4 The trends in labour market demands for digital professionals: Overview and dynamics across countries in online job postings

This chapter presents the analysis of recent trends in the demand for digital professionals across ten countries: Belgium, Canada, France, Germany, Italy, the Netherlands, the United Kingdom, the United States, Singapore and Spain. The results in this chapter are based on the analysis of millions of job postings collected from the internet and disaggregated at the occupation level. Results compare the dynamics across countries, showing the significant increase in the demand for digital professionals over time but also the negative effect that the COVID-19 crisis has had on labour markets and on the growth in the demand of some digital professions.

Digital occupations are diverse and range from jobs involving routine tasks, such as web maintenance, to more complex tasks like software development. The universe of digital occupation is large and constantly expanding with new jobs.

This chapter focuses on a selection of digital occupations to investigate the trends in the demand for digital professionals across a varied range of countries. The digital occupations analysed in this chapter have been selected for their importance in the digital transition but also with an eye to cover a broad and diverse spectrum of roles that have been affected by digitalisation in various sectors. The selection of occupations was undertaken by the OECD in collaboration with Randstad Research Italy,[1] who offered valuable feedback in the identification of the digital professions analysed herein (see Box 4.1).

Box 4.1. The selection of occupations across countries

The number of selected occupations covered in this chapter varies depending on data availability in each country. For Canada, the United Kingdom and the United States, 20 occupations have been selected, while for Singapore 17 occupations have been identified.[1] In the case of EU countries (Belgium, France, Germany, Italy, the Netherlands and Spain), 14 countries were finally selected. The final selection for all countries is shown in Figure 4.1.[2]

The precise number of selected occupations in Anglophone countries (Canada, Singapore, the United Kingdom and the United States) and in the EU (Belgium, France, Germany, Italy, the Netherlands and Spain) varies due to the way online job postings (OJPs) are classified into occupational taxonomies in the two groups of countries. As discussed in Chapter 3, the classification of occupations is made on the basis of the proprietary Lightcast occupational taxonomy for Anglophone countries (Canada, United Kingdom and the United States) and of ISCO for EU countries (Belgium, France, Germany, Italy, the Netherlands and Spain).

The advantage of using the Lightcast taxonomy lies in its high level of occupational granularity, where jobs are categorised at the eight-digit level. In contrast, the ISCO taxonomy used for EU countries is only available at the fourth digit. This means that the occupational categorisation for Anglophone countries is more detailed, covering more specific occupations than in the case of the EU. On the other hand, this also entails that when analysing online job postings through the ISCO taxonomy a larger share of postings is gauged than when mapping OJPs to more disaggregated (and smaller in size) occupations using Lightcast taxonomy. The fact that two different taxonomies are used to categorise occupations for Anglophone and EU countries also calls for some caution when comparing results between the two sets of geographical areas, given that overlap between the two occupational taxonomies is only partial. As much as possible, this chapter will try to draw references between the two sets of data to ensure the widest comparability.

1. In particular, in contrast for the rest of Anglophone countries analysed, for Singapore online job postings data is missing for the following occupations: computer scientist, data scientist, and data engineer.
2. The selection of occupations for Anglophone and EU countries, respectively, has been made in a way that the two groups of countries and occupations can be compared despite occupations being classified using different taxonomies. In particular, the ISCO-SOC crosswalk has been used with the aim of ensuring that comparisons between the two sets of data are meaningful. However, as noted throughout this chapter, some caution should still be exercised when making comparisons given the differing level of disaggregation in the occupational categorisation.

4.1. Selecting and comparing occupations across countries

Figure 4.1 presents the digital occupations under examination in this chapter. To ease comparison and in order to simplify visualisation across countries, these are grouped into four broad categories:

1. Computer and data analysts / administrators,
2. Software developers, programmers and engineers,
3. ICT technicians and data entry clerks, and
4. ICT and HR managers / marketing specialists

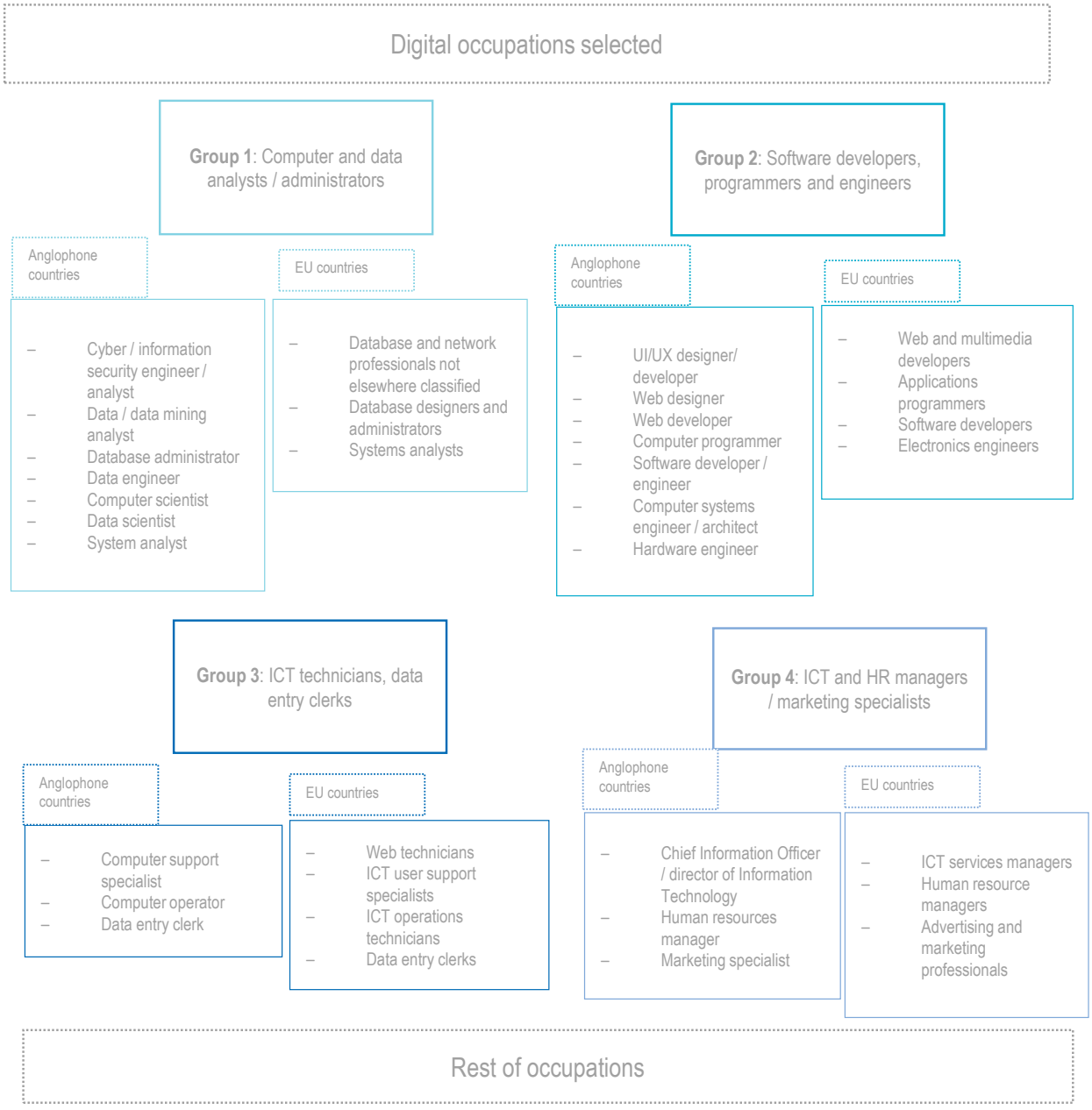
The group of computer and data analysts / administrators, includes occupations such as system analysts or database administrators. System analysts "conduct research, analyse and evaluate client information technology requirements, procedures or problems, and develop and implement proposals, recommendations, and plans to improve current or future information systems" (ILO, 2016[1]). Database designers and administrators, instead, "design, develop, control, maintain and support the optimal performance and security of databases" (ILO, 2016[1]).

The group of software developers, programmers, and engineers comprises occupations such as UI/UX designers/developers[2] who "develop and implement websites, web applications, application databases, and interactive web interfaces. [They also] Evaluate code to ensure that it is properly structured, meets industry standards, and is compatible with browsers and devices. Optimize website performance, scalability, and server-side code and processes (…)" (US Bureau of Labour Statistics, 2010[2]). Another example is the case of software developers, who "research, analyse and evaluate requirements for existing or new software applications and operating systems, and design, develop, test and maintain software solutions to meet these requirements" (ILO, 2016[1]).

The third group comprises ICT technicians and data entry clerks. Occupations in this group typically require lower skills than in the rest of groups.[3] Data entry clerks "enter coded, statistical, financial and other numerical data into electronic equipment, computerized databases, spreadsheets or other data repositories using a keyboard, mouse, or optical scanner, speech recognition software or other data entry tools. They enter data into mechanical and electronic devices to perform mathematical calculations" (ILO, 2016[1]). Other occupations in this group are computer operators[4] and ICT operations technicians.[5] Those latter, for instance, are technicians that "support the day-to-day processing, operation and monitoring of information and communications technology systems, peripherals, hardware, software and related computer equipment to ensure optimal performance and identify any problems" (ILO, 2016[1]).

The fourth and last group examined in this chapter pools together ICT and HR managers / marketing specialists. This group includes occupations such as ICT service managers, who "plan, direct and co-ordinate the acquisition, development, maintenance and use of computer and telecommunication systems, either as the manager of a department or as the general manager of an enterprise or organisation that does not have a hierarchy of managers".

Figure 4.1. Categorisation of selected digital occupations

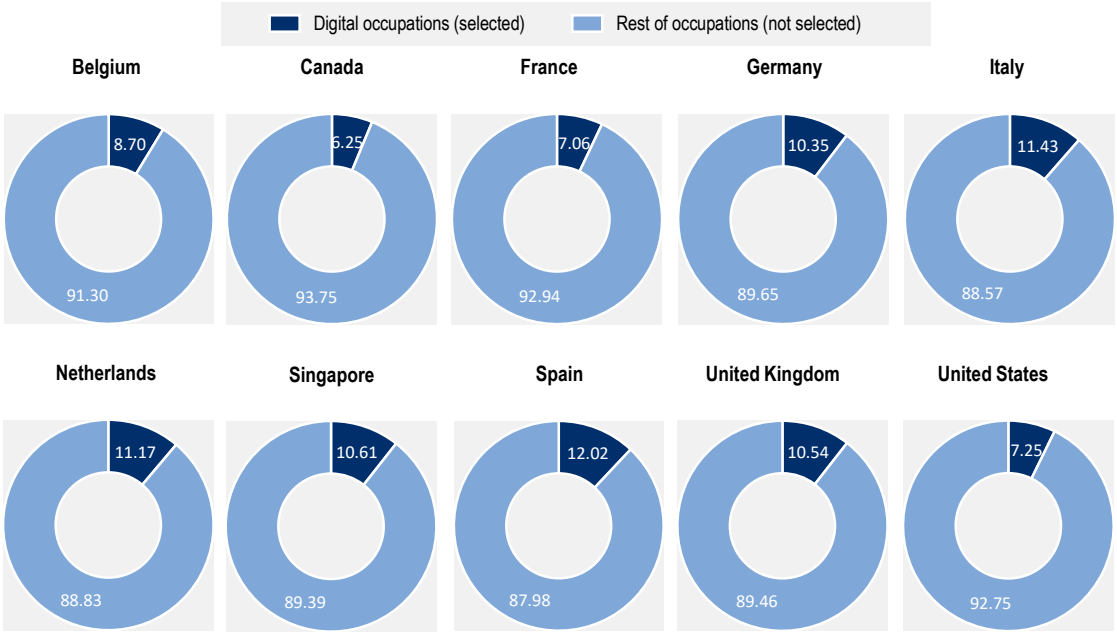


Note: Online job postings on Data Engineer, Data Scientist and Computer Scientist for Singapore is unavailable.
Source: OECD.

The digital occupations identified in this chapter represent a significant share of the labour market demand that appears online. On average, the selected digital occupations represent over 6% of total OJPs in Canada, more than 7% in the US, and close to 11% in the United Kingdom and Singapore (Figure 4.2).[6] In EU countries, the digital occupations selected for the analysis range from 7% of the total OJPs in France to 9% in Belgium, 10% in Germany, 11% in the Netherlands, and close to 12% in Italy and Spain.[7]

Figure 4.2. Selected digital occupations as a share of total job postings

Share of total postings (%), average for all years



Note: The shares are calculated as the average share over the selected time period: 2012-18 for Anglophone countries, and 2018-21 for EU countries except for Italy, where data exists as of 2014.
Source: OECD calculations based on Lightcast data.

Going deeper in the disaggregation of the results, Figure 4.3 presents the relative prevalence of each of the four broad occupational categories out of the total OJPs selected in this report (Figure 4.1 provided more detail on this classification).

Out of the selected digital occupations, software developers, programmers and engineers are the most prevalent across OJPs in countries. In the United Kingdom, for instance, approximately to 2 in every 3 online job postings for digital professionals (within the selected digital occupations for this study) are seeking software developers and programmers. In the United States the share of OJPs for software developers and engineers is 56% of the total postings related to digital professionals while in Spain, Canada and Singapore those shares are close to 50% of the total OJPs for digital jobs.

In Germany and France, the share of OJPS for software developers and programmers are slightly lower than in above mentioned countries, but still considerable (37% and 36%, respectively).

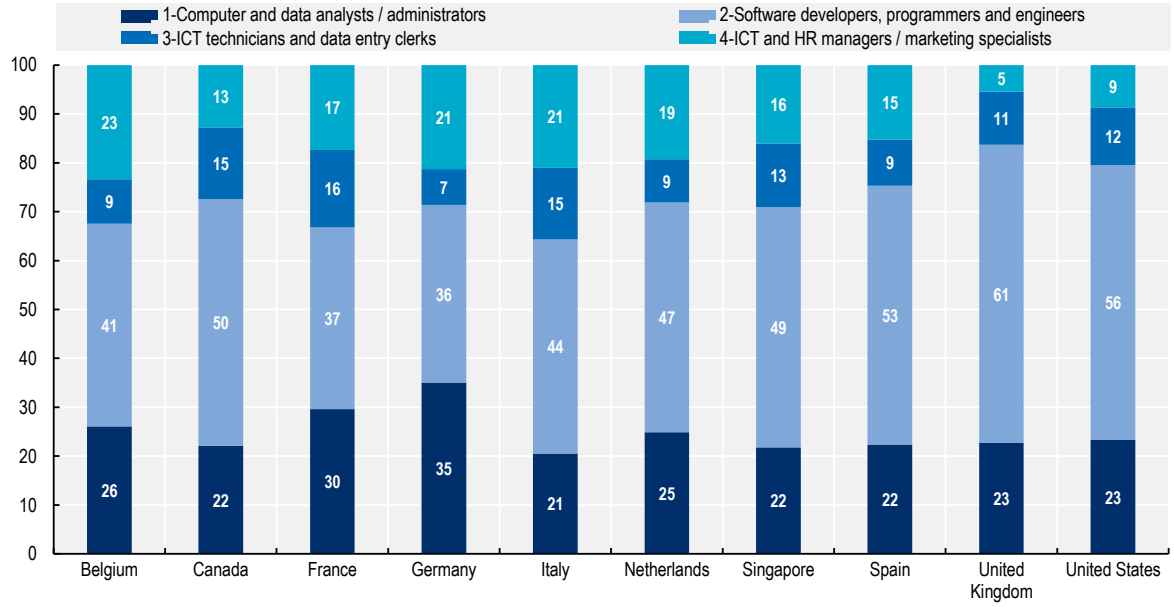
Computer and data analysts/administrators are also relatively numerous across OJPs, representing over 1 in every 5 of the selected digital occupations.[8]

ICT technicians and data entry clerks, instead, represent a smaller fraction of overall OJPs in all countries. In fact, these are below 20% for all analysed countries, ranging from 7% in Germany or 9% in Belgium, the Netherlands and Spain to around 15-16% in Canada, Italy and France.

Finally, ICT and HR managers / marketing specialists show the lowest prevalence over the total OJPs for the selected occupations in the United Kingdom (5%), whereas they are much more prominent in Belgium (23%) or in Germany and Italy (21%). This group includes ICT services managers, human resource managers and advertising and marketing professionals.[9]

Figure 4.3. Breakdown of selected digital occupations by broad occupational groups

Share of each category of job postings by occupation over selected digital occupations



Note: The shares are calculated as the average share over the selected time period: 2012-18 for Anglophone countries, and 2018-21 for EU countries except for Italy, where data exists as of 2014.
Source: OECD calculations based on Lightcast data.

4.2. Trends in online job postings for digital professionals across countries

This section describes the evolution of the OJPs for the selected digital occupations over time. Figure 4.4 shows the increase/decrease in the publication of job postings online for each occupations and since the first year for which data is available by using the volumes of OJPs in the initial year as a benchmark (i.e. as an index with value 100).

Generally, results in this section show the significant increase in the volume of online job postings published for most digital occupations but also the important negative impact that the COVID-19 crisis has had across most labour markets and, as a consequence, on some digital professions.

Focusing on the occupations where demand has increased, results below show that postings for data engineers and data scientists in Canada, the United Kingdom and the United States experienced a striking growth in the past few years. Conversely, data for Belgium, Germany or the Netherlands show a more mixed scenario, where the demand for some digital occupations has been heavily impacted during the pandemic years and has not yet fully recovered as of the end of 2021. In the case of EU countries, it is important to notice that OJPs time series only start in 2018 (with the exception of Italy in 2014) and that virtually all digital occupations in EU countries had been trending significantly upwards in pre-pandemic years. As the COVID-19 crisis struck, this implied a heavy correction in the demand for most occupations that has not yet been fully reabsorbed at the time of writing this report.

4.2.1. Computer and data analysts' trends

In a world that is reliant on interconnected devices and where large amounts of sensitive data are collected, stored and used to improve decision making, cyber threats and data breaches pose significant risks for governments and businesses. In order to reduce vulnerability to cyberattacks, organisations are increasingly investing in cybersecurity and IT risk management. This is reflected in the results looking at the evolution of the demand for cybersecurity professionals.

In the United States, Canada and Singapore, the online job postings for cyber / information security engineers / architects have, in fact, trended up steadily. The number of postings in this category has been steadily growing since 2012 and only declined in 2020, in coincidence with the COVID-19 crisis. In 2021, the demand for cybersecurity professionals has started increasing again and volumes of OJPs are back at their highest values (176 000 new online postings for cyber / information security engineers / architects in the United States). A similar trend can be observed in the United Kingdom where OJPs for cyber / information security engineers / architects in the United Kingdom are in 2021 nearly four times higher than in 2012 (from 10 600 to nearly 40 000).

OJPs for data mining analysts have also increased strikingly in all countries for which information is available and, especially, in Singapore (from slightly above 300 posting-s in 2012 to nearly 12 000 in 2021). Likewise, growth in the United States for data mining analysts has been significant with the only exception of the year 2020 (at the beginning of the pandemic) while the volume of postings in 2021 is at its record levels of 94 000 per year.

These results suggest that, as the Digital Revolution has certainly triggered an increasing availability of data and that professionals such as data mining analysts have also become increasingly important for businesses as their skills (analysing large data sets to identify patterns, trends, using statistical techniques and programming software) are becoming of paramount importance for employers to manage production and plan strategically all types of activities from marketing to logistics and distribution.

In EU countries, the availability of OJPs information starts in 2018 (with the exception of Italy, where data starts in 2014). Hence, pre-pandemic information is only available for the years 2018 and 2019, while afterwards statistics on OJPs have been heavily affected – as expected – by the strong declines in economic activity experienced by all economic sectors. That being said, even during the pandemic period, some digital occupations have experienced increased demand relative to the pre-pandemic period.

For instance, in Italy and France, job postings for database and network professionals have increased steadily since the start of the available time series. In Italy, in particular, the number of OJPs increased nearly 9 times between 2014 and 2021, although it is worth noting that the initial postings were relatively few (nearly 240). In France, online vacancies for database and network professionals more than doubled in 2021 (relative to 2018).

Conversely, for Belgium, Germany, the Netherlands and Spain, online postings for those professionals reached their peak in 2019 to then decline as the COVID-19 crisis hit. As of now, the levels of OJPs for those professionals have not yet recovered significantly but in the longer run, an increase in the demand is expected in most of those occupations. This trend is also observed for online vacancies for system analysts and database designers and administrators, where postings increased in the pre-crisis period between 2018 and 2019, but then declined coinciding with the advent of the COVID-19 crisis.

4.2.2. Software developers, programmers and engineers' trends

In the universe of digital occupations, software developers, programmers and engineers have experienced some of the most notable growth rates. In Canada, for instance, the number of job postings published online for UI / UX designers / developers in 2021 was more than three time larger than in 2012 (growing from 760 to 2 500 postings). Similarly, in the United Kingdom, online postings for UI / UX designers / developers in 2021 reached their maximum peak of close to 15 000. In the United States, the growth in online vacancies for UI / UX designers / developers was very significant, especially between 2017 and 2019, a period of sustained growth that was only interrupted in 2020 with the COVID-19 crisis. However, in 2021, as in other countries, the number of postings for UI / UX designers / developers started mounting again and are now close to the highest figure per year that was reached before the pandemic in 2019, with a total of 70 800 postings.

Some of these trends can be observed also in EU countries. In Belgium, for instance, online vacancies for web and multimedia developers doubled between 2018 and 2019 (increasing from around 4 100 to 7 700) but fell considerably during 2020 and, even more so, in 2021 during the pandemic years. More broadly, with the exception of France, postings for software developers and programmers and electronic engineers in the analysed EU countries are still far from the peak levels recorded in 2019. In the Netherlands and Italy, for instance, OJPs for electronics engineers, software developers, web and multimedia developers and applications programmers showed a sharp increase in 2019 to then decline in 2020 and 2021 with signs of a slight recovery in 2021 in the Dutch case.

4.2.3. ICT technicians and data entry clerks' trends

Among digital occupations, ICT technicians provide support for the deployment and maintenance of computer infrastructure and web technology. They also contribute to the diagnosis and resolution of technical problems.

While some of the tasks of these jobs may be more routine-intensive than those of other digital occupations, they are still essentials for ICT infrastructures to work properly. Similarly, as countries and firms transit towards a fully digital environment, the work of data entry clerks may be particularly important in sectors that are still in the process of digitalising, despite a potentially negative labour market outlook in the future due to the low skilled nature of these jobs.[10]

As a confirmation of the key role of some of these professionals during the years of the digital transformation, the analysis of online job postings for data entry clerks shows that the demand for them has increased significantly in the United States (from 25 000 in 2012 to almost 68 000 in 2021). In Canada, OJPs for data entry clerks have also followed, overall, an increasing trend since 2012 to then decrease with the advent of the pandemic in 2020 and recover to roughly pre-pandemic levels in 2021. In the United Kingdom, instead, vacancies for data entry clerks peaked in 2017 before declining yearly up until 2020. However, in 2021, postings more than doubled relative to the initial year of the pandemic showing that there is still demand for workers supporting the digitalisation of analogic processes as in the case of data entry clerks.

Similar trends are observed in some EU countries such as Belgium and the Netherlands. In Belgium, for instance, OJPs for data entry clerks have been consistently above the 2018 level and peaked in 2020. In the Netherlands, postings for data entry clerks increased annually since 2018, with the exception of 2020, and are in 2021 at their highest level (around 1 400).

In other EU countries, however, the COVID-19 crisis seems to have had a stronger negative impact on these jobs with OJPs following an inverted-U pattern: a strong growth before the pandemic and a correction during the years of the crisis. For example, in Spain and Germany, postings for data entry clerks increased in between 2018 and 2019, while they experienced a strong decline during 2020 and have not recovered the pre-crisis levels in 2021. In Germany, for instance, a peak of 7 200 OJPs was reached in 2019, and the 2021 levels are at 4 400.

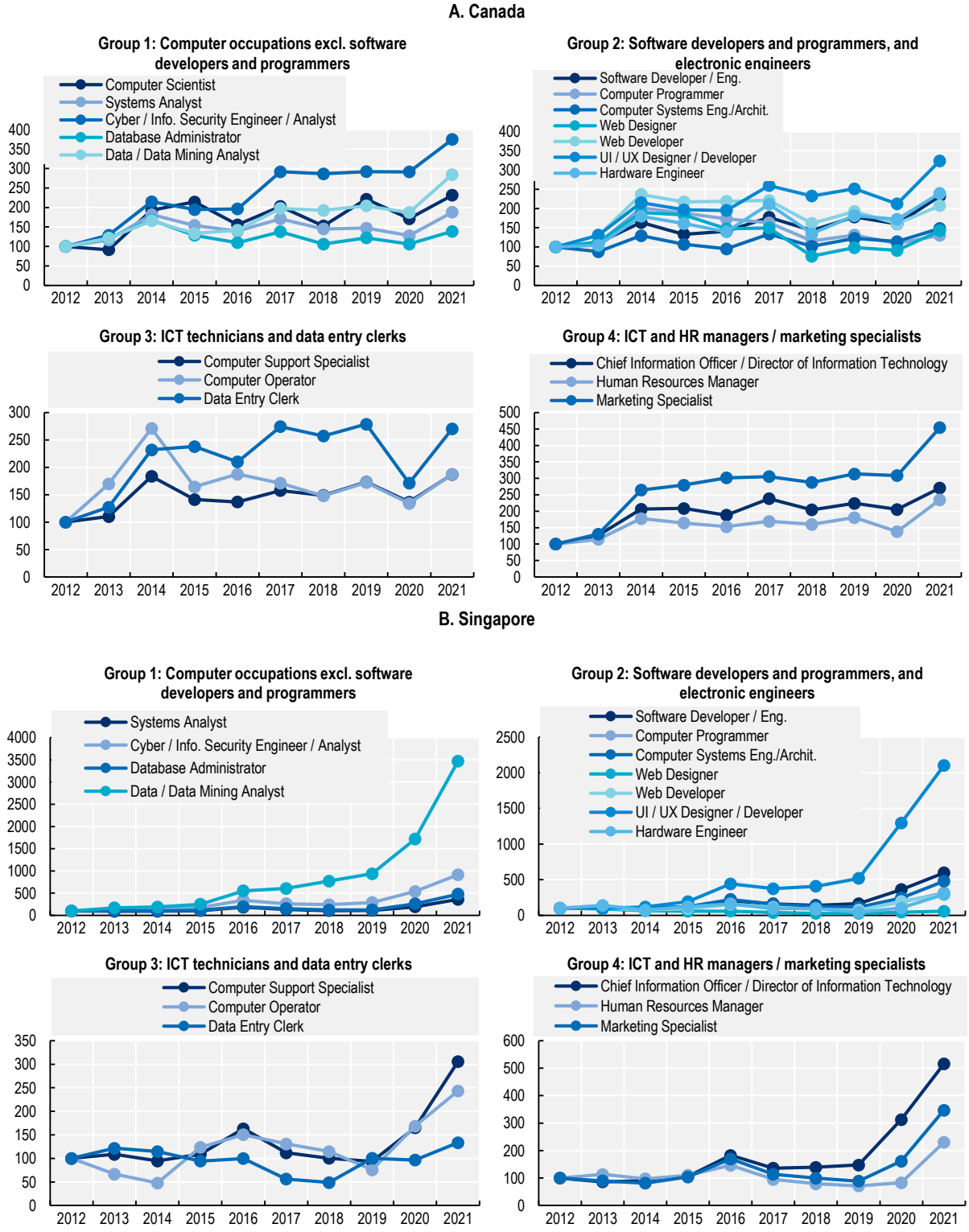
4.2.4. ICT and HR managers/ marketing specialists' trends

Vacancies for high-skilled digital professionals, such as Chief Information Officers / directors of IT, human resources managers, and marketing specialists have increased significantly in the four Anglophone countries under study. For Canada, this is particularly the case for marketing specialists, whose number of job postings has increase more than 4 times since 2012, from around 1900 to 8 600 in 2021. For the United Kingdom and the United States, postings for marketing specialists exhibit a strong growth, though the pattern has been rather volatile across years. In the United States, for instance, postings for marketing specialists declined during the pandemic in 2020 (when postings amounted to less than 65 000) before increasing very strongly to reach over 126 000 postings in 2021. For the United Kingdom, vacancies for marketing specialists declined since 2017, but the levels in 2021 picked up again significantly (8 600 postings). In Singapore, job postings related to Chief Information Officer / director of IT have also quadrupled compared to 2012 levels, although it is worth noting that the starting levels were below 200.

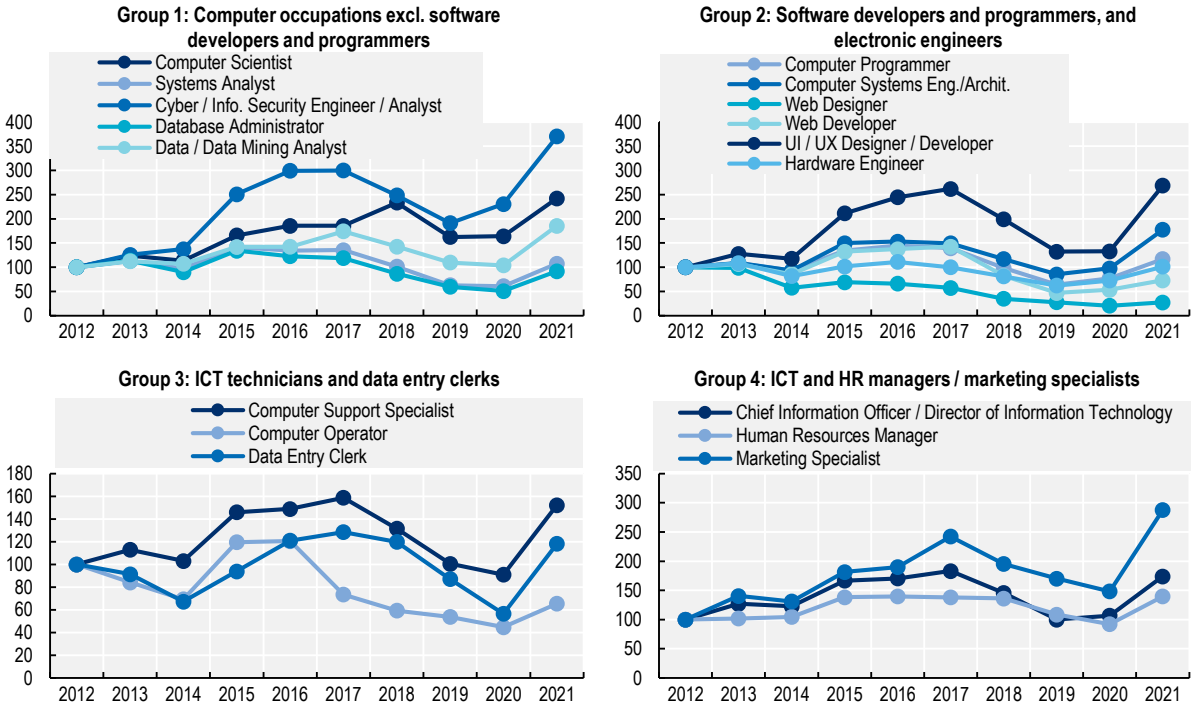
In the European countries analysed, online vacancies for these high-skilled occupations have followed relatively similar dynamics across countries, peaking in 2019 and, afterwards, declining in 2021, possibly due to the strong impact of the pandemic on economic activity. In 2019, the growth for OJPs concerning ICT service managers was particularly high in Italy, where the volume of OJPs in 2019 (3 100) was more than five times that of 2014 (640). Since then, however, postings have declined during the years of the pandemic and are yet to recover. In Germany, new postings for ICT services managers have instead declined since 2018, moving from around well above 21 000 postings in 2018 to around 15 200 in 2021.

Figure 4.4. Evolution of digital job postings by country

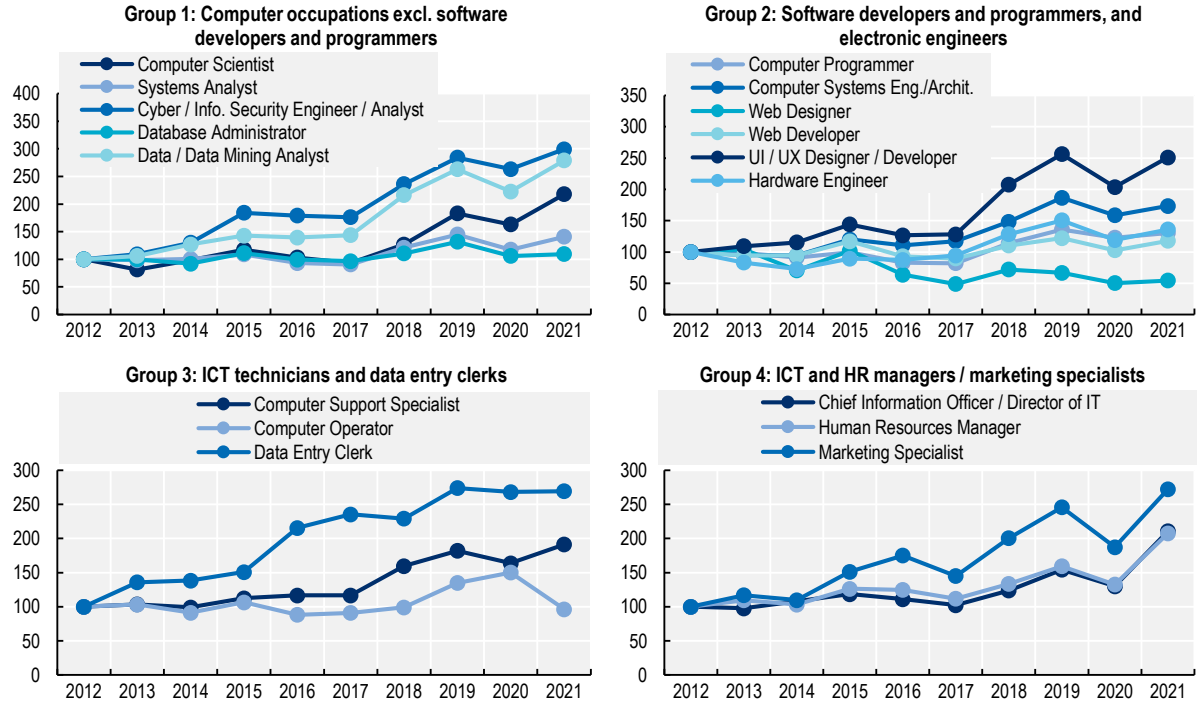
Index (initial year's level = 100)



C. United Kingdom

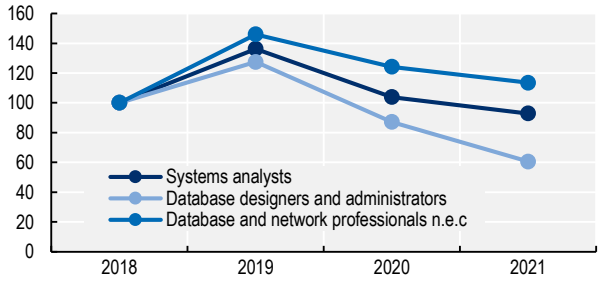


D. United States

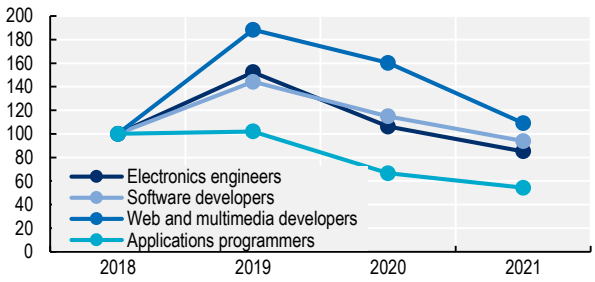


E. Belgium

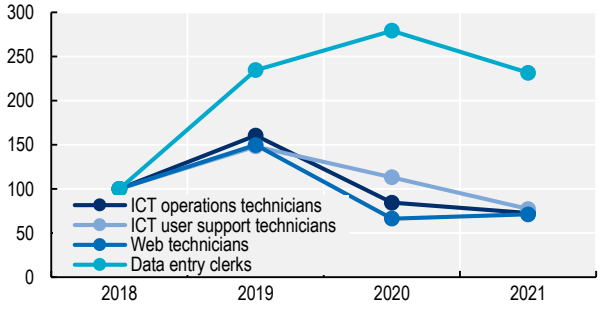
Group 1: Computer occupations excl. software developers and programmers



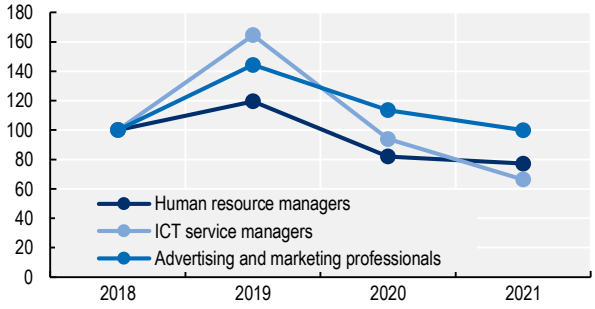
Group 2: Software developers and programmers, and electronic engineers



Group 3: ICT technicians and data entry clerks

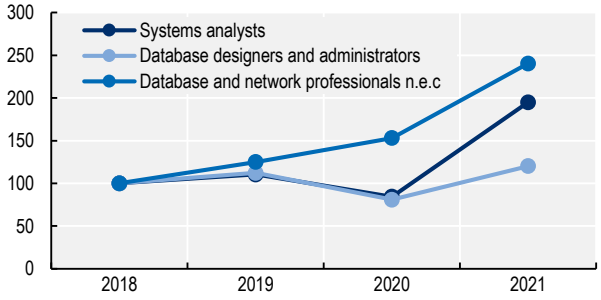


Group 4: ICT and HR managers / marketing specialists

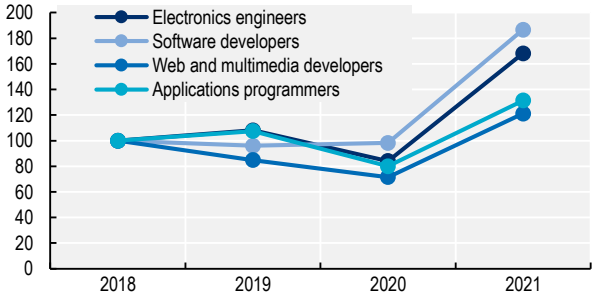


F. France

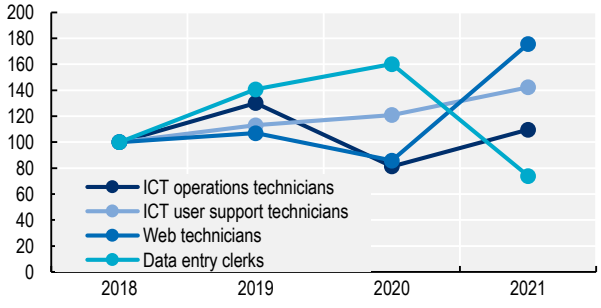
Group 1: Computer occupations excl. software developers and programmers



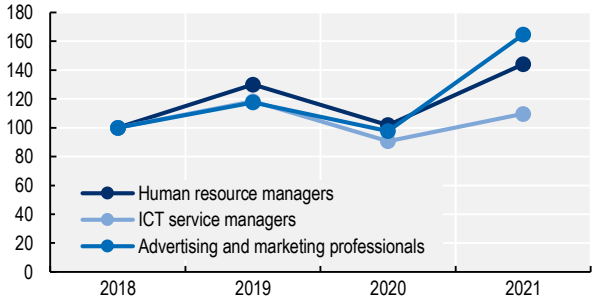
Group 2: Software developers and programmers, and electronic engineers



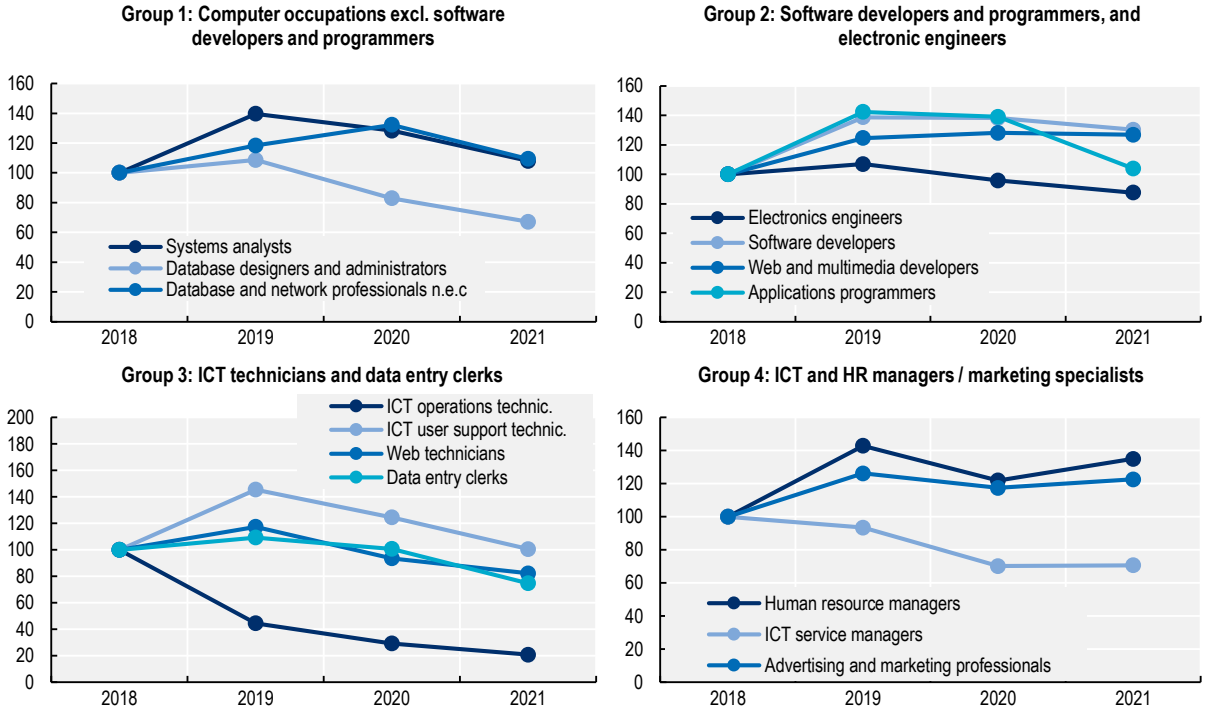
Group 3: ICT technicians and data entry clerks



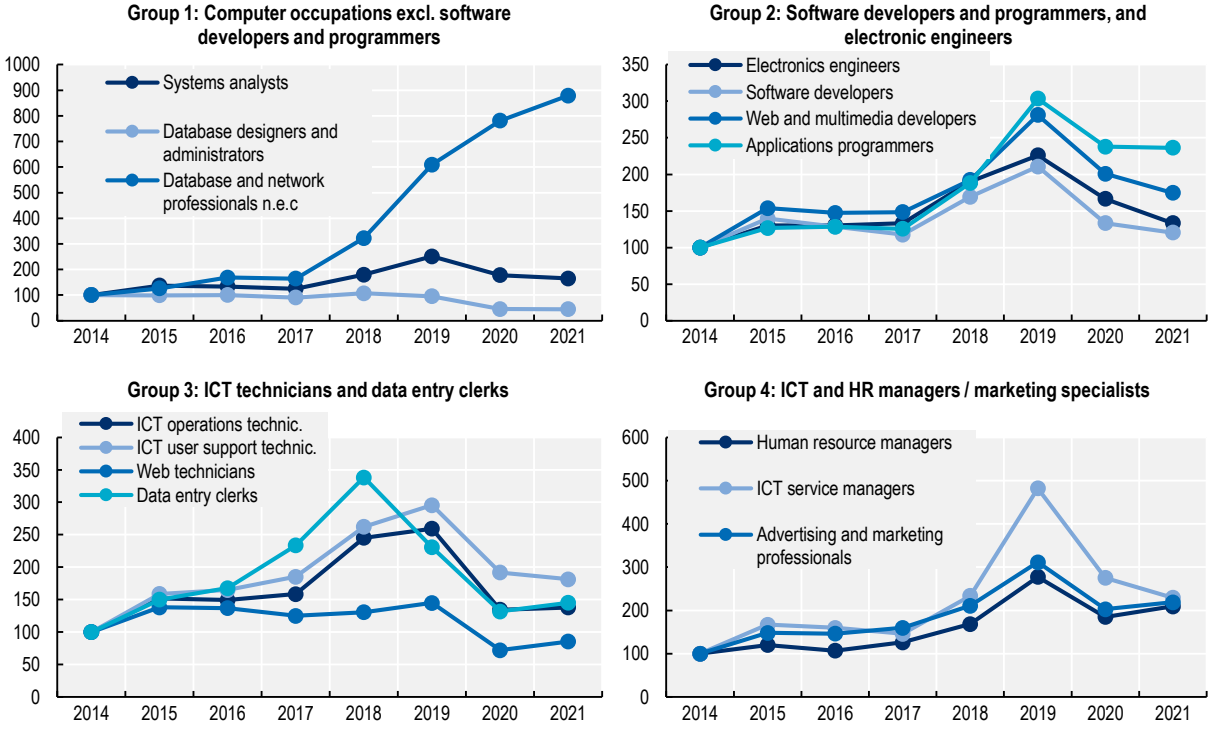
Group 4: ICT and HR managers / marketing specialists

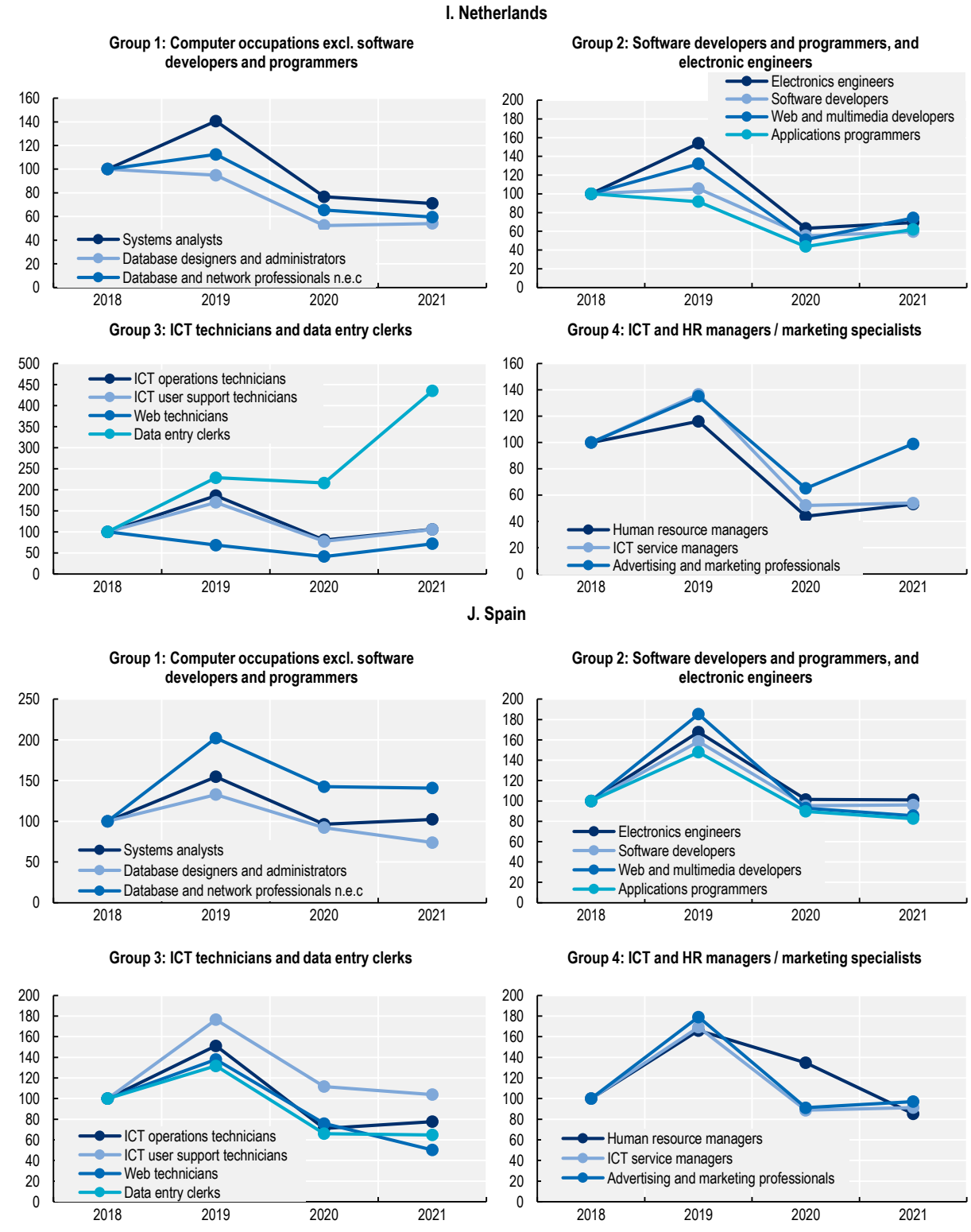


G. Germany



H. Italy





Source: OECD calculations based on Lightcast data.

4.3. In focus: The demand for digital professionals in the United States

In addition to the occupations that have been analysed above for the full cross-section of countries in this report, this section examines and identifies trends in a wider range of digital occupations by taking the United States as a case study, a country that is usually considered at the forefront of technological innovation and adoption. This section is useful as the growth in some of the occupations analysed herein has been very significant and these dynamics are, therefore, worth to be highlighted separately.

Results in this section are presented for occupations belonging to the occupational group of "computer and mathematical occupations (SOC-15) and for the years preceding the COVID-19 pandemic in order to show the magnitude of those longer-run dynamics when unaffected by the unprecedented shock in pandemic years.

4.3.1. Occupations in high demand in the United States

As this section is mostly concerned with medium to long term trends, Table 4.1 presents the top digital occupations (in SOC-15) ranked by the growth in the number of online job postings in between 2012 and 2019 excluding, therefore, the downturn during the years affected by the COVID-19 pandemic.

Table 4.1. Digital occupations in high demand in the United States

	Number of online postings in 2019	Growth between 2012 and 2019 (%)
Data scientist	42 340	3 260%
Data engineer	36 888	2 320%
Search engine operations specialist	16 000	238%
Business intelligence architect/ developer	67 000	178%
Mobile applications developer	41 000	126%
Database architect	52 000	111%
Technology consultants	37 000	111%
Data warehousing specialist	33 000	108%

Source: OECD calculations based on Lightcast data.

Results show that data scientists and data engineers have been experiencing a significative growth in the volume of new vacancies published online, signalling the increase in their demand in the US labour market. OJPs for data scientists increased, for instance, by more than 40 times going from merely 1 260 postings in 2012 to over 50 000 in 2021. A similar extraordinary growth is also registered for OJPs for data engineers which went from roughly 1 500 in 2012 to close to over 47 000 in 2021.[11]

The growing importance and relevance of these occupations lies in the central role they play in the collection and analysis of data used in a variety of different sectors that are nowadays relying on interconnected devices and where large flows of data are used to reduce mistakes in production, oversee different stages of production and minimise costs by automatising processes. Data scientists, for instance, are "employed to analyse and interpret complex digital data, such as the usage statistics of a website, especially in order to assist a business in its decision-making" (Oxford Languages, n.d.[3]) while data engineers, "administer, test, and implement computer databases, applying knowledge of database management systems. Co-ordinate changes to computer databases. May plan, co-ordinate, and implement security measures to safeguard computer databases" (US Bureau of Labour Statistics, 2010[2]).

While the figures for data scientists and data engineers are certainly striking, it is important to read them with some caution as the volumes of job postings in the initial year may be an underestimation of the true labour market demand as online job portals (from which the presented information comes from) were still relatively new "market places" and some demand may have been channelled through more traditional

advertisements. The sharp increases in the demand for these professionals in recent years, however, is warranted and the information coming from OJPs clearly identifies a booming trend that has been reshaping the IT and digital sector.

Table 4.1 and Figure 4.5 also show that other occupations have been growing very rapidly with significant increases in the volume of job postings published online. The demand for business intelligence architects / developers, for instance, has been increasing rapidly since 2012. Similar to data engineers, business intelligence architects / developers are key to businesses, as they leverage software and services to transform data into actionable insights that can inform an organisation's strategic and tactical business decisions. Postings for this occupation have almost tripled[12] by 2021 relative to 2012, as businesses have become increasingly aware of the need to use their data effectively for business planning and strategical decisions.

In a context where businesses are increasingly using data for decision-making and optimisation of processes, postings for database architects have also followed a similar trend, having nearly doubled in relation to their initial levels. The tasks of database architects vary, including the design of strategies for the use and structure of enterprise databases, multidimensional networks and warehouse systems, as well as modelling, designing and constructing large databases or optimising models for infrastructure and workflow.

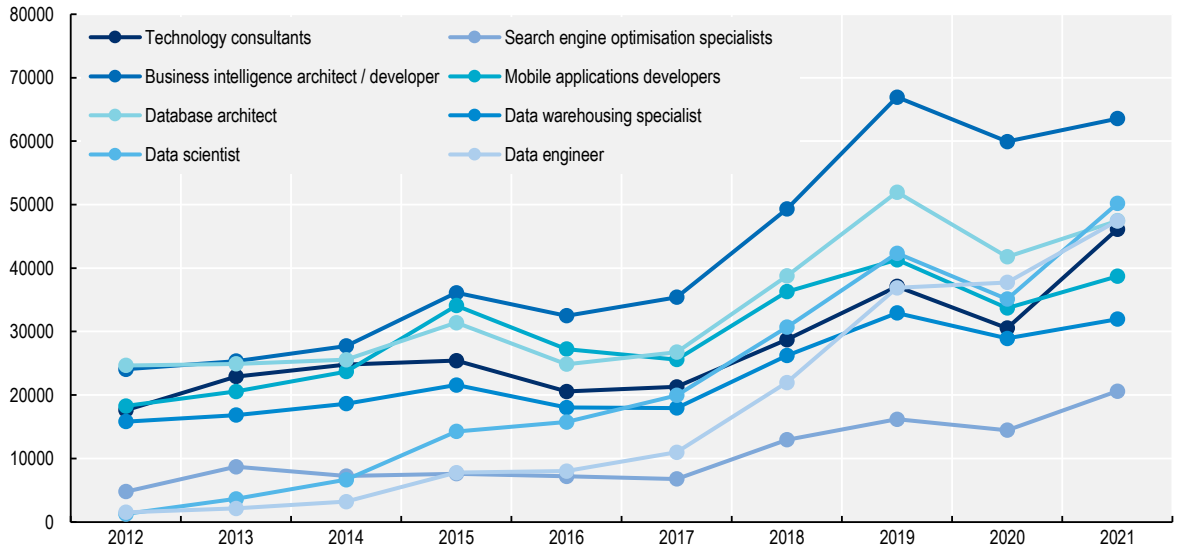
Mobile applications developers – who are in charge to create, programme, test and maintain apps and mobile platforms – are also in very high demand. Table 4.1 shows that online job postings for this occupation have more than doubled in the last nine years and this trend may continue in the future as mobile applications are becoming a standard mean to deliver services in virtually all sectors of economic activity, from entertainment to banking, education and retail.

Among the fastest growing digital occupations, the role of technology consultants (sometimes referred to as innovation or technology brokers) has also been on the rise. As the digital transition is requiring firms to transform digitally and new roles such as those of technology consultants are emerging, helping businesses to restructure their activities. Technology Consultant work with clients to help them transform the way they use technology where "traditionally, these transformations have been geared towards improving business processes, reducing costs, maximising use of tech opportunities, and more. Today, they encompass (…) more – from digital strategy to technology change projects" (PwC, n.d.[4]). Results from online job postings (Figure 4.5) indicate that vacancies for technology consultants have been on a significant rise, with over 46 000 postings in 2021, almost three times larger than the levels of 2012.

Online job postings for data warehousing specialists have also more than doubled in the last few years, increasing from 16 000 in 2012 to almost 32 000 in 2021. Some of their tasks include the development of processes and procedures for data management within an organisation, or creating software applications for data storage and management. Given the growing storage of data, their task is crucial in making procedures more efficient.

Interestingly, online job postings for search engine optimisation (SEO) specialists have also increased substantially since 2012, from 4 800 to close to 21 000 in 2021. SEO specialists analyse a client's website and carries out any changes that may be needed for its optimisation in search engines. Their role is paramount in the current environment where business positioning has gained momentum.

Figure 4.5. Evolution of number of OJPs for growing digital occupations in the United States



Source: OECD calculations based on Lightcast data.

4.3.2. Occupations showing a stable (or decreasing) demand in the United States

Along with the digital occupations that have been booming in recent years, the demand for other roles within the digital economy has instead remained relatively stable, or even declined. It is hence worth analysing also those roles as stable or declining trends may reveal longer-run dynamics.

Table 4.2 lists the growth of this smaller set of occupations within SOC group of "computer and mathematical occupations" between 2012 and 2019 while Figure 4.6 shows the detailed evolution year-by-year. Among digital occupations, webmaster/ administrators are the only ones showing a mild decline in the volume of job postings relative to the initial year (-17%) though, in recent years, the demand for them has started picking up again. Other occupations, and in particular telecommunications engineering specialists have also seen only modest increases in the volume of new job postings over time, possibly pointing to a weakening demand for those professionals.

Table 4.2. Digital occupations with stable or decreasing demand in the United States

	Number of online postings in 2019	Growth between 2012 and 2019 (%)
Computer programmer	83 981	36%
Network / systems administrator	128 464	24%
Telecommunications engineering specialist	16 030	16%
Webmaster / administrator	6 100	-17%

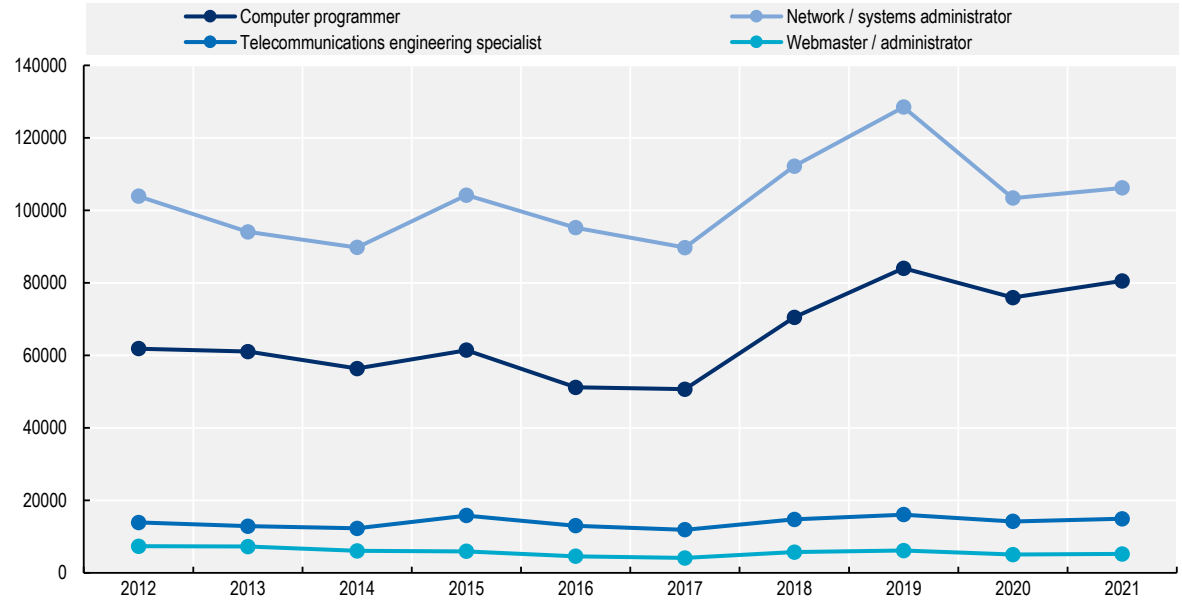
Source: OECD calculations based on Lightcast data.

Network administrators are in charge of keeping the organisation's network up to date and operating as intended. Systems administrators undertake similar tasks, but they work more directly with computer software (e.g. installation, maintenance or data recovery). The analysis of OJPs for network / systems administrators shows a rather volatile pattern between 2012 and 2017. After 2017 and up until 2019, postings instead increased steadily, before being negatively hit in 2020 with the advent of the pandemic. In 2021, postings show some signs of recovery, with levels being slightly higher than those registered in 2020. This limited growth is also highlighted in the Occupational Outlook Handbook, developed in 2022 by the US Bureau of Labour

Statistics (2022[5]), who project postings related to this occupation to grow 5% in 2020-30, slower than the average for all occupations.

Finally, online vacancies for computer programmers, after having declined between 2012 and 2017, have started to increase significantly pointing to potential labour market bottlenecks in the near future if such demand is not met by workers with adequate skills to fill the new positions.

Figure 4.6. Evolution of OJPs for stable digital occupations in the United States



Source: OECD calculations based on Lightcast data.

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Annex 4.A. Detailed results at the occupation level

Annex Table 4.A.1. Canada: Number of online job postings per year

	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
Computer and data analysts / administrators										
Computer Scientist	70	64	135	150	109	142	107	155	120	162
Data Scientist	7	33	117	193	350	449	649	949	972	1 348
Systems Analyst	4 979	5 795	9 044	7 674	6 940	8 513	7 209	7 328	6 348	9 353
Cyber / Info. Security Eng. / Analyst	1 352	1 743	2 907	2 635	2 657	3 945	3 876	3 948	3 940	5 070
Database Administrator	2 338	2 837	3 920	3 003	2 568	3 218	2 478	2 856	2 483	3 240
Data Engineer	14	22	33	40	118	225	284	614	682	1 018
Data / Data Mining Analyst	1 153	1 400	1 910	1 540	1 634	2 281	2 222	2 353	2 158	3 281
Software developers, programmers and engineers										
Software Developer / Eng.	15 612	17 363	25 548	20 745	22 014	27 647	22 231	27 822	24 998	36 238
Computer Programmer	2 544	2 777	5 130	4 788	4 406	4 146	2 946	3 335	2 776	3 315
Computer Systems Eng. / Architect	2 371	2 076	3 063	2 533	2 249	3 168	2 415	2 905	2 703	3 512
Web Designer	373	422	707	685	550	557	283	366	339	530
Web Developer	2 540	3 281	6 012	5 525	5 559	5 615	4 099	4 887	4 074	5 269
UI / UX Designer / Developer	759	995	1 634	1 492	1 480	1 971	1 766	1 908	1 609	2 459
Hardware Engineer	167	174	300	269	233	353	225	303	287	400
ICT technicians and data entry clerks										
Computer Support Specialist	5 746	6 333	10 554	8 117	7 862	9 059	8 562	9 953	7 853	10 756
Computer Operator	73	124	198	120	137	125	108	126	98	137
Data Entry Clerk	1 050	1 337	2 437	2 500	2 205	2 881	2 700	2 926	1 798	2 840
ICT and HR managers / marketing specialists										
Chief Information Officer / Director of IT	514	651	1 060	1 072	966	1 225	1 050	1 152	1 056	1 391
Marketing Specialist	2 021	2 319	3 591	3 321	3 095	3 420	3 234	3 652	2 788	4 746

	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
Human Resources Manager	1 895	2 476	5 010	5 299	5 714	5 787	5 451	5 941	5 847	8 606
Rest of occupations	441 673	681 568	1 202 809	1 103 723	1 060 807	1 163 610	1 147 788	1 380 325	1 223 192	1 691 123
TOTAL	487 251	733 790	1 286 119	1 175 424	1 131 653	1 248 337	1 219 683	1 463 804	1 296 121	1 794 794

Source: OECD calculations based on Lightcast data.

Annex Table 4.A.2. Singapore: Number of online job postings per year

	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
Computer and data analysts / administrators										
Computer Scientist	n.a	n.a	n.a	n.a	n.a	n.a	n.a	n.a	n.a	n.a
Data Scientist	n.a	n.a	n.a	n.a	n.a	n.a	n.a	n.a	n.a	n.a
Systems Analyst	3 818	3 510	3 571	4 112	7 087	5 200	4 120	4 299	7 402	13 755
Cyber / Info. Security Eng. / Analyst	1 024	1 154	1 446	1 865	3 484	2 669	2 471	2 959	5 500	9 378
Database Administrator	1 737	1980	1 788	2006	3 427	2 642	2 118	2 143	4 531	8 288
Data Engineer	n.a	n.a	n.a	n.a	n.a	n.a	n.a	n.a	n.a	n.a
Data / Data Mining Analyst	341	578	653	857	1 882	2066	2 631	3 201	5 850	11 834
Software developers, programmers and engineers										
Software Developer / Eng.	9 965	10 084	9 340	11 746	20 266	16 279	14 167	16 383	36 069	59 536
Computer Programmer	1 883	1 818	1 616	1 743	3 053	2090	1 679	1 603	3 554	5 933
Computer Systems Eng. / Architect	4 125	4 562	4 283	5 126	9 224	6 494	5 257	4 689	10 124	19 816
Web Designer	721	669	473	418	437	285	204	195	331	420
Web Developer	1 417	1 475	1 076	1 349	2 168	1 624	1 258	1 053	2 788	4 129
UI / UX Designer / Developer	178	173	211	344	786	668	726	924	2 306	3 740
Hardware Engineer	160	223	122	194	260	154	155	70	167	471
ICT technicians and data entry clerks										
Computer Support Specialist	5 734	6 224	5 431	6 239	9 346	6 414	5 749	5 378	9 460	17 543
Computer Operator	111	74	53	137	167	145	127	84	187	270
Data Entry Clerk	1 061	1 290	1 215	1 001	1 059	594	519	1 063	1 023	1 414
ICT and HR managers / marketing specialists										
Chief Information Officer / Director of IT	173	149	156	184	316	235	241	255	541	892
Marketing Specialist	5 257	5 955	5 114	5 777	7 690	4 983	4 146	3 735	4 348	12 090
Human Resources Manager	3 502	3 134	2 847	3 644	5 936	3 974	3 478	3 112	5 650	12 144
Rest of occupations	466 980	478 605	457 484	492 719	691 917	460 421	392 856	408 708	630 878	1 289 393
TOTAL	508 187	521 657	496 879	539 461	768 505	516 937	441 902	459 854	730 709	1 471 046

Note: For Singapore, online postings for computer scientists, data scientists and data engineers is unavailable.
Source: OECD calculations based on Lightcast data.

Annex Table 4.A.3. United Kingdom: Number of online job postings per year

	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
Computer and data analysts / administrators										
Computer Scientist	1 037	1 284	1 179	1 720	1926	1924	2 420	1 686	1 702	2 514
Data Scientist	179	768	1 276	3 993	5 798	11 116	8 699	6 687	7 049	10 986
Systems Analyst	37 022	41 809	35 909	52 269	49 619	50 129	37 422	23 222	22 573	39 824
Cyber / Info. Security Eng. / Analyst	10 615	13 350	14 587	26 615	31 776	31 846	26 393	20 288	24 488	39 298
Database Administrator	33 591	38 144	30 191	45 083	41 197	39 935	29 053	19 957	17 046	30 821
Data Engineer	956	1 407	1 441	2 522	3 857	6 115	6 188	5 521	8 760	20 238
Data / Data Mining Analyst	56 434	63 456	60 523	80 078	80 373	98 233	80 523	61 905	58 517	104 795
Software developers, programmers and engineers										
Software Developer / Eng.	238 650	265 742	225 010	362 409	379 556	427 734	297 448	191 617	231 024	380 864
Computer Programmer	27 394	29 645	25 475	36 876	39 730	38 170	26 935	17 576	21 112	31 999
Computer Systems Eng. / Architect	39 436	42 854	36 683	59 127	60 401	58 958	46 151	33 662	38 488	69 957
Web Designer	7 966	7 862	4 583	5 484	5 258	4 555	2 763	2 211	1 632	2 178
Web Developer	98 150	104 610	84 100	129 608	134 983	139 880	80 974	45 879	52 377	71 700
UI / UX Designer / Developer	5 574	7 121	6 550	11 787	13 630	14 594	11 085	7 361	7 406	14 969
Hardware Engineer	4 364	4 724	3 568	4 432	4 839	4 356	3 543	2 707	3 171	4 411
ICT technicians and data entry clerks										
Computer Support Specialist	66 724	75 392	68 781	97 450	99 393	105 950	87 811	67 125	60 734	101 641
Computer Operator	310	261	215	371	374	228	184	167	139	203
Data Entry Clerk	4 434	4 055	2 983	4 165	5 368	5 700	5 319	3 866	2 511	5 243
ICT and HR managers / marketing specialists										
Chief Information Officer / Director of IT	12 152	15 455	14 922	20 253	20 723	22 277	17 704	12 153	12 984	21 150
Marketing Specialist	20 238	20 608	21 198	28 029	28 299	27 939	27 573	22 011	18 674	28 292
Human Resources Manager	1 227	1 724	1 610	2 227	2 330	2 975	2 397	2089	1 822	3 529
Rest of occupations	5 033 724	6 004 014	5 450 037	6 798 134	7 630 494	8 280 361	7 897 370	6 397 915	5 834 325	8 967 339
TOTAL	5 700 177	6 744 285	6 090 821	7 772 632	8 639 924	9 372 975	8 697 955	6 945 605	6 426 534	9 951 951

Source: OECD calculations based on Lightcast data.

Annex Table 4.A.4. United States: Number of online job postings per year

	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
Computer and data analysts / administrators										
Computer Scientist	4 519	3 679	4 444	5 314	4 665	4 226	5 732	8 273	7 369	9 844
Data Scientist	1 260	3 649	6 644	14 272	15 749	19 936	30 696	42 340	35 123	50 175
Systems Analyst	119 301	117 430	119 985	129 972	111 126	108 029	144 642	172 809	140 069	167 979
Cyber / Info. Security Eng. / Analyst	58 911	64 262	76 568	108 520	105 548	103 794	139 203	167 385	155 028	176 352
Database Administrator	89 629	89 426	82 557	99 783	89 102	86 519	99 196	118 055	95 018	98 032
Data Engineer	1 524	2 137	3 204	7 766	8 019	10 983	21 973	36 888	37 729	47 434
Data / Data Mining Analyst	33 587	35 595	42 654	47 974	46 821	48 228	72 609	88 304	74 827	93 714
Software developers, programmers and engineers										
Software Developer / Eng.	549 292	509 986	495 853	632 326	564 180	592 382	820 633	1 061 418	900 090	1 020 960
Computer Programmer	61 812	61 034	56 354	61 415	51 130	50 652	70 470	83 981	75 912	80 519
Computer Systems Eng. / Architect	100 702	95 709	94 884	120 768	111 560	118 008	149 323	187 859	159 677	174 556
Web Designer	12 832	13 364	9 032	13 059	8 172	6 259	9 233	8 536	6 467	6 983
Web Developer	101 336	95 889	95 644	118 606	94 251	90 865	111 788	123 604	104 056	119 402
UI / UX Designer / Developer	28 207	30 805	32 474	40 607	35 727	36 133	58 565	72 300	57 397	70 799
Hardware Engineer	8 658	7 189	6 284	7 725	7 552	8 169	11 120	13 036	10 299	11 774
ICT technicians and data entry clerks										
Computer Support Specialist	128 767	133 355	127 478	144 758	150 305	150 215	205 638	234 241	210 914	246 179
Computer Operator	3 417	3 526	3 115	3 639	3 015	3 113	3 390	4 607	5 131	3 291
Data Entry Clerk	25 127	34 132	34 770	37 870	54 172	59 135	57 583	68 808	67 350	67 690
ICT and HR managers / marketing specialists										
Chief Information Officer / Director of IT	18 308	17 890	19 750	21 681	20 331	18 722	22 664	28 257	23 804	38 555
Marketing Specialist	48 751	53 405	50 306	61 566	60 844	54 535	65 095	77 735	64 679	101 165
Human Resources Manager	46 381	54 216	50 883	70 210	81 233	67 325	92 998	113 997	86 897	126 218
Rest of occupations	12 818 523	16 873 610	17 827 737	19 284 447	22 087 074	20 833 750	26 909 522	32 774 677	34 152 816	42 478 505
TOTAL	14 260 844	18 300 288	19 240 620	21 032 278	23 710 576	22 470 978	29 102 073	35 487 110	36 470 652	45 190 126

Source: OECD calculations based on Lightcast data.

Annex Table 4.A.5. Belgium: Number of online job postings per year

	2018	2019	2020	2021
Computer and data analysts / administrators				
Systems analysts	14 299	19 489	14 845	13 274
Database designers and administrators	631	804	550	382
Database and network professionals n.e.c.	1 606	2 345	1995	1 823
Software developers, programmers and engineers				
Electronics engineers	2 473	3 767	2 627	2 106
Software developers	16 720	24 098	19 202	15 702
Web and multimedia developers	4 086	7 695	6 549	4 461
Applications programmers	1 567	1 599	1 043	852
ICT technicians and data entry clerks				
ICT operations technicians	899	1 442	759	653
ICT user support technicians	3 603	5 337	4 078	2 782
Web technicians	243	364	161	173
Data entry clerks	539	1 265	1 506	1 248
ICT and HR managers / marketing specialists				
Human resource managers	1 842	2 203	1 510	1 423
ICT service managers	2 899	4 772	2 723	1924
Advertising and marketing professionals	9 883	14 270	11 227	9 878
Rest of occupations	680 019	883 188	756 054	579 973
TOTAL	741 309	972 638	824 829	636 654

Source: OECD calculations based on Lightcast data.

Annex Table 4.A.6. France: Number of online job postings per year

	2018	2019	2020	2021
Computer and data analysts / administrators				
Systems analysts	55 013	60 691	46 423	107 258
Database designers and administrators	1 892	2 122	1 530	2 274
Database and network professionals n.e.c.	1 229	1 537	1 880	2 954
Software developers, programmers and engineers				
Electronics engineers	7 076	7 644	5 947	11 896
Software developers	55 902	53 683	54 885	104 344
Web and multimedia developers	12 092	10 248	8 650	14 646
Applications programmers	2 480	2 666	1984	3 258
ICT technicians and data entry clerks				
ICT operations technicians	4 450	5 790	3 619	4 877
ICT user support technicians	16 921	19 132	20 463	24 071
Web technicians	3 140	3 358	2 696	5 515
Data entry clerks	7 935	11 168	12 710	5 864

	2018	2019	2020	2021
ICT and HR managers / marketing specialists				
Human resource managers	5 347	6 947	5 442	7 703
ICT service managers	13 018	15 404	11 806	14 267
Advertising and marketing professionals	18 168	21 367	17 742	29 905
Rest of occupations	2 645 523	3 208 988	3 340 048	3 465 205
TOTAL	2 850 186	3 430 745	3 535 825	3 804 037

Source: OECD calculations based on Lightcast data.

Annex Table 4.A.7. Germany: Number of online job postings per year

	2018	2019	2020	2021
Computer and data analysts / administrators				
Systems analysts	214 633	299 599	275 429	231 676
Database designers and administrators	8 566	9 302	7 099	5 750
Database and network professionals n.e.c.	11 506	13 621	15 209	12 579
Software developers, programmers and engineers				
Electronics engineers	14 980	16 028	14 364	13 126
Software developers	167 909	232 996	232 144	218 826
Web and multimedia developers	27 220	33 924	34 890	34 548
Applications programmers	22 125	31 508	30 784	23 019
ICT technicians and data entry clerks				
ICT operations technicians	12 264	5 451	3 573	2 539
ICT user support technicians	33 817	49 195	42 099	34 013
Web technicians	5 397	6 335	5 048	4 434
Data entry clerks	7 181	7 842	7 231	5 361
ICT and HR managers / marketing specialists				
Human resource managers	13 991	19 991	17 059	18 881
ICT service managers	21 457	20 040	15 055	15 164
Advertising and marketing professionals	113 445	143 224	133 237	139 057
Rest of occupations	5 573 289	7 491 100	7 864 914	6 396 169
TOTAL	6 247 780	8 380 156	8 698 135	7 155 142

Source: OECD calculations based on Lightcast data.

Annex Table 4.A.8. Italy: Number of online job postings per year

	2014	2015	2016	2017	2018	2019	2020	2021
Computer and data analysts / administrators								
Systems analysts	7 153	9 814	9 546	8 912	12 856	17 948	12 691	11 796
Database designers and administrators	683	674	684	616	729	651	310	305
Database and network professionals n.e.c.	236	297	397	388	761	1 438	1 843	2075
Software developers, programmers and engineers								
Electronics engineers	1 625	2 115	2 117	2 163	3 088	3 673	2 707	2 167
Software developers	14 964	20 873	19 250	17 597	25 323	31 531	19 954	18 017
Web and multimedia developers	1 630	2 505	2 400	2 419	3 137	4 582	3 271	2 846
Applications programmers	644	815	826	809	1 213	1955	1 531	1 522
ICT technicians and data entry clerks								
ICT operations technicians	1 091	1 658	1 628	1 728	2 675	2 828	1 467	1 505
ICT user support technicians	2 635	4 185	4 345	4 879	6 908	7 784	5 051	4 777
Web technicians	1 094	1 510	1 498	1 368	1 427	1 585	788	934
Data entry clerks	527	790	884	1 231	1 783	1 215	694	765
ICT and HR managers / marketing specialists								
Human resource managers	498	597	533	628	839	1 382	921	1 043
ICT service managers	643	1 073	1 027	939	1 502	3 101	1 770	1 475
Advertising and marketing professionals	5 823	8 625	8 522	9 312	12 271	18 133	11 815	12 735
Rest of occupations	270 501	371 428	386 089	446 769	641 101	694 197	508 364	559 181
TOTAL	309 747	426 959	439 746	499 758	715 613	792 003	573 177	621 143

Source: OECD calculations based on Lightcast data.

Annex Table 4.A.9. The Netherlands: Number of online job postings per year

	2018	2019	2020	2021
Computer and data analysts / administrators				
Systems analysts	12 261	17 233	9 398	8 715
Database designers and administrators	793	752	416	429
Database and network professionals n.e.c.	2 189	2 461	1 433	1 302
Software developers, programmers and engineers				
Electronics engineers	1 697	2 613	1 071	1 177
Software developers	19 208	20 267	10 611	11 427
Web and multimedia developers	9 868	13 032	5 039	7 324
Applications programmers	1 792	1 642	783	1 112
ICT technicians and data entry clerks				
ICT operations technicians	368	685	297	390
ICT user support technicians	3 345	5 693	2 585	3 541
Web technicians	152	104	63	109
Data entry clerks	319	730	690	1 388

	2018	2019	2020	2021
ICT and HR managers / marketing specialists				
Human resource managers	759	881	333	403
ICT service managers	2 372	3 242	1 237	1 280
Advertising and marketing professionals	8 498	11 478	5 536	8 405
Rest of occupations	352 544	643 912	352 164	487 938
TOTAL	416 165	724 725	391 656	534 940

Source: OECD calculations based on Lightcast data.

Annex Table 4.A.10. Spain: Number of online job postings per year

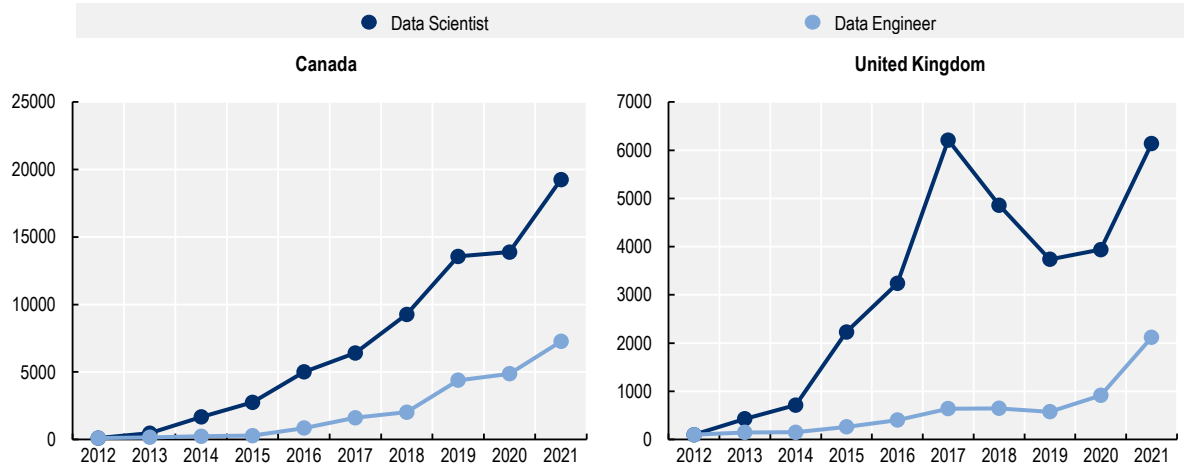
	2018	2019	2020	2021
Computer and data analysts / administrators				
Systems analysts	20 659	31 945	19 904	21 124
Database designers and administrators	1 807	2 400	1 665	1 333
Database and network professionals n.e.c.	1 607	3 249	2 290	2 262
Software developers, programmers and engineers				
Electronics engineers	1 675	2 808	1 698	1 693
Software developers	47 569	75 392	45 301	45 649
Web and multimedia developers	6 644	12 306	6 177	5 686
Applications programmers	2 184	3 230	1959	1 804
ICT technicians and data entry clerks				
ICT operations technicians	426	644	303	331
ICT user support technicians	8 633	15 237	9 645	8 971
Web technicians	195	269	148	98
Data entry clerks	532	701	351	345
ICT and HR managers / marketing specialists				
Human resource managers	1 702	2 824	2 293	1 453
ICT service managers	4 835	8 183	4 292	4 414
Advertising and marketing professionals	9 661	17 304	8 811	9 375
Rest of occupations	784 793	1 300 964	784 910	746 736
TOTAL	892 922	1 477 456	889 747	851 274

Source: OECD calculations based on Lightcast data.

Annex 4.B. The labour market demand for data scientists and data engineers in Canada and the United Kingdom

Annex Figure 4.B.1. Evolution of online postings for data scientists and data engineers in Canada and the United Kingdom

Index (2012 = 100)



Source: OECD calculations based on Lightcast data.

Notes

[1] Randstad Research Italy (RRI) (n.d.[7]) is a research centre of the Randstad group, born in 2019. The institute undertakes a number of qualitative and quantitative surveys, case studies and sector studies, analysing the supply and demand in the labour market and the future skills needs.

[2] These fall under the six-digit SOC category of web developers. This latter is also the corresponding occupation for EU countries where, due to the more aggregated occupational taxonomy, information on UI/UX designers/developers cannot be directly extracted, but more broadly that related to web developers.

[3] In fact, the EU occupations within this group belong to the ISCO (one-digit) groups 3 and 4, and to Lightcast (two-digit) groups 43 (this is the case for two out of the three occupations within this group).

[4] In the Anglophone countries' taxonomy.

[5] In EU countries' taxonomy.

[6] These shares should not be interpreted as the weight of digital occupations in the labour market, as it is just a fraction of those (20 for Canada, the United Kingdom, and the United States; 17 for Singapore; and 14 for EU countries) that are under study.

[7] Annex 4.A provides more detail in the levels of OJPs for each of the ten countries analysed.

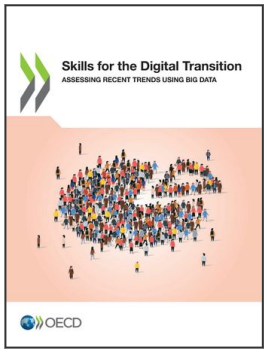
[8] The lowest shares for this occupational group are in Italy (21%), and Canada, Singapore and Spain (22%). On the other hand, in France and Germany this occupational group is relatively more important, as it represents 30% and 35% of the total selected digital OJPs, respectively.

[9] Notice that differences in the results across EU and Anglophone countries may be partly driven by the different occupational classifications used in the two sets of countries which are likely to affect results particularly in occupational groups with fewer sub-categories.

[10] As noted in the OECD's Employment Outlook 2021 (OECD, 2021[6]) employment in several routine and low-skilled occupations, as is the case for data entry clerks, "is expected to decline in the short term and to further deteriorate in the long-run".

[11] In the United Kingdom, the increase in OJPs for data scientists has also been strong, going from merely 179 postings in the initial year of observation to more than 11 000 new postings in 2017, a figure that is 60 times larger in the time span of only 5 years. After then, postings declined but have lately recovered, being back again at levels close to 11 000 in 2021. More details on the evolution of OJPs for data scientists and data engineers for the UK, as well as Canada, can be found in Annex 4.B.

[12] In particular, their size has increased 2.6 times relative to 2012.



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