a single database (SAP, PeopleSoft, Oracle, etc.). ERP incorporates the following functions: planning, purchasing, sales, marketing, customer relations, finance and human resources, etc.

Radio-frequency identification: this automatic identification method enables data to be stored and retrieved remotely via radio waves using markers called radio tags or transponders that can be attached to or embedded in a product or object. This technology includes the Near Field Communication (NFC) standard, enabling communication between devices at short range (10 cm or less).

Research and experimental development (R&D): R&D work has been defined and codified by the Organisation for Economic Co-operation and Development (OECD). It includes creative work undertaken in a systematic manner in order to increase the body of knowledge. This exclusively includes the following activities: basic research, applied research and experimental development.

Social networks: websites (applications) used create a network of friends or to find business partners, a job, etc. Websites such as these are grouped under the term "online social networks", for example Facebook, LinkedIn and Snapchat. They enable users to display personal information (education, interests, etc.) and to find other users who share the same interests.

Information and communication technologies (ICTs): all IT, telecommunications and multimedia technologies, devices and services used to produce, store, process and disseminate information.

Telework: telework refers to a form of work organisation in which work that might have been performed in the workplace is carried out in another location using information and communication technologies. Until September 2017, the French Labour Code provided that such work must be regular and carried out within the scope of the contract of employment or an amendment thereto. The order of 22 September 2017 extends the scope of telework to include occasional practice and coverage by any type of formal written record (including e-mail).

Electronic sales: carried out via electronic data interchange or via a web application.

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