



Labour and Skills Demand in Alberta

INSIGHTS USING BIG DATA INTELLIGENCE



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Foreword

Both long-term and short-term economic changes such as the digital transition and the COVID-19 pandemic have had a profound impact on the labour market in Alberta. For instance, as technology continues to advance rapidly, industries are undergoing significant transformations, leading to shifts in job requirements and skills. The pandemic further accelerated these changes, forcing businesses to adapt to remote work and digital operations. Consequently, both challenges and opportunities have appeared for Alberta's labour market, as labour demand across sectors and occupations has shifted over the last decade.

This report aims to provide an analysis of Alberta's labour market dynamics, with a particular focus on the impact of the digital transition, COVID-19, and related trends. By examining a dataset of online job postings spanning from 2015 to 2022, the report analyses the evolution of job demand, qualifications, and degrees sought by employers, as well as the growth of different sectors and occupations, both pre- and post-pandemic. Additionally, the report explores the specific challenges and opportunities faced by youth in the labour market, including the skills demanded and career pathways available to them. The analysis in this report provides insights for policy makers, suggesting a need to support growing sectors, enhance digital skills development, address demand for health workers, and improve youth job access. Additionally, to navigate through this complex data, an interactive data visualisation application (available in the publication's web page) accompanies the results in the report and provides detailed information about the most relevant technical and transversal skills demanded by employers for all occupations analysed.

This work has been carried out by Annikka Lemmens and Diego Eslava, under the supervision of Fabio Manca in the OECD Directorate for Employment, Labour and Social Affairs. The report benefitted from comments by colleagues in the OECD, including Stefano Scarpetta (OECD Director for Employment, Labour and Social Affairs), Mark Pearson (OECD Deputy Director for Employment, Labour and Social Affairs), Glenda Quintini (OECD, Senior Economist, Skills and Employability Division, Directorate for Employment, Labour and Social Affairs), and Francesca Borgonovi (Head of Skills Analysis, OECD Centre for Skills). Comments were also kindly provided by Kara Sherwin (Alberta's Ministry of Advanced Education) and Krishna Modupalli (Alberta's Ministry of Advanced Education). Editorial assistance was provided by Natalie Corry. This report is published with the financial assistance of the Alberta's Ministry of Advanced Education.

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Executive summary

The Alberta labour market experienced a significant contraction in 2016, with a decrease in both employment and in the volume of new job postings published online. The decreases in employment were most pronounced in the sectors of Manufacturing, Mining, Quarrying and Oil and Gas Extraction and were most likely correlated with a sharp decline in the oil price. However, from 2017 to 2019, the labour market improved and saw steady growth.

As in many other countries, the COVID-19 pandemic had a significant impact on Alberta's labour market, causing a 17% drop in the number of online job postings in 2020. The impact of the pandemic on workers of different educational levels was relatively homogeneous. However, the post-pandemic recovery was particularly strong for workers with a high school diploma, with the number of new online job postings nearly tripling for this group.

Mining, quarrying, and oil and gas extraction in Alberta was one of the fastest-growing sectors before the pandemic but suffered a significant decline during the pandemic due to the impact of COVID-19 and a decrease in oil prices. Among the different occupations hit by this shock, data show that the average number of online job postings for Welders and Machinists in Alberta declined steeply in 2020 due to lockdowns, social distancing measures and the decrease in oil prices that reduced industrial and manufacturing activity. However, this sector has shown quick recovery in demand since 2021.

The transportation and warehousing sector is one of the few sectors that continued to see growth in online job postings during the pandemic, due to the rise of e-commerce. The growth in demand for workers in transportation and warehousing has persisted post-pandemic, making it one of the few industries that has consistently experienced growth in demand for workers during and after the pandemic.

Post-pandemic, both employment and online job postings in Alberta quickly recovered, with employment growing by 5.4% and online job postings increasing by 70% in 2022. This remarkable difference in the growth of online job postings compared to employment suggests a tight labour market and the emergence of labour shortages in the near future.

In addition to the shortages emerging after the COVID-19 crisis, mega-trends such as digitalisation, the adoption of AI and of automation and population ageing are also affecting Alberta's labour market demand. Data mining analysts and business intelligence analysts are among the top ten fastest-growing occupations in the Alberta's labour market as a whole. These occupations are in high demand as organisations continue to collect and use more data in their activities. Data show that the largest share of online job postings (OJPs) for digital occupations is for software developers, programmers, and engineers, accounting for 36.7% in Alberta and 40.5% in Canada. Data in this report show that in a context of rapid digitalisation, the demands for several management, marketing, and HR professionals have also changed, as they now require proficiency in using software packages, web analytics, and online media, making them digital occupations as well.

The rise of e-commerce and changes in consumer behaviour, including an increased preference for online shopping, has also led to a growth in demand for delivery drivers and truck drivers in Alberta which add to shortages in the logistics sectors that are likely to create bottlenecks in the near future.

An ageing population in Alberta and Canada has also increased the demand for healthcare professionals, particularly Home Health Aides and Licensed Practical Nurses, who provide care to individuals in their homes or in healthcare facilities. The pandemic has further boosted this demand creating additional shortages.

The crisis in 2020 had a severe impact on young Albertans who experienced an average youth unemployment rate of 24% in 2020, higher than the average of 12.6% in 2019. Despite the negative impact of the pandemic on the demand for 'youth-accessible jobs' (i.e. jobs that require relatively low levels of work experience), the demand started to recover as the economy re-opened with a particularly significant increase in the job postings requiring a high-school diploma or no diploma. This can be attributed to the emerging shortages in the labour market, as employers struggle to find qualified workers and relaxed some of the education requirements to face labour market bottlenecks.

In such complex and evolving context, Alberta will need to consider encouraging and supporting those industries that have shown consistent growth in demand during and after the pandemic, such as the transportation and warehousing sector.

Similarly, government intervention should foster further the development of skills to adopt, manage and develop digital tools and AI to meet the increasing demand for data mining analysts, business intelligence analysts, and software developers, programmers, and engineers. This could be done through investment in training programmes, incentives for businesses to adopt AI and automation, and fostering a culture of innovation and digitalisation. In such rapidly evolving landscape, it is also imperative to monitor the impact of automation on lower-skilled occupations and provide support and retraining opportunities for workers who are at risk of losing their jobs to automation.

Policies should also be targeted to address the growing demand for healthcare professionals shown by the data, particularly home health aides and nurses. This can be done by investing in training programs, encouraging immigration, and promoting the healthcare sector as a stable and rewarding career option. Similarly, investments in elderly care facilities and support for families who provide care for elderly relatives could alleviate emerging shortages in the labour market.

Finally, policy intervention is needed to improve access to job opportunities for youth in Alberta as youth unemployment remains a key challenge despite the increase in the demand in the aftermath of the pandemic. Partnerships between government, educational institutions and the private sector can support the creation of these job opportunities in sectors in high demand through the alignment of education programmes to skill demands of firms in Alberta.

This report shows that labour markets and skill demands are changing rapidly and that timely labour market statistics is necessary to plan training policies and align them to new and emerging labour market demands. Big data intelligence, used in this report, is one of the tools that policy makers can leverage to support career guidance and advice in such fast-changing context. Many countries are already implementing new interactive career guidance tools and platforms that integrate real-time labour market intelligence. Alberta could also consider incorporating this feature into its existing career guidance portals. This would help to target enrolment in education programmes that develop skills in high demand and provide support to youth in making increasingly difficult education and training decisions.

1 The context: Trends in online job postings in Alberta

This chapter utilises a dataset of online job postings (OJPs) from January 2015 to May 2022 to analyse Alberta’s labour market trends. It focuses both on long-term trends, and on the short-term impact of the COVID-19 crisis. Insights about Alberta’s labour market demand are disaggregated by qualification levels required by employers in OJPs and geographically to explore the heterogeneity of Alberta’s job market trends. Results are also provided on the increasing prevalence of work-from-home arrangements spurred by the pandemic. By exploring these points, the chapter offers an aggregate understanding of Alberta’s labour market dynamics.

Highlights

- The Albertan labour market witnessed a major contraction in 2016, with a decline in both employment and online job postings. However, from 2017 to 2019, the labour market showed improvement and saw steady growth. The COVID-19 pandemic subsequently caused a significant decrease in online job postings, with a 17% drop in the number of online job postings in 2020.
- Post-pandemic, both employment and online job postings in Alberta recovered quickly, with employment growing by 5.4% and online job postings increasing by a staggering 70% in 2022. This significant difference in the growth of online job postings compared to employment suggests a tight labour market and the possibility of labour shortages in the near future.
- The impact of the pandemic on workers of different educational levels was relatively equal. However, the post-pandemic recovery was strongest for workers with only a high school diploma, as new online job postings for these workers nearly tripled.
- The two largest regions in Alberta, Calgary and Edmonton, saw differences in labour demands during the pandemic. While Calgary's online job postings saw a steep decrease of -22%, Edmonton's online job postings decreased by -6%.

This chapter discusses insights about trends in labour demand in Alberta between 2015 and the most recent months for which information on job postings published online is available: September 2022. Statistics about the evolution of demand are presented for Alberta and commented along with results for Canada as a whole. The information stemming from the collection of job postings published online allows the analysis of very granular occupation titles. Using the Lightcast occupational taxonomy, this chapter reviews the trends in demand of occupations up to the 8th digit level, 2 levels more granular than the Standard Occupational Classification utilised in previous skill analyses such as the O*NET in the United States.¹

The analysis in this chapter focuses on different time periods, conscious of the unprecedented shock to labour markets in the year 2020 as the COVID-19 crisis unfolded across the globe. Trends in labour market demand (as they appear across millions of job postings collected from the internet in Alberta and Canada) are examined for the 'pre-pandemic' period in between 2015 and February of 2020, during the peak of the pandemic (March to December 2020) and in the post-pandemic period (from January 2021 up September 2022).

Given the large number of occupations that could be potentially analysed using the occupational information of online job postings at the 8th digit level, the analysis presented in this chapter focuses on those which had above-average number of job postings in between 2015 and the pandemic period (February 2020)² in order to highlight the pre-pandemic trends and to assess how those may have been disrupted or accelerated by the COVID-19 and in the aftermath of the pandemic.

Results in this chapter show that the COVID-19 pandemic had a strong impact on economic activity in Alberta and Canada, leading to a 17% decrease in the number of online job postings and a 6.5% decrease in employment in Alberta in 2020 compared to 2019.

Despite a large negative impact, Alberta's employment levels and the number of new online job postings recovered rapidly post-pandemic, growing by 5.4% and 70% respectively in 2022. This chapter shows that the significantly larger growth in online job postings than in employment numbers is signalling a tight labour market and potential labour shortages in 2022 across a variety of occupations and sectors.

Similarly, the analysis of online job postings in this chapter shows that the pandemic affected the demand for workers with different education levels relatively equally, but that the post-pandemic recovery has been stronger for workers with only a high school diploma as new online job postings for these workers nearly tripled.

When disaggregating the results at the sub-province level, the analysis shows that Alberta's largest regions, Calgary and Edmonton, had very different labour demand during the pandemic, with Calgary's online job postings decreasing more steeply (-22%) compared to -6% for Edmonton.

The data: Using online job postings to track Alberta's labour market evolution

Millions of jobs are advertised every day, and an increasing number of these are advertised on online platforms like LinkedIn, Monster, Indeed, ZipRecruiter and CareerBuilder. Likewise, millions of individuals around the world use these same platforms to search for a job. All those platforms provide these users, individuals and firms, with an 'electronic labour market' where they can find one another.

Advancements in automated web scraping technologies, that is, the automated retrieval and storage of information from online platforms, allows the collection and use of information contained in job postings to analyse trends in labour market dynamics and skill demands. The advantages of using the information contained in online job postings over traditional labour market statistics lie in its timeliness, richness, and granularity (OECD, 2021^[1]).

Unlike traditional labour market survey data, which may be costly and require time to design, administer and analyse, online job postings are captured continuously. Algorithms standardise, quality assure, and store the information which is then made available for analysis on a continuous manner. This allows frequent updating of the results as labour markets and demands from employers evolve. Further, the richness and granularity of the information contained in online postings allows analysts and policy makers to move beyond the analysis of generic concepts such as the demand for the "Knowledge of Informatics" (assessed in databases like O*NET) to the assessment of the demand of more granular and specific knowledge domains such as "Python programming" or "Web design".

While the richness and granularity of skills and labour market information contained in online postings is unprecedented, caveats and limitations to the use of this data also exist. First, not all job openings are published online and therefore statistics therein may not be representative of the whole universe of job openings. As pointed out by (Hershbein and Kahn, 2016^[2]) vacancies appearing online are likely to be skewed towards certain areas of the economy despite the fact that available jobs have been increasingly appearing online instead of in traditional sources, such as newspapers. On these regards, (Carnevale, Jayasundera and Repnikov, 2014^[3]) estimate that around 80-90% of postings requiring at least a Bachelor's degree can be found online, whereas 40-60% of job postings requiring a high school diploma are channelled through the internet. That being said, (Hershbein and Kahn, 2016^[2]) also suggest that when comparing the relative frequency of postings in online vacancies data to survey-based data, online vacancy data reflect labour demand reasonably well and that the differences that emerge appear relatively stable over time. Recent OECD studies also highlight that the potential bias is likely to be more pronounced in low skilled jobs and less of a concern for high-skilled occupations and sectors (Cammeraat and Squicciarini, 2021^[4]). Further, not all high skilled vacancies are posted online and some are channelled through informal and internal company channels.

This chapter uses a dataset of online job postings with monthly information between January of 2015 to May of 2022 to analyse Alberta's labour market trends and compare them with those in Canada. The data is collected, transformed and harmonised by Lightcast (formerly Emsi-Burning Glass Technologies). The data is composed of millions of individual level job postings with up to 70 different variables ranging from skill keywords contained in each job posting, qualifications and experience required to fill the job and its geographical location, the name of the firm that is advertising the vacancy as well as the type of contract (permanent, temporary) and, when available, the salary offered for the specific role advertised. The OECD further transformed the data to create yearly aggregates, cross tabulations and other statistics presented in the document.

The context: Overall trends in online job postings in Alberta around the COVID-19 crisis

Looking at the years 2015-2019, it is clear that Alberta's labour market took a dip in 2016, both in terms of employment (see Figure 1.1) and in terms of the average number of online job postings (OJPs henceforth) (see Figure 1.2). The decreases in employment were most pronounced in the sectors of Manufacturing, Mining, Quarrying and Oil and Gas Extraction and Agriculture (Government of Alberta, 2017^[5]) and were most likely correlated with a sharp decline in the oil price (Fields and Bourbeau, 2017^[6]).³ The decrease in OJPs was more pronounced for Alberta than for Canada as a whole, again related to the job losses in goods-producing industries due to the oil prices (Fields and Bourbeau, 2017^[6]).

In between 2017 and 2019, data show clear recovery in terms of Alberta's employment figures, as the number of employed Albertans in 2018 exceeded those in 2015. The sectors that saw the largest decreases in 2015 and 2016 also experienced the largest gains in employment in 2018, the Manufacturing industry, followed again by the Mining, Quarrying and Oil and Gas Extraction sector (Government of Alberta, 2019^[7]). The average number of OJPs was more volatile than the employment numbers, as they still decreased in 2018 (see Box 1.1 for further details).

Generally, the volume of OJPs tracks the evolution of the demand for labour,⁴ that is the number of new available vacancies in the economy as they were published online. The interpretation of the evolution of OJPs and of employment calls for some attention when interpreting the results. New vacancies may be filled leading to the creation of new employment. New job postings, however, may also remain unfilled when the available workforce does not match the increasing demand by quantity or quality sought by employers. This latter situation, in which the rate by which new OJPs are posted exceeds employment growth, is likely to signal the emergence of labour shortages and bottlenecks. Conversely, employment figures may grow faster than OJPs when, for instance, hiring is done internally within the firm and candidates with adequate profiles are abundant in the labour market, signalling potential surpluses of workers (see Box 1.1).

Box 1.1. The evolution of OJPs and employment growth trends

Trends in OJPs and employment growth may diverge. It is important to notice that online job postings capture (part) of the demand for labour, and a decrease in OJPs and an increase in employment are not incompatible. For example, a large increase in online job postings but a constant or slight increase in employment can be interpreted as an indication of labour market shortages, where employers publish vacancies that are difficult to fill, with little or no impact on overall employment levels. Similarly, the speed by which OJPs are published may decrease when new jobs are gradually filled, releasing pressure on labour markets and decreasing its tightness. Increases in the volume of new OJPs in specific sectors (or even over particular period of time) may also signal employment churn (i.e. the overall turnover in an organisation's staff as existing employees leave and new ones are hired).

For example, analysis of the evolution of new job postings shows that OJPs decreased in 2018 in Alberta. The volume of new monthly job postings went from an average of 13 152 per month in 2017 to 10 991 in 2018. At the same time, Alberta's employment rate increased slightly that year (+1.9%) (Government of Alberta, 2019^[7]). The decline in OJPs and moderate increase in employment in the same year could indicate the province's labour market being less tight in that year. Analyses of the OJPs at the sector level indicate that retail trade and the healthcare sectors experienced declines in the volume of new vacancies published online, with however, positive rates of employment growth, as vacancies started to fill and new jobs were created in those sectors (Government of Alberta, 2019^[7]).

The COVID-19 crisis in 2020 was a sudden and unprecedented event that significantly transformed the lives of every person around the world (OECD, 2021^[11]). Fear of infection, strict public health guidelines and great uncertainty produced a sharp and sudden contraction in economic activity. The result was a

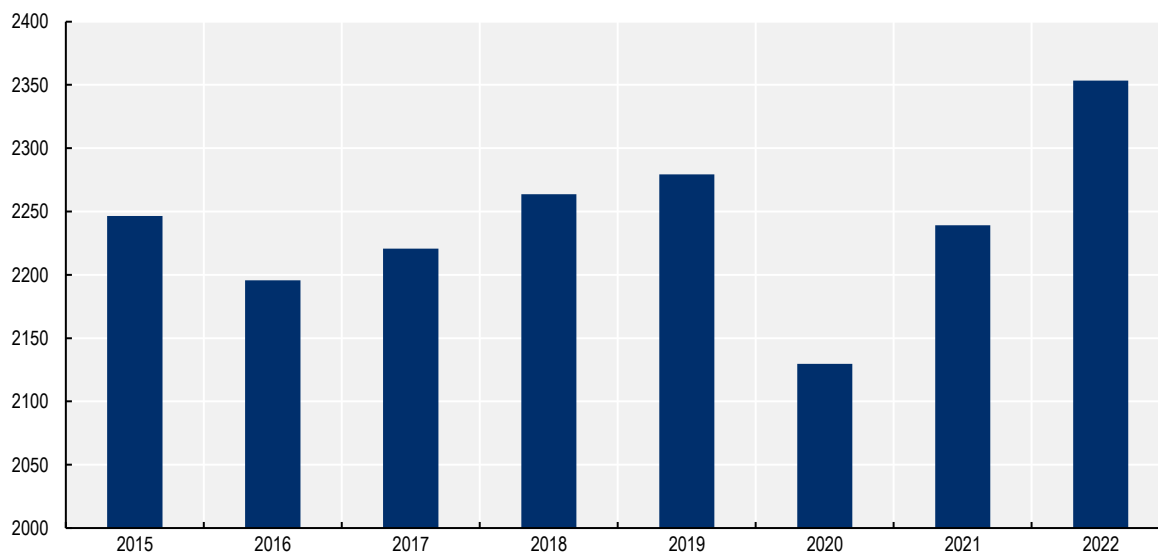
deep and widespread shock to the labour market, with a serious impact on the demand for skills and labour. Many industries were forced to cease operations to protect their workers' health and comply with policies aiming to contain the virus. Whenever possible, employers reorganised their operations to facilitate remote working, but many individuals lost their jobs and livelihoods. At the same time, the health crisis created shortages of workers in specific occupations (mainly healthcare and public safety), and labour markets and governments struggled to find skilled professionals to fill the gaps.

As the SARS-CoV-2 virus began to spread, countries introduced containment and mitigation strategies, such as limiting the movement and travel of individuals, closing schools and other educational institutions, halting non-essential activities and postponing non-essential medical interventions. Although the exact nature, timing, scope and intensity of responses varied substantially across countries, and sometimes even within countries, the containment measures inevitably had a profound impact on labour markets.

In Alberta, the dual shock of the COVID-19 pandemic and the collapse in oil prices in March and April of 2020 severely impacted the labour market. Figure 1.1 shows that total employment declined by 6.6% (Statistics Canada, 2022^[8]) as the record number of job losses in spring 2020 was the largest annual contraction since 1976.

Figure 1.1. Employment trends in Alberta between 2015 and 2022

Employment: Total, all industries (thousands)



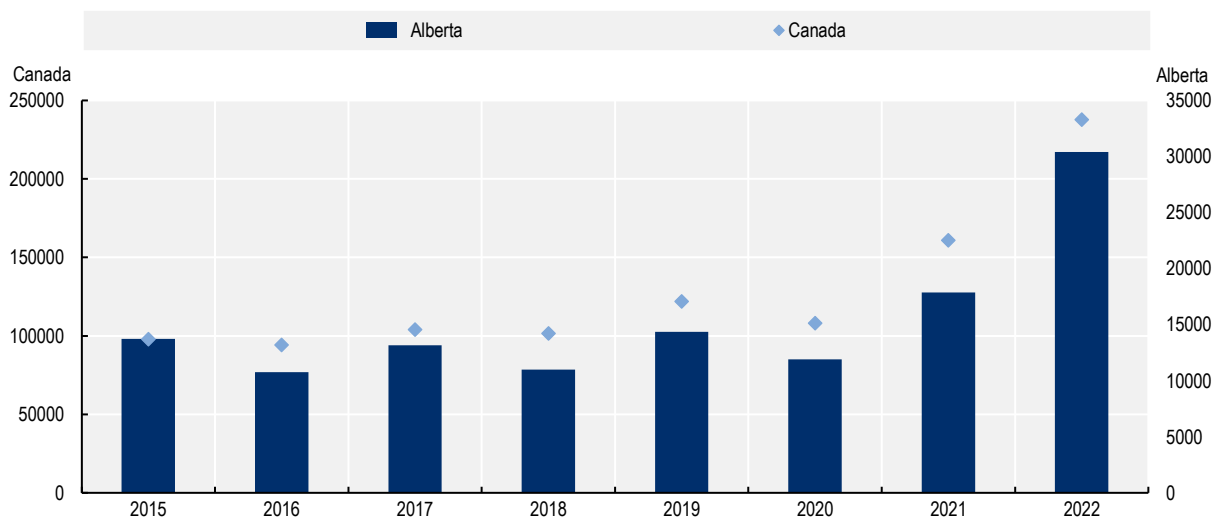
Source: Statistics Canada (2022^[8]), Table 14-10-0023-01 Labour force characteristics by industry, annual (x 1 000) <https://www150.statcan.gc.ca/t1/tbl1/en/tv.action?pid=1410002301>.

The decline in employment impacted almost all types of workers across the different sectors of the economy (Statistics Canada, 2022^[8]; Statistics Canada, 2022^[9]). In Alberta, the goods sector lost more jobs compared to the services sector and the private sector suffered relatively more job losses than the public sector, 7.1% versus 0.3%. The only two sectors that saw an increase in employment in 2020 were “Healthcare and social assistance” and “Finance and insurance”. Both full-time and part-time jobs were lost in almost equal measure, 6.6% and 6.2% respectively across the province. In contrast, the number of self-employed Albertans increased modestly during the year.

The analysis of online job postings confirms the unprecedented impact of the pandemic on Alberta’s labour market. The volume of OJPs in April 2020, at the start of worldwide lockdown measures, decreased by 39% relative to the previous month. This is consistent with the lockdown and restrictions implemented

during the COVID-19 pandemic that halted economic and productive activities to safeguard the health of workers in non-essential sectors. In the rest of 2020, the number of job postings increased when compared to April, notably by 53% in May. May also coincides with a partial reopening of business in Alberta, with e.g. restaurants, cafes, day-cares and retail stores opening from 14 May onwards (Government of Alberta, 2020_[10]). On average in Alberta, however, in 2020 the number of OJPs remained about 17% lower than in 2019. Job postings published online in the whole Canada followed a very similar dynamic, suffering a noticeable drop in 2020 as well (see Figure 1.2.).

Figure 1.2. Average number of monthly online job postings per year in Canada and Alberta in 2015-2022



Source: OECD calculations based on Lightcast data.

Despite the sharp decline in economic activity experienced in 2020, Alberta (and Canada as a whole) experienced a strong recovery afterwards in 2021 and 2022. For instance, Albertan employment statistics for the period in between January and October 2022 show an increase in employment by 5.4% compared to the same months in 2021 (Statistics Canada, 2022_[11]). Most of the growth in Alberta's employment was experienced in the service industry, with "professional, scientific and technical services" leading the recovery with an increase in employment of approximately 13% (Government of Canada, 2022_[12]).

Data on job postings published online also confirm this significant labour market rebound in 2021 and especially in 2022, signalling a strong recovery and the increasing pressure on labour markets to find workers and talent.

The stark increase in Alberta's OJPs in January to September of 2022 and the moderate increase in employment are consistent with the reported shortages in the labour market. Results in Figure 1.2. indicate that OJPs in Alberta increased by approximately 70% compared to the same period in 2021, while employment increased by approximately 5%. Results seem to suggest that even though more Albertans have been able to find employment in the recent recovery, a large share of vacancies that are posted online may still remain unfilled. In this context, shortages have for example been reported in the hospitality sector, healthcare sector, and construction sector (Government of Canada, 2022_[12]). Notably, employment in the healthcare sector decreased while OJPs for this sector increased by approximately 59% in January-September 2022 compared to the same period in the previous year. Canadian news outlets have been reporting on healthcare professionals quitting or relocating due to the pressure that was put on them in the COVID-19 crisis throughout 2022 (Mertz, 2022_[13]; Randhawa and Slack, 2022_[14]). The mismatch

between employment and job postings dynamics is indicative of the shortages which have caused disruptions to services, with for example hospitals having to temporarily close acute care beds (Government of Canada, 2022_[12]).

The pandemic also led to new forms of work: Remote working opportunities

The COVID-19 pandemic has had a profound impact on the way people work, with many companies and organisations shifting to remote working to slow the spread of the COVID-19 virus. Notably, prior to the pandemic, remote working was already a growing trend, but the rapid spread of COVID-19 accelerated the shift to remote working at an unprecedented rate.

With governments around the world implementing strict measures to slow the spread of the virus, many businesses were forced to close their offices and ask employees to work from home. This has resulted in a significant increase in the number of people working remotely, with some estimates suggesting that the number of Canadian remote workers increased from 4% in 2016 to 32% at the beginning of 2021 (Statistics Canada, 2021_[15]).

The shift to remote working has also been driven by advances in technology, which have made it easier for employees to work remotely. Cloud-based tools and apps have made it possible for employees to access the same resources and applications they would normally use in the office, regardless of their location. This has enabled employees to continue working on projects, communicating with colleagues, and collaborating on documents, even when they are working remotely.

While the pandemic has been a significant strain on many workers, it has also highlighted the benefits of remote working for both employees and employers (Statistics Canada, 2021_[15]). For employees, remote working has meant greater flexibility and autonomy in terms of when and where they work. This has allowed many employees to better balance their work and personal lives, resulting in improved work-life balance and reduced stress levels. For employers, remote working has meant reduced costs associated with office space and other overhead expenses, as well as increased productivity, as employees are able to work more efficiently when they are not commuting to the office.

Remote working has also played a role in addressing some current labour market challenges. With many businesses shutting down or reducing their operations due to the pandemic, remote working has allowed employees to continue working, even when their usual place of work was not available. Additionally, remote working has also been a way for employers to retain their employees, even when they are not able to operate at full capacity.

However, remote working also has its own set of challenges as workers may have struggled in maintaining a sense of connection and collaboration among team members. While technology has made it easier to communicate and collaborate remotely, it can be still difficult to replicate the informal interactions and face-to-face conversations that take place in the office or in the workplace.

The pandemic has also highlighted the existence of digital divides, with some employees not having access to the technology and resources needed to work remotely. This has resulted in a further widening of the gap between those who have access to digital technologies and those who do not, making it difficult for some employees to fully participate in remote working.

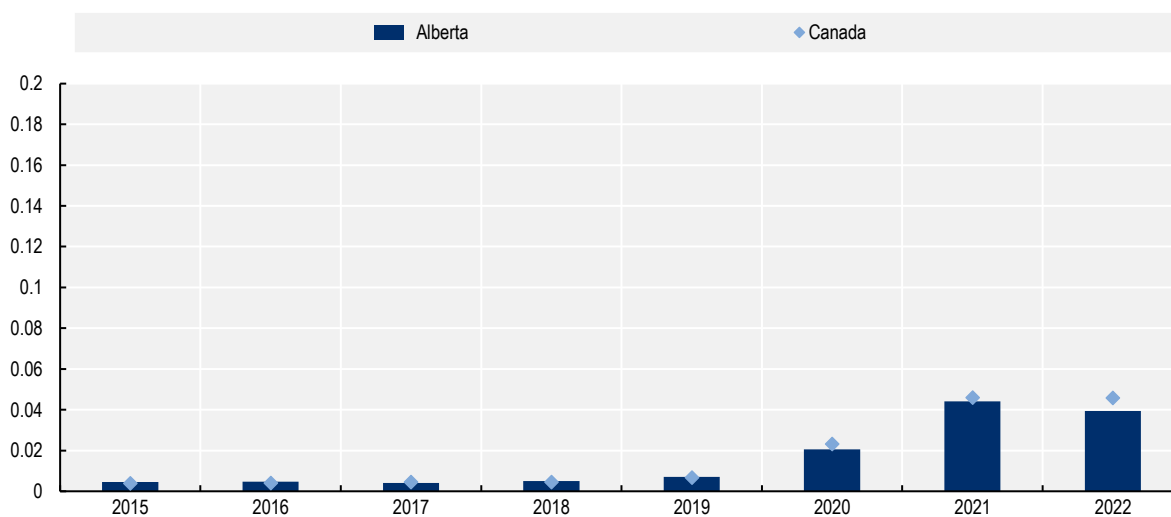
Looking at the number of jobs that explicitly mention work-from-home opportunities in their job posting, the impact of the pandemic is undeniable (Figure 1.3). Before 2020, less than 1% of OJPs mentioned remote working options, both in Alberta and in Canada as a whole. During the pandemic in 2020, this number doubled to 2% and 2.3% respectively. In 2021 the share of OJPs that mentioned remote working possibilities more than doubled again, to 4.4% and 4.6% in Alberta and Canada.

Possibly people were still worried about COVID-19, as well as finding that they preferred working from home at least some of the time. For instance, 80% of Canadians that were new to teleworking in the

pandemic mentioned wanting to continue working at least half of their hours from home, also after the pandemic. (Statistics Canada, 2021^[15]) Between January and September of 2022, with all COVID-19 restrictions lifted, the number of OJPs that mentioned WFH decreased to 3.9% in Alberta. In Canada as a whole however, the number of OJPs that explicitly mentioned remote working options did not decrease in 2022 but stayed at 4.6%.

All in all, the number of OJPs that mentions teleworking options is, however, rather limited. Note that this does not mean that only 4% of employers offer remote working opportunities. It is quite probable that more employers offer teleworking, but that this is not explicitly mentioned in their online vacancies. For example, in 2021 32% of Canadians reported working most of their hours from home (Statistics Canada, 2021^[15]), which is considerably more than the 4% of OJPs that mention remote options, as teleworking arrangements have been implemented on existing jobs and not only on new vacancies. Furthermore, the data on WFH opportunities needs to be carefully interpreted, as there is a higher chance of misclassification. Certain jobs, like “*Home Appliance Repairer*”, are often wrongly classified as jobs that can be done remotely, but in fact cannot be done from the worker’s home. These types of jobs have been excluded from WFH-jobs in the current analysis, for a full list of excluded professions see Annex A.

Figure 1.3. Share of OJPs that mention WFH possibilities



Source: OECD calculations based on Lightcast data.

Evolution of online job postings by required qualifications and degrees

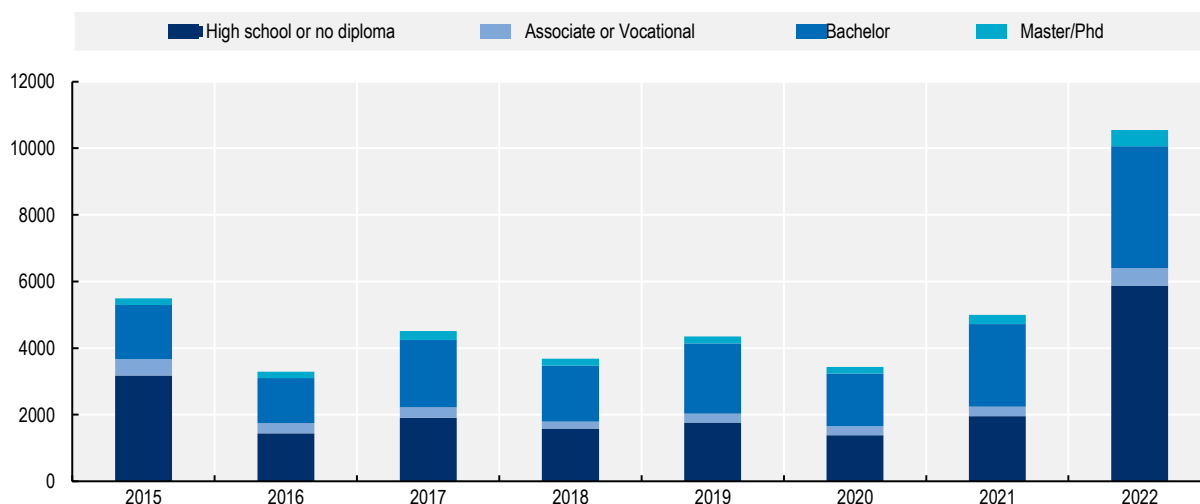
While the pandemic impacted all workers, the extent of such impact was heterogeneous across workers with different education and training levels in Alberta and in Canada. For this reason, the distribution of OJPs across different educational requirements is analysed. Results in Figure 1.4 show that job postings requiring a bachelor or college degree represented the largest share (around 50%) of total OJPs⁵ published in Alberta in the years preceding the pandemic (2015-2019). Jobs requiring high school education or no degree were the second largest group, at around 36%. Some 7% of new job postings in the same period were explicitly seeking candidates with at least a master’s degree while around 6% of jobs asked for at least an associate’s or vocational degree.

A direct comparison between the required education level (in job postings) and educational attainment in Alberta shows that the two dimensions are relatively aligned, despite OJPs searching for highly educated employees slightly more often.⁶ Analysis by (Statistics Canada, 2022^[16]) shows, in fact, that just over half

(55.1%) of Alberta's population has a non-university certificate/diploma or a bachelor's degree or higher in 2021 relative to about 60% of the OJPs requiring this level of education. Some 35% of Albertans have a high school diploma or no diploma. Around 34% of all Albertan job postings seek candidates with this education level.⁷

Pre-pandemic, the distribution of demand for workers with different types of qualifications as measured by OJPs had been relatively stable in Alberta, with a notable exception in 2015. Most OJPs are posted for positions requiring a bachelor's degree, followed by jobs looking for employees with a high school diploma or no diploma. Data for 2015 and 2016, however, shows a notable decline in the number of OJPs searching for employees with a high school diploma or no diploma. This is most likely due to the drop in oil prices that was experienced in 2015 and 2016, which had a disproportionate impact on the goods-producing industries, which are industries that typically also employ many people without post-secondary education (Fields and Bourbeau, 2017^[6]).

Figure 1.4 Average number of monthly OJPs per education level in Alberta



Note: The category "High school or no diploma" consists of OJPs that ask for a minimum of 10 to 12 years of education. "Associate or Vocational" is defined as 13 to 14 years of education. One reason to group associate degrees and vocational studies together is that the former are typically more 'specialisation-focused' than other degrees and much of the learning is specialised technical or vocational coursework. "Bachelor" is either a bachelor at a university or at a college, which both take 15 to 16 years of education. Requiring 17+ years of education leads to the classification "Master/PhD".

Source: OECD calculations based on Lightcast data.

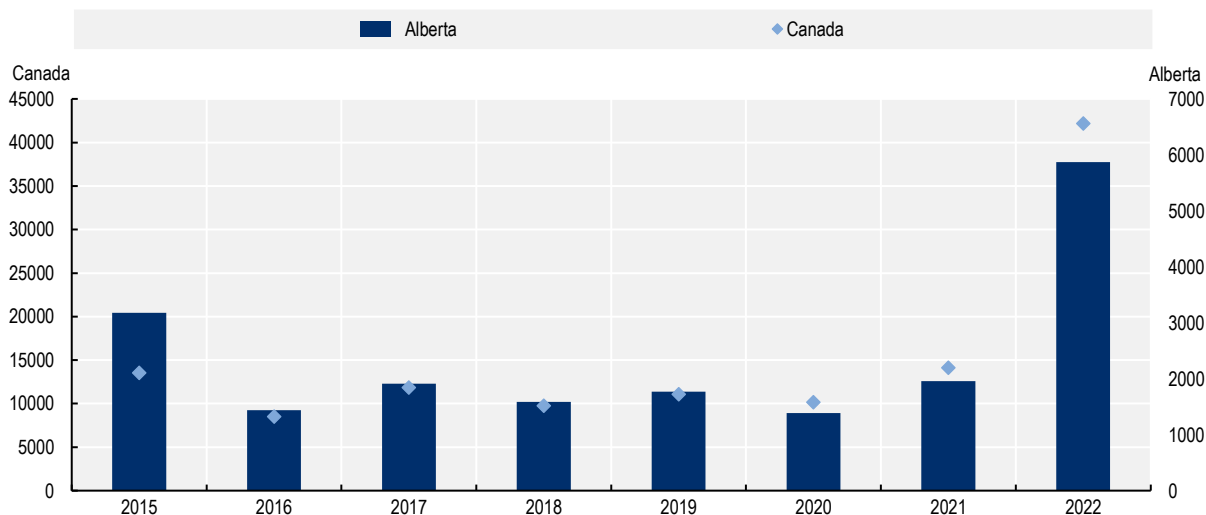
The pandemic led to significant shifts in the demand for workers across different education levels. Demand decreased for three out of the four categorised education levels when comparing 2020 to 2019. The average number of postings requiring a bachelor's degree or master's/PhD both decreased by 11%, while jobs requiring a high school diploma decreased by 8%. In contrast, jobs requiring at least an associate's or vocational degree instead increased slightly by 7%. One reason why the loss of OJPs requiring less than a college education was smaller, could be that many blue-collar jobs were deemed "essential jobs" during the pandemic and workers in those occupations were allowed to continue their operations (Milligan et al., 2021^[17]). For example, cashiers, people involved in the production and distribution of food, logistics and delivery were able to continue working, even during the peak of the pandemic (Milligan et al., 2021^[17]).

In the post-pandemic period, starting from January 2021 demand picked up again and the volume of OJPs increased for each education level. Differently from the decline in OJPs triggered by the pandemic, the recovery in the demand was less homogenous. The number of jobs requiring lower education titles grew

much faster, especially in 2022. For instance, OJPs requiring at least a bachelor's degree increased by 33% in 2022. At the same time, OJPs requiring a minimum of a high school degree/no degree nearly tripled in 2022. The post-pandemic growth in demand for lower educated workers is not unique to Canada. In the United States, shortages for manual labour jobs have been increasing in 2022, leading to a tight labour market and high wage growth for blue-collar workers (Levanon, 2022^[18])

The number of job postings requiring high school/no diploma nearly tripled post-pandemic

Figure 1.5. Average number of monthly OJPs requiring a high school diploma or no diploma



Source: OECD calculations based on Lightcast data.

Just like for most other education levels, the average number of OJPs requiring a high school diploma or no diploma decreased in 2020, by 8% (see Figure 1.5). Post-pandemic, especially in 2022, they increased significantly, both in Alberta and in Canada as a whole.⁸ In the first nine months of 2021 there were on average 2084 monthly job postings explicitly looking for workers with this education level in Alberta. For same period in 2022, this number increased to about 5872.

When crossing information at the education level with sector dynamics, as presented in Table 1.1, indicators show that the largest relative decrease in OJPs seeking workers with a high-school diploma was experienced in the “Mining, Quarrying, and Oil and Gas Extraction” sector in 2020. Notably, however, the volume of new OJPs in the mining sector for this education level was decreasing already in the pre-pandemic period. In the post-pandemic period (from January 2021) the mining sector saw a remarkably large rebound and increase in the volume of new vacancies posted online.

Table 1.1. Year-on-year growth of the number of average monthly OJPs seeking workers with a high school diploma/no diploma by sector

	Accommodation and Food Services	Administrative and Support and Waste Management and Remediation Services	Healthcare and Social Assistance	Mining, Quarrying, and Oil and Gas Extraction	Professional, Scientific, and Technical Services	Retail Trade	Transportation and Warehousing
2016	-69.0%	-59.1%	-55.7%	1.5%	-66.3%	-32.6%	-42.8%
2017	-0.3%	25.7%	18.3%	98.1%	168.2%	104.5%	-1.0%
2018	-1.2%	5.4%	-53.2%	-18.5%	-59.0%	25.4%	-24.9%
2019	-15.5%	-21.6%	76.8%	-47.3%	24.0%	56.9%	7.2%
2020	-38.3%	-20.2%	4.9%	-49.7%	-40.4%	-48.9%	3.6%
2021	53.2%	21.9%	21.1%	157.4%	107.6%	14.4%	22.4%
2022	241.8%	224.2%	181.3%	143.2%	130.7%	216.7%	134.7%

Note: Occupations in this table represent at least a 5% share of all OJPs, for which the sector was known, and which were looking for workers without a diploma or at least a high school diploma over the period January 2016 and December 2019. It should be noted that for 20-30% of OJPs that require at least a high school diploma or no diploma, the sector of the job posting is unknown.

Source: OECD calculations based on Lightcast data.

The largest decrease in the total number of OJPs instead happened for the Accommodation and Food Service sector. This sector, along with the Retail Trade sector, accounts for the largest share of OJPs looking for high school graduates/people without a diploma. In 2019, there were on average 169 OJPs looking for people of this education level to work in accommodation and food services. During the pandemic, the number of new vacancies posted online for this education level was instead approximately 104. This sector was significantly affected by the pandemic, as restaurants, cafes and bars had to close to limit the spread of the SAR-CoV-2 virus. Although establishments were allowed to open again in May of 2020 (Government of Alberta, 2020_[10]), OJPs did not increase remarkably. Analysis by Statistics Canada (2020_[19]) indicates that many workers who were inactive during the peak of the pandemic in this sector were simply hired again, potentially through informal channels, which would entail a less pronounced use of online job postings to advertise vacancies. When looking at the post-pandemic period, as demand for accommodation and food services increased again, finding new employees became increasingly more difficult, leading to an increase in the volume of new OJPs in 2022 and to the reported labour shortages in Alberta and Canada as a whole.

Retail Trade is one of the Alberta's sectors that most often advertise jobs for workers with lower qualifications, typically a high school diploma (or no diploma). Notably, this is one of only two sectors that experienced a positive growth in the average number of OJPs for this education level in 2020, see Table 1.1. The average number of OJPs looking for workers with a high-school diploma or lower grew by 3.6% in Alberta in between 2019 and 2020, despite a significant decline in demand in March and in April of 2020, during the peak of the pandemic. The overall growth in demand started in May 2020 and coinciding with a partial reopening of business in Alberta.⁹

Comparing the growth trajectories of the two largest sectors looking for workers with a high school diploma or no diploma, the retail industry recovered faster than the hospitality industry. Firstly, measures to reduce the spread of COVID-19 were more limiting for the day-to-day business of for example a restaurant or café than for a shop. Secondly, customers felt hesitant to dine-in and spend a prolonged time inside surrounded by other people (Sood, 2021_[20]), more so than to visit a shop for a short while.

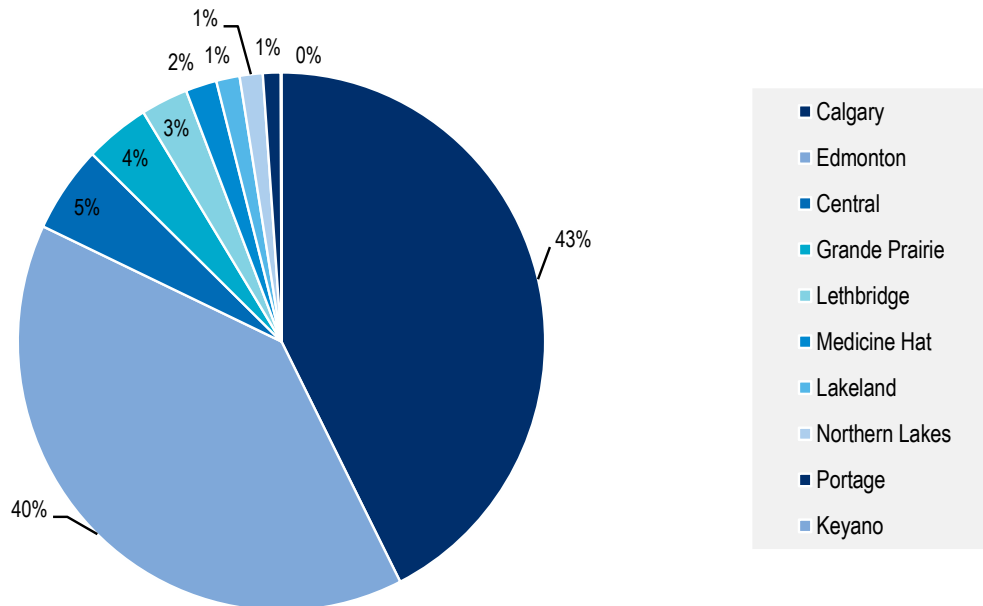
Apart from retail trade, one other sector saw an increase in OJPs looking for people with a high school diploma or no diploma during the pandemic: “Healthcare and Social Assistance”, where the number of new online job postings grew by 4.9%. Evidently, the pandemic put pressure on the healthcare system. While the total number of OJPs for the healthcare sector decreased in 2020, the number of jobs in this sector for people with lower qualifications (i.e. lower than bachelor’s) increased instead. Potentially, demand for practical tasks, such as cleaning hospitals and delivering food to patients, increased during the pandemic, which workers with these types of education are more likely to perform. Tasks performed by healthcare support staff are often overlooked, but necessary to keep a hospital running. As Zorimar Rivera-Núñez, author of a recently published study on health support staff during the pandemic,¹⁰ said: “without the crews that clean and sanitize operating rooms, there can be no surgery [...] and without meals prepared in hospital kitchens and delivered to patients’ bedsides, there can be no hospital recuperation.” (Washburn, 2022_[21])

Furthermore, the analysis of OJPs indicates that the construction sector in Alberta experienced one of the largest increases post-pandemic, as the number of OJPs searching for people with a high school diploma or no diploma tripled in size in 2022. Construction accounted for 3.8% of the total OJPs searching for people of this education level when looking at all years, but for 7.2% in 2022.¹¹ In their labour market bulletin of September 2022, the Canadian Government mentions construction as one of the industries facing the largest shortages at this moment (Government of Canada, 2022_[12]). To address these shortages, leaders in Alberta’s construction industry have recently made millions of dollars in funding available to help students pursue training in the form of apprenticeship and diploma programs (Global News Canada, 2022_[22]).

Trends in online job postings for different Albertan regions

The majority of Alberta’s OJPs are published for jobs that are either in the Calgary (41%) or Edmonton (38%) service region¹² (Figure 1.6). This is unsurprising, as in terms of population sizes, Calgary and Edmonton together make up 36% of the total Albertan population in the 18-64 age group.¹³ Central (5%), Grande Prairie (4%) and Keyano (3%) are the other three regions with the largest concentration of new OJPs across Alberta’s territory. The remaining, less populated, regions¹⁴ account for 8.6% of the total number of job postings, with only Lethbridge being larger than 2% (2.8%). In the rest of this section Calgary, Edmonton and Grande Prairie are discussed in more detail, including how different sectors developed in these regions.

Figure 1.6. Percentage of total OJPs per service region

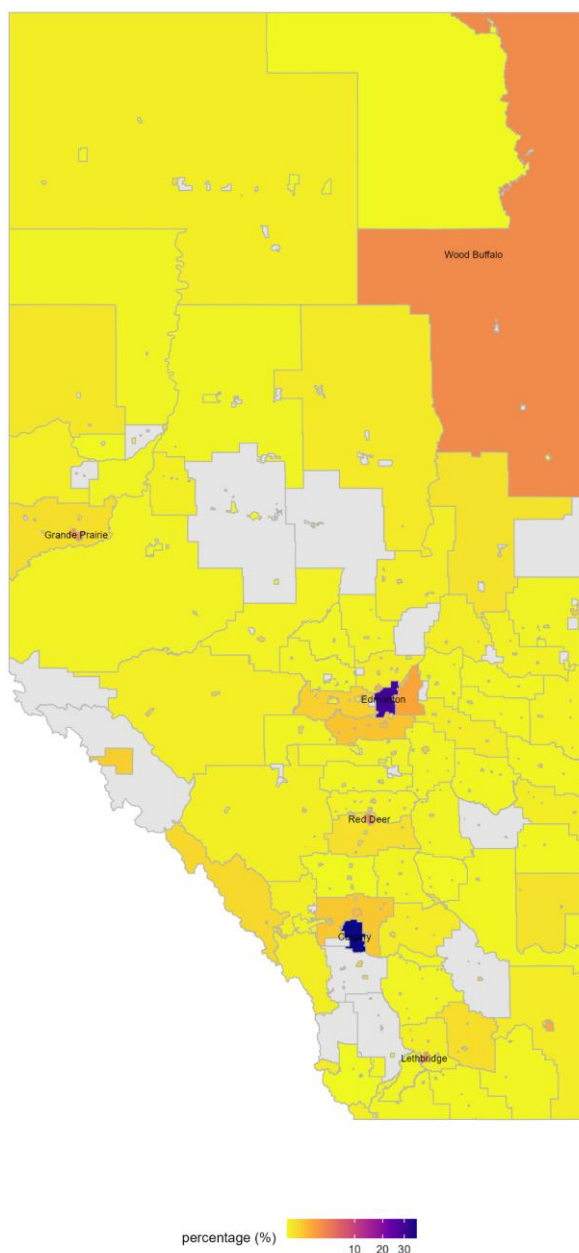


Note: The share is calculated in between January 2015 and September 2022.
Source: OECD calculations based on Lightcast data.

The distribution of OJPs in Alberta on the map in Figure 1.7, confirms the analysis at the service region level. Indeed, Calgary and Edmonton together account for over 60% of the total OJPs in Alberta. Most of Alberta's OJPs are posted in the southern half of the province, with a notable exception being the area in the specialised municipality:¹⁵ "Regional Municipality of Wood Buffalo" in the northeast of Alberta, which accounts for around 5% of OJPs as well. This area is home to oil sands deposits, among which the Athabasca Oil Sands. This is only area in Alberta where oils are at a shallow enough depth to be mined (Government of Alberta, 2017^[23]), and it is therefore home to Alberta's oil mining industry (Government of Alberta, 2017^[24]). The presence of the oil mining industry partially explains why there are a relatively higher number of OJPs in that area compared to most other areas, as the mining sector contributed to about 21% GDP in Alberta over the last two decades (Wang, 2021^[25]). The city of Wood Buffalo itself, which is located in service region Keyano, accounts for around 3% of OJPs, which corresponds to the share of OJPs found in that service region.

It is important to note that areas where the map is greyed-out are areas for which no OJPs were available between 2015 and 2022.¹⁶ The lack of available OJPs reflects in part the distribution of economic activity, meaning that potentially these areas do not have a very active labour market. It also partially reflects how well the usage of ICT and the use of web portals for posting vacancies has penetrated that area.

Figure 1.7. Distribution of OJPs in Alberta (January 2015 – September 2022)



Note: Grey areas indicate non-available information. Names are shown for areas with higher share of job postings.

Source: OECD calculations based on Lightcast data. Digital boundary file adapted from (Statistics Canada, 2022^[26]) <https://www12.statcan.gc.ca/census-recensement/2021/geo/sip-pis/boundary-limit/limites/index2021-eng.cfm?year=21>. This does not constitute an endorsement by Statistics Canada of this product.

Calgary's decline in OJPs during the pandemic and recover period afterwards were much steeper than the decline and recovery in Edmonton

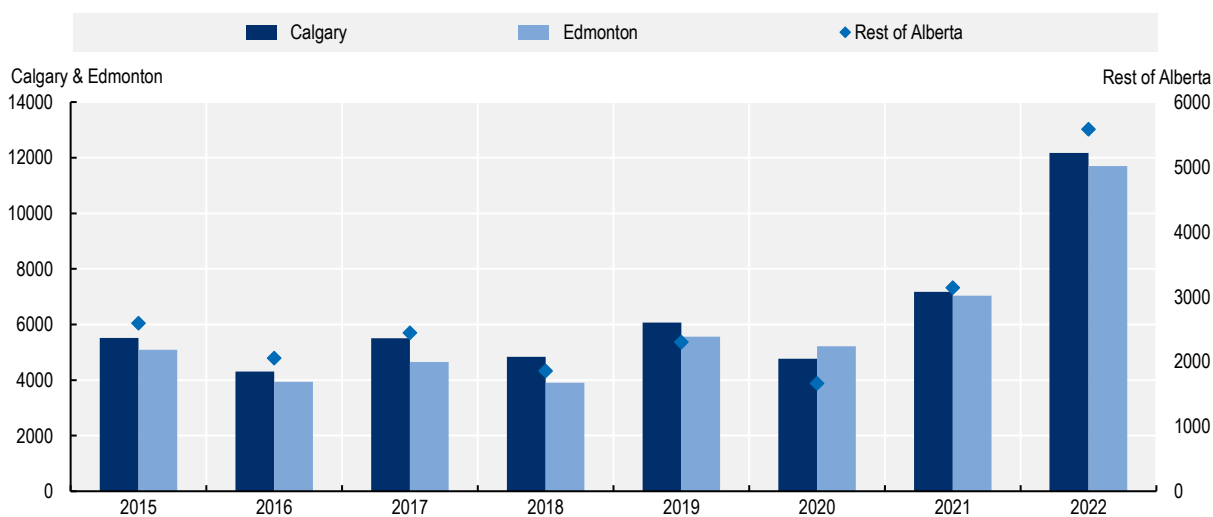
As mentioned, the relative majority of OJPs in Alberta are looking for workers in the Calgary area. This holds true in all years between 2015 and 2022, except during the peak of the pandemic in 2020 (see Figure 1.8). At that time, the number of average new monthly OJPs was larger in Edmonton.

Analyses of the evolution of demand indicates that Calgary experienced a much larger decrease in the number of OJPs than Edmonton during the pandemic. Calgary's OJPs diminished by about 21% relative to 6% in Edmonton.

Calgary economic structure relies significantly on its energy industry (World Energy Cities Partnership, 2022^[27]), which saw a significant decrease in revenue during 2020 due to the combination of the pandemic and the fall in oil prices (Wang, 2021^[25]). Calgary's manufacturing sector, mining sector, transportation sector, and professional, scientific, and technical services sector took large hits in 2020. These four sectors together account for 33% of the decrease in OJPs in Calgary in 2020. It is worth noting that employees in these sectors often had fewer opportunities to work from home, limiting their ability to remain active during the peak of the pandemic and leading to a strong contraction in their demand.

In contrast to Calgary, Edmonton had a smaller decrease in the volume of new OJPs in 2020, the smallest out of all five largest regions (-6%). Edmonton as the capital city of Alberta, represents a major hub for Alberta's government jobs. For instance, before the pandemic, in 2019 some 2600 monthly OJPs were looking for workers in the public administration sector, in contrast, in Calgary there were 1 230 monthly public administration postings in the same period. Edmonton did not go through the pandemic unscathed and 2020 brought the largest decrease in Edmontonian jobs for the public administration sector, with new job postings decreasing to around 1 480 per month. This decrease accounted for 29% of the total decrease in OJPs in Edmonton.¹⁷

Figure 1.8. Average number of monthly OJPs in Calgary and Edmonton



Source: OECD calculations based on Lightcast data.

In the recovery period, starting in 2021, the number of new job postings increased more pronouncedly in Calgary than in Edmonton, signaling a stronger recovery that followed the much more severe previous decline in that region. The dynamics during the recovery confirm that lockdowns have played a significant role in the sharp decline in labour market demand in Calgary's region during the pandemic.

To put these trends into perspective, in 2021 the average number of monthly OJPs increased by 50.5% in Calgary, and by 34.9% in Edmonton. Calgary's Manufacturing, Mining, Transportation, and Professional, Scientific, and Technical Services sectors account for about 23% of the total increase. However, the recovery was the strongest in the Accommodation & Food Services. Edmonton saw its starkest increase in OJPs in Construction and in Finance & Insurance.

More recently, in 2022, the growth rates in the two largest regions have started to become more similar, with significant increases in the volume of new job postings (69.7% and 66.2% in Calgary and Edmonton respectively). During that year, Accommodation & Food Services, followed by Retail Trade grew the fastest in both regions. Notably, both sectors are now dealing with pressing shortages in Alberta (Government of Canada, 2022^[12]). For the hospitality industry in particular, news outlets have reported that many ex-hospitality workers switched industries, moving for example into healthcare or financial services (Zapata, 2022^[28]).

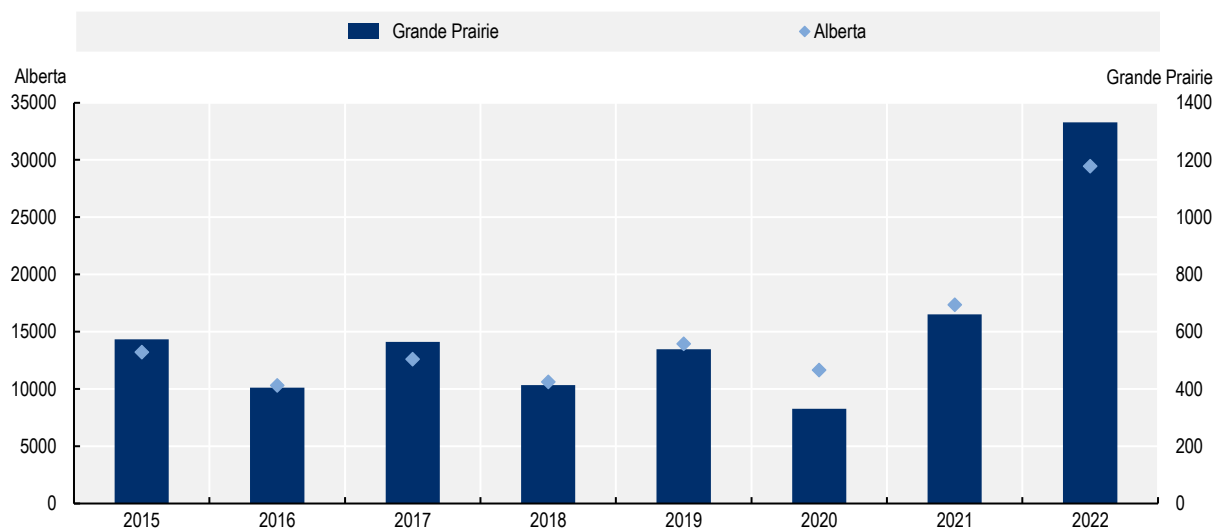
Grande prairie saw the largest decrease in 2020, and the steepest recovery post-pandemic

Although Grande Prairie is much smaller than Calgary and Edmonton¹⁸ in terms of population, this region has some characteristics that make it of particular interest. Firstly, the city of Grande Prairie has a relatively young population, with the median age being just 32 (City of Grande Prairie, 2020^[29]). The labour force therefore makes up a relatively large part of its total population. Secondly, the pandemic had a really strong impact on the number of OJPs for this region.

Figure 1.9 shows that, in 2020, the average number of OJPs in Grande prairie decreased by 38.7%, going from on average 538.5 per month to 330.1. This is the largest decrease out of all the Albertan regions. The reason why the pandemic impacted Grande Prairie so significantly has likely to do with the key industries in this region. Some of the most important industries in Grande Prairie are agriculture, forestry, oil & gas, retail and tourism (City of Grande Prairie, 2020^[29]). Similar to service region Calgary, the number of OJPs for the mining sector decreased strongly in 2020, going from on average 230 OJPs to 72. Canada's tourism industry of course suffered greatly from travel restrictions and other measures designed to diminish the spread of the virus (LMIC, 2020^[30]). Tourism is part of the Accommodation and Food service industry, which saw a 25% decrease in OJPs in 2020 in Grande Prairie.

Post-pandemic, Grande Prairie has had a strong recovery, with new job postings nearly doubling in 2021 and increasing from an average of 660 new vacancies per month in 2021 to 1 332 in 2022. Just like for the rest of Alberta, the driving forces behind the recovery are the Accommodations and Food Service sector and the Retail Trade sector. The mining sector also saw a large increase, going from 72 monthly OJPs in Grande Prairie during the peak of the pandemic to 590 in 2022.

Figure 1.9. Average number of monthly OJPs in Grande Prairie



Source: OECD calculations based on Lightcast data.

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Notes

¹ Results are also available, upon request to Alberta's Department of Advanced Studies, using the Canadian National Occupational Classification.

² These occupations characterise Alberta's online job postings' demand and their dynamics are particularly important for policy makers as they represent a large share of the demand published online in the province.

³ For more details on the Mining, Quarrying and Oil and Gas Extraction sector and the oil prices, see Chapter 2.

⁴ It is worth noting that data on job postings can also capture turnover and churn. Additionally, OJPs partially capture the increase in the use of online platforms to advertise jobs that used to be advertised in a different way, for instance through word of mouth or informal channels (see Box 1.1).

⁵ Total OJPs for which the minimum required education level is known. For the majority of OJPs the minimum required education level is unknown. In 2022 this requirement can be extracted for about 35% of postings. In 2021 it can be extracted for 28% and 29% in 2020.

⁶ An overrepresentation of demand for workers with higher degrees in OJPs could indicate a mismatch between the education level of the population and the labour demand by employers, though OJPs may also be naturally skewed towards jobs requiring college or higher qualifications. Similarly, credential inflation (i.e. the practice by employers of advertising educational requirements that are above the standards required for the job) may also be partly affecting the results, signalling some mild apparent

mismatch. Carnevale, Jayasundera and Repnikov (2014^[3]) found that jobs asking for a bachelor's degree are more likely to be posted online, than jobs with a lower minimum education requirement.

⁷ The other 10% of Albertans have obtained either a non-apprenticeship trades certificate or an apprenticeship certificate.

⁸ In 2022 the minimum required education level of 65% of all OJPs was unknown. This is quite a reduction, as in 2021 72% were unknown and in 2020 it was 71%. It is possible that some of the OJPs in earlier years for which the minimum degree requirements were unknown, already searched for employees with high school as their education level. This would lead to an overestimation of the increase of demand for high school graduates.

⁹ Non-essential retail stores were allowed to open from 14 May onwards (Government of Alberta, 2020^[10])

¹⁰ In particular, this author and co-authors looked at the experiences of Black and Latinx healthcare workers in support roles during the COVID-19 pandemic (Rivera-Núñez et al., 2022^[31]).

¹¹ The largest percentual increase can be found for the category: "Other Services", which grew by 330%. In 2022, this industry accounts for 3.3% of the total number of OJPs for this education level for which the sector is known.

¹² To aggregate OJPs a mapping from municipalities to service regions has been used. Service regions are a term used by Alberta Advanced Education, which refers to regions that have one or more post-secondary institutions. 96.1% of all OJPs in between 2015-2022 can be allocated to service regions.

¹³ Population data on regions provided by Alberta Advanced Education.

¹⁴ Medicine Hat, Northern Lakes, Portage, Lakeland and Keyano. In terms of population size, these regions combined are about 9.8% of the total population in the ages of 18-64.

¹⁵ Specialised municipalities are unique municipal structures that can be formed without resorting to special Acts of the Legislature. Often, specialised municipalities allow urban and rural communities to coexist in a single municipal government (Government of Alberta, n.d.^[32]).

¹⁶ It is likely that OJPs in the greyed-out area around Calgary are attributed to the city of Calgary itself.

¹⁷ More details about the public administration sector can be found in Chapter 2.

¹⁸ Grande Prairie is the fourth largest region by volume of OJPs accounting for about 4% of total job postings in Alberta. In 2020, the number of average monthly OJPs decreased by 39.5%. (See Figure 1.9).

2 Tracking demand in online job postings by sector of activity in Alberta

This chapter uses information contained in online job postings (OJPs) to examine Alberta's labour demand across various sectors, comparing them to the broader Canadian market. The chapter provides an analysis of the sectors' pre-pandemic growth rates and sheds light on the top-growing sectors. Specifically, results delve into three sectors – mining, quarrying, oil and gas extraction; transportation and warehousing, and public administration – that exhibited the highest growth rates and discusses their labour demand trends during the pandemic and post-pandemic. Additionally, the chapter explores the different career areas within these top growing sectors, offering insights into the distribution of occupational categories within each sector. By investigating these points, the chapter provides valuable information on sectoral demand, growth patterns, and occupational distributions within top-growing sectors.

Highlights

- During the pre-pandemic period, the three largest sectors in terms of online job postings in Alberta and Canada were accommodation and food services (NAICS 72), retail trade (NAICS 44-45), and healthcare and social assistance (NAICS 62). These sectors showed stable and slow growth in online job postings.
- In Alberta, the public administration sector (NAICS 91) experienced rapid growth in online job postings between 2017 and 2020, with a 49% increase. However, the same sector saw a slight decrease (-4%) in Canada as a whole.
- The mining, quarrying, and oil and gas extraction sector (NAICS 21) in Alberta was one of the fastest-growing before the pandemic, but suffered a significant decline during the pandemic due to the impact of COVID-19 and a decrease in oil prices. However, this sector has shown quick recovery in demand since 2021.
- The transportation and warehousing sector (NAICS 48-49) is one of the few sectors that continued to see growth in online job postings during the pandemic, due to the rise of e-commerce. This growth has not slowed down post-pandemic, and the sector remains one of the few that has seen consistent growth in demand for workers during and after the pandemic.

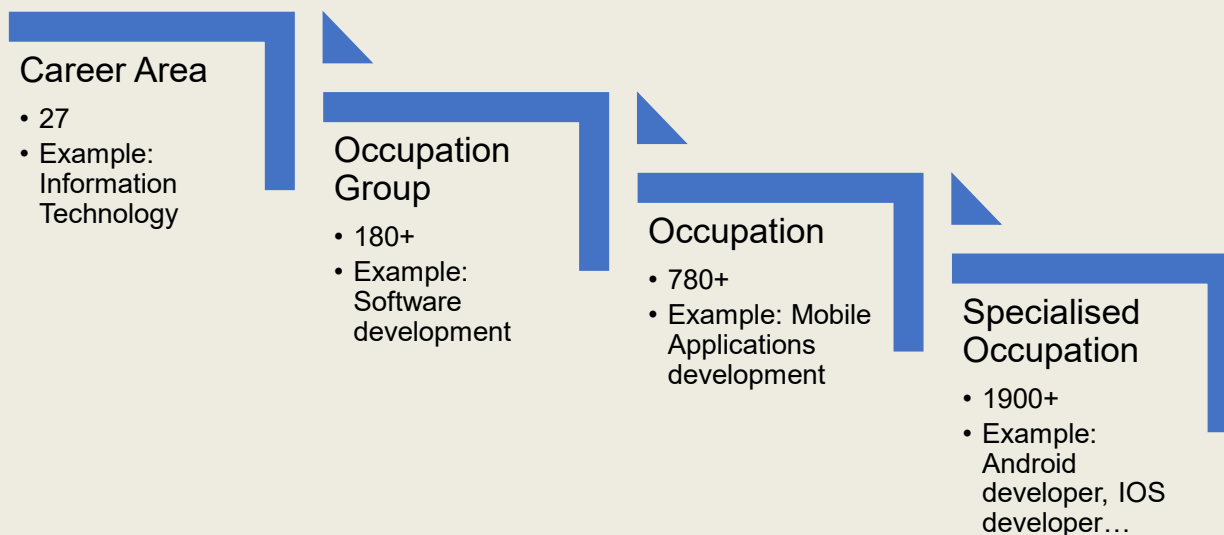
The intensity of the demand for labour can differ across types of jobs and across sectors, reflecting structural factors such as the economic and productive structure of a country or a region, or transitory shocks to the economy that lead to shifts in demand. Besides the geographical location and the education level, another key element for policy makers to understand the dynamics of labour markets is the analysis of sectoral trends.

This chapter discusses the evolution of demand in Alberta at the sector level by analysing trends in online job postings. The analysis reveals the large shock that the COVID-19 crisis had on the demand's sectoral composition as well as the trends that were already ongoing in the pre-pandemic period. As expected, while particular sectors account for a large part of the total number of online job postings, some of the sectors that used to be in high demand have experienced a slowdown, while other smaller sectors become much more prominent in the total number of OJPs. For example, demand for employees with expertise in data science was relatively small in 2015, while now they account for a much larger part of total demand.¹ This chapter focuses on three sectors that showed the most rapid growth in the years pre-pandemic, and analyses how the pandemic impacted them. Their growth post-pandemic, and details about demand for specific career areas within these sectors are investigated as well. The term career area is explained in Box 2.1.

Box 2.1. Career areas in the Lightcast Occupation Taxonomy

The Lightcast Occupation Taxonomy (LOT) is a classification system that consist in four different levels: Career Area, Occupation Group, Occupation and Specialised Occupation. Career areas are the most general layer of the Lightcast occupational taxonomy. One of the advantages of this classification is the one-to-one relationship between levels, which implies that each specialised occupation maps only to one occupation and so on up in the classification hierarchy, as shown in Figure 2.1.

Figure 2.1. Lightcast Occupation Taxonomy (LOT) hierarchy

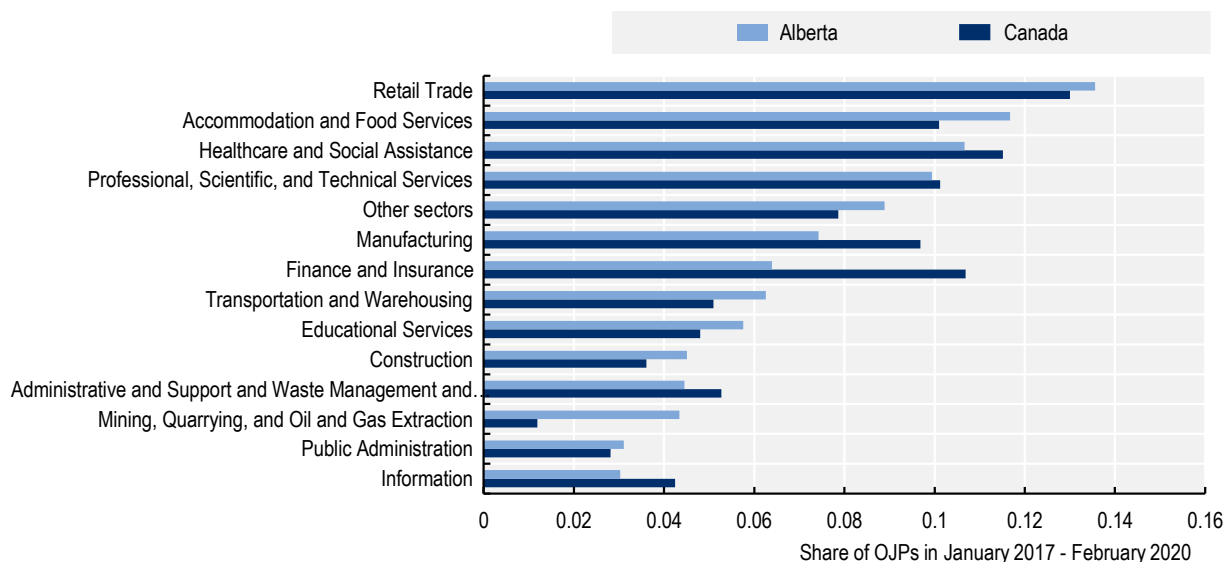


Career areas can be used to look at the distribution of different occupational categories within a sector. Someone working in the transportation sector for example could be working within the career area of transportation in the specialised occupation of driver, or as a data entry clerk in the career area of business, management and operations.

Source: Example adapted from Lightcast (2022^[1]), The Lightcast Occupation Taxonomy, <https://lightcast.io/resources/blog/new-occupation-taxonomy>.

As Figure 2.2 shows, categorising the online job postings in the three years directly before the pandemic by sector leads to broadly comparable distributions of the demand for labour in Alberta and Canada as a whole.² Still, there are some small differences when ranking the sectors. In Alberta, Retail Trade (13.6%), Accommodation and Food Services (11.7%) and Healthcare and Social Assistance (10.7%) represent more than 10% of the total share of OJPs. The fourth largest sector by volume of OJPs is Professional, Scientific, and Technical Services, which contributes 9.9%. In Canada, instead, there are five sectors which are larger than 10% of the total demand: Retail Trade (13%), Healthcare and Social Assistance (11.5%), Finance and Insurance (10.7%), Professional, Scientific, and Technical Services (10.1%), and Accommodation and Food Services (10.1%). The main difference therefore is the sector Finance and Insurance, which is the third largest sector in Canada, but sixth in Alberta at 6.4% of the total demand.

Figure 2.2. January 2017- February 2020 share of OJPs per sector, in Alberta and Canada



Note: The category “Other sectors” includes all sectors that accounted for 2% or less of total OJPs in Alberta pre-pandemic: “Other Services (except Public Administration)”, “Wholesale Trade”, “Utilities”, “Arts, Entertainment, and Recreation”, “Agriculture, Forestry, Fishing and Hunting”, and “Management of Companies and Enterprises”.

Source: OECD calculations based on Lightcast data.

Alberta’s sectors with the largest number of monthly OJPs in 2015–2016 were also among the sectors with relatively stable demand during the pre-pandemic period.³ In particular, on average, the top three largest sectors in Alberta (retail trade, accommodation and food services and healthcare and social assistance) had slightly fewer monthly OJPs in the period between January 2017 to February 2020, when compared to January 2015 to December 2016 (See Table 2.1).

For instance, the analysis of the Accommodation and Food Services sector indicates that, in the period in between January 2015 and December 2016, an average of 1 243 monthly job postings were published online, relative to 1 101 average monthly job postings in the period in between 2017 and February 2020. Employment figures for the same time periods show that the number of employees in the Accommodation and Food Services sector also stayed relatively stable (Statistics Canada, 2022^[21]), signalling a relative balance between demand and creation of employment in the pre-pandemic period in this sector.

OJPs for Alberta’s Healthcare and Social Assistance sector stayed relatively stable as well, showing a slight decrease in the volume of new job postings (-7%) over the pre-pandemic period (see Table 2.1). Industry profiles by the Government of Alberta also show relatively steady employment numbers in the years before the pandemic (Alberta Labour and Immigration, 2020^[3]; 2018^[4]; Government of Alberta, 2017^[5]). Employment in Alberta’s Healthcare and Social Assistance sector grew by 1.7% in 2017, and 1.6% in 2018.

Notably, as Table 2.1 shows, the number of OJPs in the Healthcare and Social Assistance sector increased by 28% in the pre-pandemic period compared to the period 2015 to 2016 when considering Canada as a whole. OJPs increased much more rapidly than employment in the Healthcare & Social Assistance sector, this latter increasing by 2-3% per year (Statistics Canada, 2022^[6]). The strong increase in new OJPs coupled with a moderate increase in employment figures can be seen as evidence of shortages in the Canadian healthcare sector, which have already been noted by (Islam, 2014^[7]) and (Malko and Huckfeldt, 2017^[8]).⁴

When focusing on the most notable dynamics in Alberta, Table 2.1 shows that the sectors that had the largest pre-pandemic growth rates in new online job postings were Transportation & Warehousing (61%), Public Administration (49%), and Mining, Quarrying, Oil & Gas Extraction (46%). These dynamics are further discussed in the next subsection.

Of the three fastest growing sectors in Alberta, one behaved differently from the countrywide trend. OJPs for Public Administration increased by an average of 49% in Alberta in the period in between January 2017 and February 2020. When looking at employment figures, the total number of employees in public administration also expanded in Alberta by about 4.9% in 2019 (Alberta Labour and Immigration, 2020^[9]), with the main driving factor for the increased demand for this sector stemming from replacement demand (Alberta Labour and Immigration, 2019^[10]). *Alberta's Occupational Outlook (2019-2028)* (Alberta Labour and Immigration, 2019^[10]) expects more than half of the job openings in “education, law and social, community and government services” between 2019 and 2028 to be caused by replacement demands, as for example previous employees retire. The high number of OJPs may, therefore, be a signal of this replacement demand and not an increase in overall demand in this sector.

By contrast, the number of OJPs in the public administration sector in between January 2017 and February 2020 stayed relatively stable in Canada as a whole, showing only a slight decrease (-4%) over the 3 years under consideration. Part of the explanation for this result might relate to a large increase in OJPs recorded in the public administration sector in the second half of 2016 (used as a benchmark to calculate the growth rate for the following 2017-2020). A large increase in the base year (in particular in the year 2016) can be followed by a relative contraction in the following years' volume of job postings as jobs are gradually filled over time. Among the potential reasons for such a large increase in job postings in the Canadian public administration sector in 2016 is the pressure that the staff of the public administration sector faced during the Syrian refugee crisis, with a sharp increase in the inflow of migrants into Canada. The quarterly financial report for September 2016 by the Canadian Government for example shows that extra budget was announced for Immigration, Refugees and Citizenship Canada (IRCC) programs to be able to handle this crisis (Government of Canada, 2017^[11]). The Labour Force Survey by (Statistics Canada, 2016^[12]) also showed that employment in public administration increased by 19,000 employees in September 2016, a 2.1% increase in one month.

Table 2.1. Evolution of OJPs by sector in the pre-pandemic period

The growth of average number of OJPs per month in between Jan 2017 and February 2020 relative to average monthly OJPs in the period 2015-2016.

Lightcast sector name	Alberta pre-pandemic (Jan 2017- Feb 2020)	Canada pre-pandemic (Jan 2017- Feb 2020)
Transportation and Warehousing	61%	42%
Public Administration	49%	-4%
Mining, Quarrying, and Oil and Gas Extraction	46%	48%
Agriculture, Forestry, Fishing and Hunting	42%	76%
Information	24%	33%
Manufacturing	15%	19%
Wholesale Trade	14%	16%
Construction	13%	41%
Finance and Insurance	13%	35%
Professional, Scientific, and Technical Services	11%	11%
Educational Services	2%	29%

Lightcast sector name	Alberta pre-pandemic (Jan 2017- Feb 2020)	Canada pre-pandemic (Jan 2017- Feb 2020)
Real Estate and Rental and Leasing	2%	29%
Utilities	-1%	16%
Management of Companies and Enterprises	-4%	57%
Healthcare and Social Assistance	-7%	28%
Administrative and Support and Waste Management and Remediation Services	-10%	5%
Other Services (except Public Administration)	-11%	9%
Accommodation and Food Services	-11%	15%
Arts, Entertainment, and Recreation	-14%	-8%
Retail Trade	-19%	-2%

Source: OECD calculations based on Lightcast data.

Tracking the demand in online job postings published in Alberta: Top growing sectors

Two of the three sectors with the highest growth rates in OJPs pre-pandemic saw a large decrease in OJPs during 2020 (Figure 2.3). During the peak of the pandemic, online job postings for public administration jobs decreased by 39% in Alberta. Similarly, employment in this sector also decreased in 2020 but the decrease can only be partially attributed to the impact of the pandemic as the Albertan Government had already planned to reduce the public sector's spending by 7.7% in 2020 (Labour Market Information Directorate, Service Canada, 2022_[13]).⁵

The Mining, Quarrying, Oil and Gas Extraction sector ('Mining sector' henceforth) experienced declines in the number of new job postings published online. Despite a relatively small volume of total OJPs (4%), the Mining sector contributed to about 21% GDP in Alberta over the last two decades (Wang, 2021_[14]) and it showed a rapid upward trending number of OJPs pre-pandemic starting in 2017 after the oil price collapse in 2014-2016, see Box 2.2. By contrast, during the pandemic, OJPs decreased by nearly 70%, going from an average of 410 job postings to 126 per month. The reasons behind such large decline in demand intertwine the impact of the pandemic and the reduction in oil prices and its extraction in 2020.

As travel and mobility restrictions implemented during the pandemic decreased the demand for oil (Wang, 2021_[14]), this also led to a significant drop in oil price (in particular in the first two months of the pandemic). Notably, the decrease in number of job postings in the oil sector does not perfectly line up with employment figures in this sector at that time. Employment in oil production is often slow to change after a price fluctuation. If demand for oil is low, companies often prefer to keep producing it, even at a loss. This is because the market conditions might change quickly and stopping and starting up oil production is more expensive than producing at a loss for a short time (Wang, 2021_[14]). Combining the slow change in employment numbers with the steep decline in OJPs in 2020, it is likely that while employees were not (immediately) laid off, but that the search for new employees was instead temporarily halted.

Box 2.2. Oil price collapse 2014-2016 and the impact on Alberta's economy

The years 2014-2016 saw one of the largest collapses in oil price since the second world war. The drop in price was mainly driven by a growing role of the United States' shale oil industry, shifts in OPEC policy, reassessment of geopolitical risks due to disruptions in the Middle East, and deteriorating global growth prospects (World Bank Group, 2018^[15]). The WTI reference price fell from USD 105.79 per barrel in June 2014 to a minimum price of USD 30.32 per barrel in February 2016 (U.S. Energy Information Administration, 2023^[16]). Alberta, as a province that exports oil, was impacted greatly by the decrease in the oil price. Alberta's GDP decreased by 7% in between 2014 and 2016 (Government of Alberta, 2022^[17]) and the province suffered job losses in particular in the manufacturing and mining, quarrying and oil and gas extraction sectors (Fields and Bourbeau, 2017^[18]).

After the oil prices recovered and stabilised in 2017, partially due to policy enacted by OPEC (Arezki and Matsumoto, 2017^[19]), Alberta's employment rate recovered as well. Similarly, the volume of monthly OJPs in the mining, quarrying and oil and gas extraction sector in between 2017-2020 was significantly higher than in the years 2015-2016, signalling a recovery after the recession.

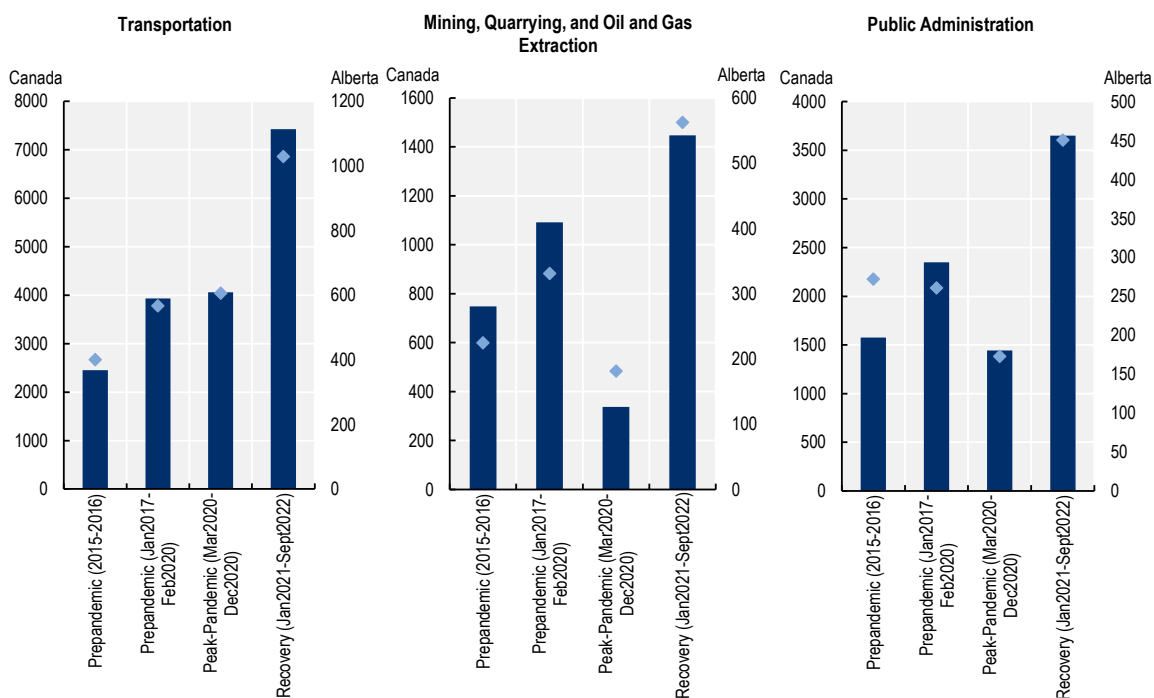
The dynamics for the third top-growing sector, the transportation sector, are particularly interesting as this is one of the few sectors where the pre-pandemic positive trend has not stopped during the peak of the pandemic. Figure 2.3 shows that the number of OJPs for the Transportation and Warehousing sector did not halt but, instead, increased – even if slightly – by 3% during the toughest months of the pandemic (March 2020 to December 2020). Different (and sometimes competing) dynamics played a key role in the demand for workers in this sector. On the one hand, this sector is responsible for passenger transportation. This segment of the sector suffered majorly due to the pandemic, with multiple lockdowns shutting down air transport and a fear of shared spaces decreasing willingness to use public transport (Conference Board of Canada, 2021^[20]). On the other hand, this sector is responsible for delivering goods to businesses and to consumers, with truck transportation being the largest career area within the transportation sector. And while the number of employed truckdrivers in Canada decreased from 308 800 to 283 800 between February and June, it also increased back to 313 800 in August, which is above the initial level (Conference Board of Canada, 2021^[20]). The increased demand for employment in the second half of the year is the main reason why OJPs for the transportation and warehousing sector did not decrease during the pandemic, even though there was a decline in OJPs during the first half of the year.

In the post-pandemic period (starting in January 2021) the three sectors⁶ that were growing particularly fast before the pandemic, resumed their fast-growing trends, even exceeding the number of average monthly OJPs experienced before the pandemic. For the Public Administration sector and the Mining sector, this can be seen as a swift recovery from the large declines experienced at the peak of the pandemic. For instance, relative to a 39% decrease in OJPs for the public administration sector during the peak of the pandemic, the volume of new demand increased by 153% in the recovery phase. The Mining sector even had the largest growth rate among all sectors in 2021 and 2022, going from 126 monthly average to 543 OJPs. Again, the number of employees is slow to change in this industry, but demand for employees is higher than the supply. Oil prices increased in 2021, providing incentives to produce more oil (ATB Economics, 2022^[21]). Following Russia's invasion of Ukraine in 2022, there has been a lot of turmoil on the energy markets, culminating into a global energy crisis, the consequences of which are likely to be felt for the next decades (IEA, 2022^[22]). As Russia's supply of oil and gas to Europe has decreased, this has put pressure on Canada's oil and gas industry to export more (Lee, 2022^[23]).

The post-pandemic growth rate for Transportation and Warehousing new vacancies is also significant (+83%) despite being lower than the rebound experienced in other sectors. Notably, however, the transportation sector did not go through a slow down at the peak of the pandemic, signalling that the

demand in this sector has remained very strong in Alberta. Looking ahead, as household spending may increase after the declines during the pandemic, the transportation sector is expected to grow as well (Conference Board of Canada, 2021^[20]), although the impending recession might dampen the growth.

Figure 2.3. Evolution of online job postings in fast growing sectors: Average monthly OJPs per period



Source: OECD calculations based on Lightcast data.

Which occupational career areas represent the largest volume of OJPs within the top growing sectors in Alberta?

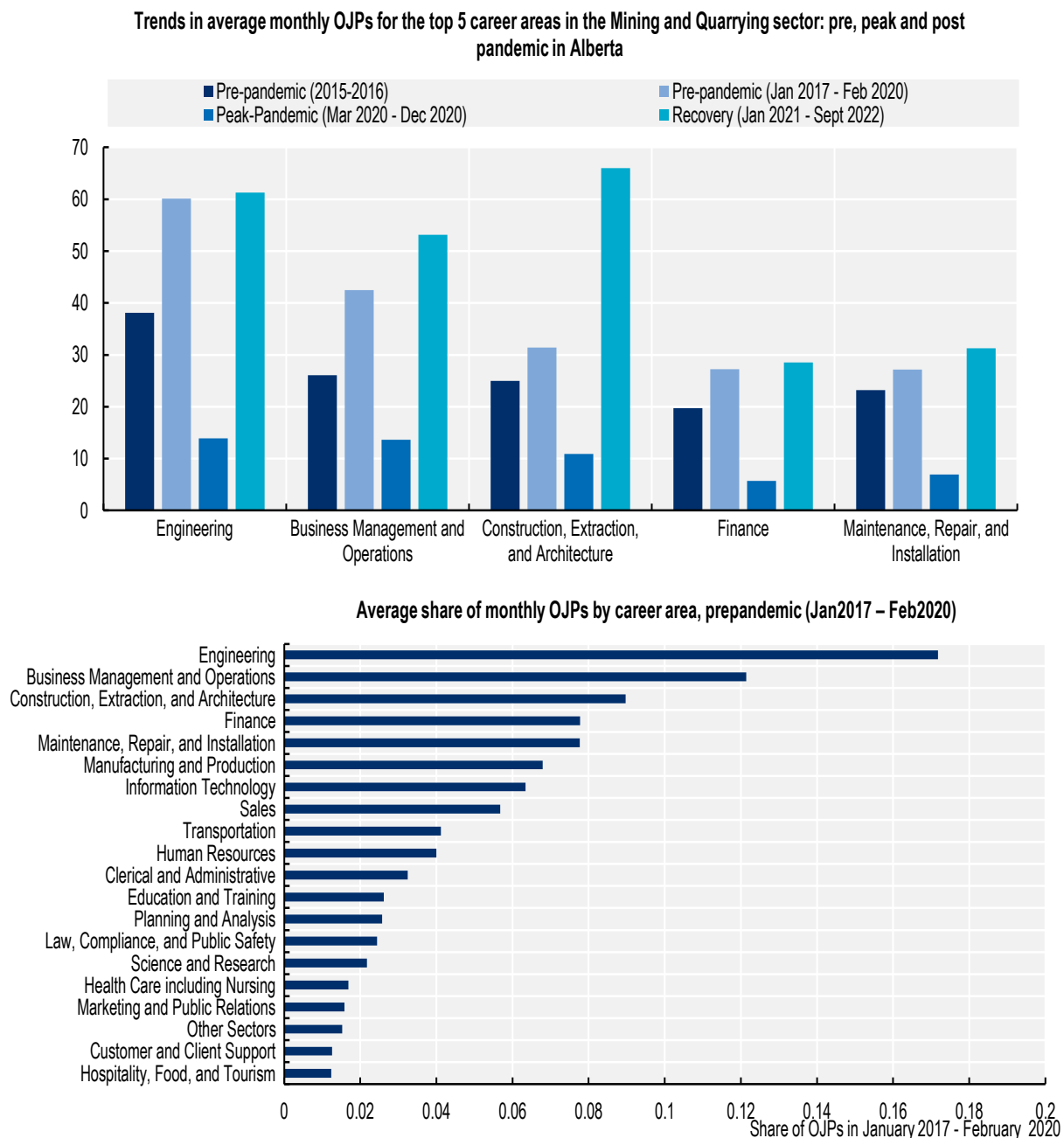
Although sectors or industries provide a good way of categorising the labour market demands, employees within a sector all have a variety of specialisations and perform number of widely different tasks. For example, the transportation sector employs, engineers, human resource management, administrative workers and many other workers in different areas and job roles. To shed more light on the demand for different types of jobs within the top-growing sectors, this section discusses the demand for specific occupational career areas within these sectors. This section also covers how the demand for different types of jobs within the sector responded to the COVID-19 crisis and which types of jobs were fastest to recover. The analysis is performed at the career area level rather than at the disaggregated occupation as it strikes a good balance between data availability and sufficient level of detail to analyse the main drivers behind the growth in OJPs within a sector.

The Mining, Quarrying, Oil and Gas Extraction is a volatile sector that faces labour shortages post-pandemic

The pandemic, combined with the declines in oil price, had a large impact on the mining sector. Pre-pandemic, the majority of new online job postings in the mining sector were for engineering jobs (17%), followed by business and operations jobs (12%) (see Figure 2.4). Within the mining sector, the third largest demand was for workers in the occupational area of Construction, Extraction and Architecture at 9%. Labour demand for the top ten largest occupational career areas within this sector decreased in 2020, but the brunt of it was borne by the three largest career areas. For instance, the number of new job posts for engineers in the mining sector in Alberta dropped from an average of 60 per month to 14 new vacancies. On the one hand engineering is a mostly white-collar job which can be done from home, meaning that engineers did not lose their jobs *en masse*. On the other hand, as production slowed down fewer new engineers were needed, which still led to a sharp decline in new vacancies offered during the pandemic.

The entire mining sector is now re-emerging after the pandemic, as oil prices have increased as well. Demand for engineering jobs increased significantly, surpassing its pre-pandemic levels. The average number of monthly OJPs for engineers more than tripled compared to the peak of the pandemic. Finding engineers to work in the oil and gas industry is difficult, as there is a lot of competition from the technology sector (CBC News, 2022^[24]). As countries make large investments in clean technologies and in the transition to a greener and more sustainable economy, employees in the oil and gas sector are actively encouraged to retrain to be able to work in the tech sector. Calgary has for example instituted a programme that teaches former oil and gas-professionals the skills to fulfil jobs in Calgary's digital economy (EDGE Up, 2022^[25]). This dynamic, however, puts pressure on the oil and mining sector in the transition phase where the demand is still high, and is likely to stay high due to the global energy crisis triggered by Russia's invasion of Ukraine (Lee, 2022^[23]). The demand for workers in the mining sector with a background in construction, extraction and architecture also surpassed pre-pandemic levels. Shortages are largest for entry level jobs, which are often physically demanding positions like field workers that help lay down pipe on service rigs, maintain it during the lifetime of the oil well and decommission it when the work is finished (Smith, 2022^[26]).

Figure 2.4. Mining and Quarrying sector by career area: Shares and trends of OJPs



Note: Other sectors include Agriculture, Horticulture, & the Outdoors, Design, Media, and Writing, Community and Social Services, Performing Arts and Personal Services, which all represent less than 1% of the total share of OJPs.

Source: OECD calculations based on Lightcast data.

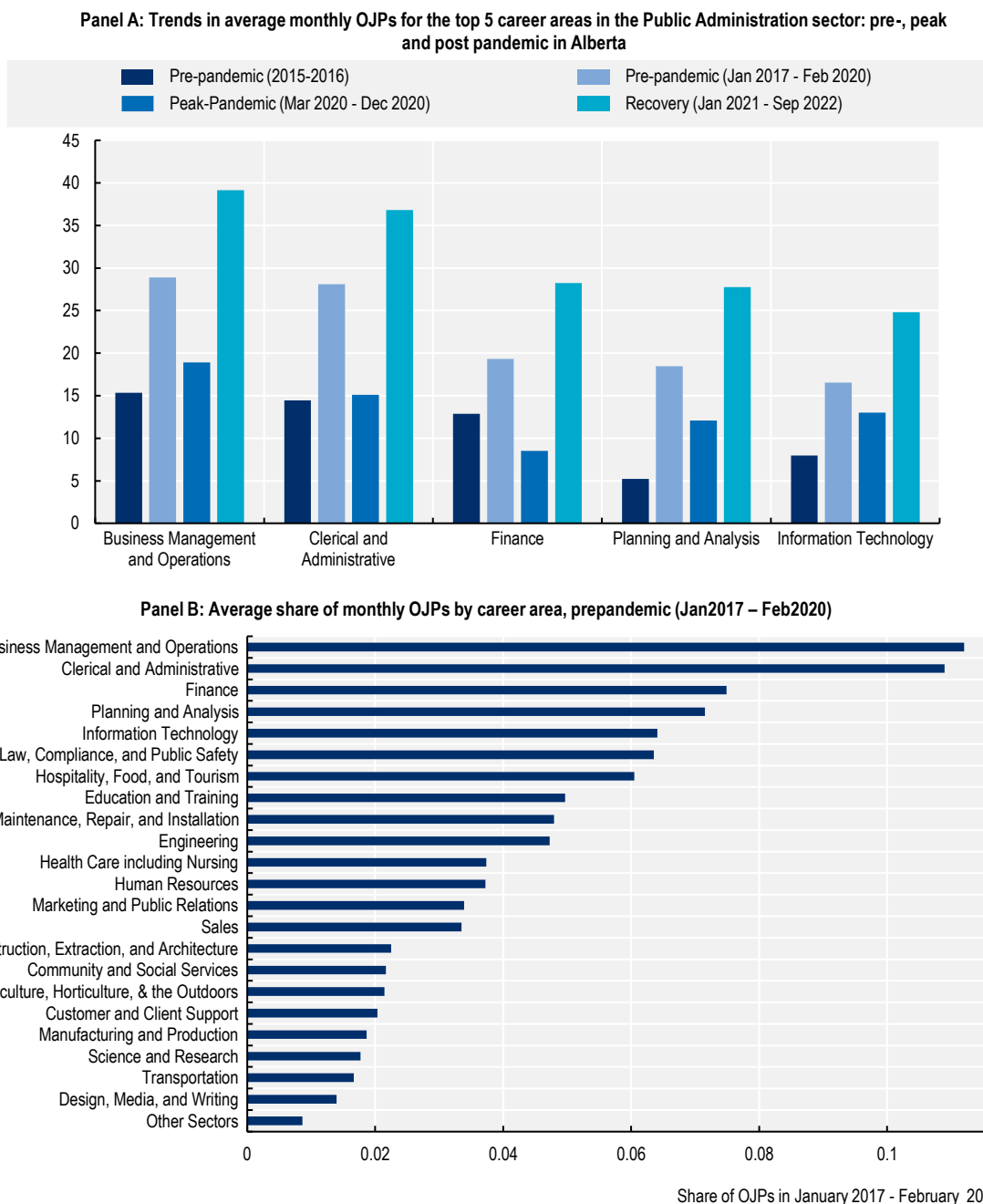
The number of OJPs for the Public Administration sector decreased significantly in 2020

As can be seen in Figure 2.5, while the growth in OJPs for the public administration sector has been strong in the pre-pandemic period, the relative volume of job postings is still small. Smaller sample sizes are typically related to higher volatility, and results analysing the public administration sector need to be interpreted with this caveat in mind, especially when further disaggregation at the career area level is carried out as in this section.

In the pre-pandemic period, jobs in the business management and operations and clerical and administrative occupational areas represented the largest share of new online job postings published in the public administration sector. As mentioned in previous sections, however, the volume of new OJPs for this sector decreased significantly during the pandemic. Such decline can only partly be attributed to the negative shock of the COVID-19 crisis as the Albertan Government had already planned to reduce the public sector's spending by 7.7% in 2020 (Labour Market Information Directorate, Service Canada, 2022^[13]). The overall impact of both drivers, however, resulted in the decrease in the number of OJPs in all of the top 20 largest occupational areas in this sector, all with a similar intensity.⁷

Starting in 2021, the volume of new OJPs in the public administration sector in Alberta recovered swiftly, with the demand in the top 20 career areas increasing significantly. Amongst the sharpest increases in new OJPs within the public administration sector, the demand for workers with a background in Hospitality, Food and Tourism was particularly strong.

Figure 2.5. Public Administration sector by career area: Shares and trends of OJPs in Alberta



Note: Other sectors include Personal Services and Performing arts, which both represent less than 1% of the total share of OJPs.
 Source: OECD calculations based on Lightcast data.

OJPs for Transportation and Warehousing sector kept increasing during and after the pandemic

Revenue in the logistics and transportation sector is closely related to household spending. For instance, households use transportation to travel around, and in fact household spending on personal travel accounted for 11% of Canada's GDP between 2015-2019 (Transport Canada, 2021^[27]). Besides that, transportation brings materials to the manufacturing sector and makes sure that goods are delivered to consumers (Transport Canada, 2021^[27]). As households earn more, they consume more as well. The last couple of years a large share of consumption has taken a new form, as more and more consumers shop online. The pandemic, which led to shops closing, drastically increased the prevalence of e-commerce. Online shopping and home delivery has increased the demand for transportation. While regular retail sales fell by 17.9% in between February and May of 2020, e-commerce sales in Canada nearly doubled (+99.3%) (Aston et al., 2020^[28]). Post-pandemic, online sales show no signs of slowing down, although physical shops have been able to open their doors again (Shaw, Eschenbrenner and Baier, 2022^[29]).

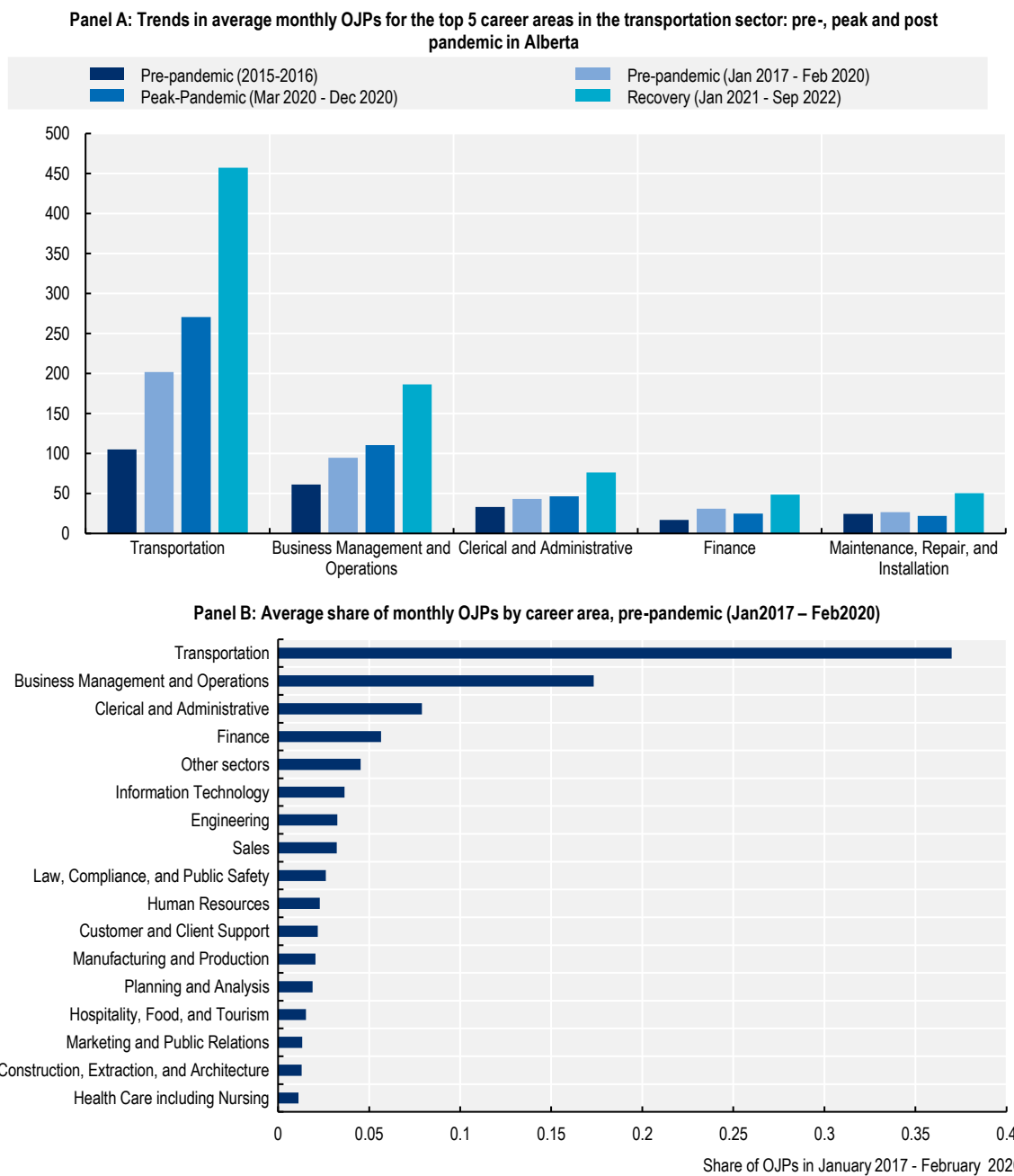
Data from the Alberta's industry profile for 2020 (Alberta Labour and Immigration, 2021^[30]) shows that the Transportation and Warehousing industry accounted for roughly 6% of total employment in Alberta in 2021. Employment in this industry is also expected to increase at an average rate of 1.2% from 2020 to 2023. The strategic importance of this sector is confirmed by the fact that, over the last 10 years, employment in this industry in Alberta rose by 11 500. This is a 10.6% increase, leading to 120 200 people employed in the industry in 2020. 87.8% of employees in this industry worked full-time and 12.2% were part-time (Alberta Labour and Immigration, 2021^[30]).

Perhaps not surprisingly, Figure 2.6 shows that, in January 2017-February 2020 37% of all OJPs in Alberta's transportation sector were looking for people with specific background in transportation activities. This career area includes truck drivers amongst other occupations. Canada has been predicting shortages in the number of truck drivers for years, mostly because a large part of drivers is reaching retirement age (Statistics Canada, 2019^[31]). This replacement demand is expected to increase the number of job postings looking for truck drivers. Another large share (17%) of job postings in between January 2017 and February 2020 were seeking workers in the area of Business, Management and Operations. This field represents a more white-collar part of jobs within the transportation area.

Job postings for workers with specific transportation skills as well as workers in managerial careers also represented the largest share of new vacancies in the transportation sector during the peak of the pandemic.⁸ Furthermore, OJPs looking for transportation personnel are the main reason that demand for the entire sector increased during the pandemic, as they for instance increased from 202 on average per month to 271. During the first months of the pandemic, OJPs for transportation personnel did decrease, but in the second half of 2020, demand increased rapidly, as stores started reopening and more people started to use e-commerce.

Post-pandemic, the demand for employees in the transportation career area continued growing by 69%, averaging more than 450 online job postings per month. Shortages in this area are expected to continue for the coming years (Conference Board of Canada, 2021^[20]). In 2022, the province announced they expanded the eligibility criteria for the Driving Back To Work grant programme⁹ and increased the budget to CAD 30 million for the coming three years, in hopes of combatting the shortages in this area (Government of Alberta, 2022^[32]; Aldrich, 2022^[33]).

Figure 2.6. Transportation sector by career area: Shares and trends of OJPs in Alberta



Note: Other sectors include Education and Training, Science and Research, Personal Services, Community and Social Services, Agriculture, Horticulture, & the Outdoors, Design, Media, and Writing, and Performing Arts, which all represent less than 1% of the total share of OJPs.
 Source: OECD calculations based on Lightcast data.

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Notes

¹ See Chapter 4 for a closer look at data mining analysts and business intelligence analysts and on digitalisation in general.

² Job postings based in Alberta make up 12.7% of all of Canada's OJPs.

³ Partially, this has to do with the fact that small changes in the number of job postings have a much larger relative effect on small sectors than on large sectors, so more volatility in smaller sectors is to be expected.

⁴ These papers describe that physician shortages, in particular, in rural areas lead to unequal access to healthcare. Alternatively, a large increase in OJPs, coupled with a moderate/low increase in employment figures could be evidence of churn/high turnover. However, in the context of the healthcare sector, it is more likely that shortages are playing a role.

⁵ This top growing sector has been discussed in comparison to the trend for the entirety of Canada in the previous subsection.

⁶ Public administration, mining and transportation sectors.

⁷ None of the career areas stand out as having diminished particularly more than others. The two largest career areas: Business, Management and Operations and Clerical and Administrative went from 29 postings to 19, and from 28 to 15 postings respectively.

⁸ 2020 is also the year that the province of Alberta announced their “Driving Back To Work” programme (see Box 3.1 in Chapter 3) to combat shortages (Therien, 2020_[34]).

⁹ See Box 3.1 in Chapter 3.

3 The evolution of growing occupations in online job postings in Alberta

This chapter provides insights into the occupations that grew the fastest in terms of online job postings (OJPs) in the years before the COVID-19 pandemic. It also analyses the specific skills that are typically required by employers in Alberta and Canada to fulfil these roles, which include health related jobs, professionals in the logistics and transportation sector. Additionally, the chapter identifies which occupations that usually require post-secondary education experienced rapid growth, examining the skill demands within these roles as well. The chapter also addresses the impact of the pandemic on various occupations that were most heavily impacted, such as certain health-related jobs and welders/machinists. By providing insights into these factors, the chapter offers an understanding of the evolving labour and skill demand within Alberta's labour market.

Highlights

- Businesses are increasingly relying on data to drive decision-making and strategy, leading to rapid growth in digital occupations in Alberta and Canada. This particularly holds true for occupations that require post-secondary education, as seven out of ten fastest growing jobs that require PSE can be considered digital occupations.
- The ageing population in Alberta and Canada has increased the demand for healthcare professionals, particularly Home Health Aides and Licensed Practical Nurses, who provide care to individuals in their homes or in healthcare facilities. The pandemic has further boosted this demand as more people are seeking medical care due to health concerns and restrictions on travel and public gatherings.
- The rise of e-commerce and changes in consumer behaviour, including an increased preference for online shopping, has led to a growth in demand for delivery drivers and truck drivers in Alberta. These workers are responsible for transporting goods and products from one location to another, and play a critical role in ensuring that businesses can meet the demands of their customers.
- The average number of online job postings for Welders and Machinists (skilled workers who fabricate and repair metal products) in Alberta declined steeply in 2020. The steep decline in online job postings for these workers in 2020 was due to a combination of factors, including lockdowns and social distancing measures that reduced industrial and manufacturing activity, as well as the decrease in oil prices, which impacted the demand for workers in the oil and gas extraction industry.

In the previous chapter, trends at the sectoral level were discussed. This chapter adds to that analysis by exploring trends in OJPs at the occupational level, thereby adding a more detailed look. This makes it possible to study more specific impacts of the pandemic, as well as capturing occupational trends, identifying those that are in high demand as well as those that suffered the most during the pandemic. Furthermore, this chapter looks at qualification requirements and remunerations for the different occupations.

In order to strike a balance between examining occupations at the highest disaggregation level but, at the same time, capturing the most relevant dynamics, specific data choices were made. To maintain the highest level of disaggregation possible, the results presented in this chapter focus on occupations at the 8th digit occupational level as presented in Lightcast occupational taxonomy (see Chapter 1). However, only those occupations that had a sufficient number of job postings published online during the pre-pandemic period are analysed for their growth, as not every occupation in the full set of 679 different occupations has enough information in every month.¹ This chapter therefore studies occupations at the 8th digit level that have had an above average number of job postings over the period between January 2015 and end of February 2020, right before the beginning of the pandemic period. This guarantees that the occupations that are surveyed have sufficient information available. Analyses on this set of occupations are, run for three different periods: pre-pandemic between January 2017-February 2020, peak pandemic during March 2020-December 2020, and post-pandemic during January 2021-September 2022. The remainder of this chapter analyses the most notable trends in occupational demand, by comparing the statistics for Alberta to the trends observed in Canada as a whole.

The analysis of OJPs in Alberta shows that demand in the pre-pandemic period has been strong in a variety of occupations of a very different nature. Results in Table 3.1 show, for instance, that high skilled and digital occupations such as Data Mining Analysts or Business Intelligence Analysts have shown a steady and significant growth in the number of OJPs in the period between 2017 and the beginning of the

COVID-19 pandemic (end of February 2020). These two jobs are exemplary for the rise of digital occupations, and will be discussed in more detail in Chapter 4.

However, occupations in other sectors have also seen significant increases in the demand in the pre-pandemic period in Alberta. Home Health Aides, for instance, or Dispatchers and Schedulers in the logistics sector have been in high demand in the 'pre-pandemic world'.

Table 3.1. Fastest growing OJP's demand in Alberta by occupation in the pre-pandemic period

8th digit occupation level, the growth of average number of OJPs per month in between Jan 2017 and February 2020 relative to average monthly OJPs in the period 2015-2016.

Lightcast occupation code	Occupation titles	Alberta (2017 to pre-pandemic)	Canada (2017 to pre-pandemic)
15-1199.91	Data / Data Mining Analyst	104%	46%
15-1199.93	Business Intelligence Analyst	71%	46%
31-1011.00	Home Health Aide	81%	38%
43-5031.00	Dispatcher	96%	38%
43-5081.04	Order Processor / Order Entry Clerk	74%	42%
43-5061.00	Scheduler / Operations Co-ordinator	67%	33%
53-3033.00	Light Truck Delivery Driver	73%	96%
53-3032.00	Tractor-Trailer Truck Driver	71%	25%
53-3031.00	Sales Delivery Driver	68%	37%
51-4041.00	Machinist	79%	18%

Note: Occupations selected in the sample have above average OJPs over the period January 2015 and February 2020, before the COVID-19 pandemic. Lightcast occupation codes are based on the US Standard Occupational Classification (SOC), 2010. The reference period for the calculations of the growth rates is the average number of OJPs in the occupation for the period in between January 2015 and December 2016. Source: OECD calculations based on Lightcast data.

The top ten fastest-growing occupations require a variety of in-demand skills, as shown in Table 3.2. Three of the top eight occupations require digital skills, such as dispatchers who must use SAP software for order tracking, order processors/entry clerks who need e-commerce knowledge, and scheduler/operations co-ordinators who must have project management software expertise.

Table 3.2 also reveals that the required skills for light truck delivery drivers, tractor trailer truck drivers, and sales delivery drivers are alike. These jobs all require familiarity with product delivery and transportation operations. Light truck delivery drivers and tractor trailer truck drivers also require the ability to transport heavy products/equipment and knowledge of load security. Sales truck drivers, however, are typically expected to have knowledge of the transportation industry and the household appliance industry.

Table 3.2. Five most important skills for the top growing occupations

	Skill 1	Skill 2	Skill 3	Skill 4	Skill 5	Requires Post-secondary Education
Data / Data Mining Analyst	SQL databases and programming	Microsoft power bi	Data visualisation	Extraction	Data mining	Yes
Business Intelligence Analyst	Business intelligence	SQL databases and programming	Microsoft power BI	Data warehousing	SAP	Yes
Home Health Aide	Basic living activities support	Healthy meal preparation	Geriatrics	Mental health diseases and disorders	Medical support	
Dispatcher	Monitoring road conditions	Radio frequency equipment	Order tracking in SAP	Ground transportation industry knowledge	Emergency services	
Order Processor / Order Entry Clerk	Order management	General shipping and receiving	Material handling	E commerce	Stock counting	
Scheduler / Operations Co-ordinator	Logistics	Supply chain management	Project management software	Transportation operations management	Supply chain planning	
Light Truck Delivery Driver	Transportation operations	Product delivery	Heavy hauling	Heavy equipment	Load security	
Tractor-Trailer Truck Driver	Transportation operations	Load security	Product delivery	Weigh station	Heavy hauling	
Sales Delivery Driver	Product delivery	Transportation industry knowledge	Transportation operations	Material handling	Household appliances industry knowledge	
Machinist	Machine tools	Computer aided manufacturing	Sawing machines	Radial drills	Powermill	

Note: Occupations indicated by * require post-secondary education.
Source: OECD calculations based on Lightcast data.

The fastest-growing occupations that require post-secondary education

Examining the results in Table 3.2 it is evident that eight of the most rapidly growing occupations do not necessitate post-secondary education (PSE). However, when focusing on the top 25 most rapidly growing occupations, that proportion shifts, as 12 out of 25 do require PSE. Ten of these occupations are outlined in Table 3.3.

Table 3.3. Fastest growing OJP's for jobs that require PSE in Alberta by occupation in the pre-pandemic period

8th digit occupation level, the growth of average number of OJPs per month in between Jan 2017 and February 2020 relative to average monthly OJPs in the period 2015-2016.

Lightcast occupation code	Occupation titles	Alberta (2017 to pre-pandemic)	Canada (2017 to pre-pandemic)
15-1199.91	Data / Data Mining Analyst	104%	46%
15-1199.93	Business Intelligence Analyst	71%	46%
15-1133.00	Computer Systems Engineer / Architect	61%	19%
15-1199.01	Software QA Engineer / Tester	58%	15%
15-1134.93	UI / UX Designer / Developer	50%	27%
15-1131.00	Software Developer / Engineer	49%	22%
15-1199.95	IT Project Manager	46%	32%
25-2011.00	Preschool / Childcare Teacher	61%	26%
13-1021.00	Buyer / Purchasing Agent	59%	20%
17-2051.00	Civil Engineer	51%	38%

Note: Occupations selected in the sample have above average OJPs over the period January 2015 and February 2020, before the COVID-19 pandemic. Lightcast occupation codes are based on the US Standard Occupational Classification (SOC), 2010. The reference period for the calculations of the growth rates is the average number of OJPs in the occupation for the period in between January 2015 and December 2016. Source: OECD calculations based on Lightcast data.

Notably, seven of the occupations in Table 3.3 are digital professions. Aside from Data/Data Mining Analyst and Business Intelligence Analysts, which were also in the top ten occupations listed in Table 3.1, the other four digital occupations listed in Table 3.3 are among the 25 fastest-growing occupations, with and without PSE. These are computer systems engineer/architect, software QA engineer/tester, UI/UX designer/developer, software developer/engineer and IT project manager. All these roles necessitate a college or university degree. The fact that there are seven digital occupations among the fastest growing occupations that require PSE demonstrates the increasing importance of digitalisation in Alberta, which is described in more detail in Chapter 4.

However, not all of the fastest-growing occupations that necessitate PSE are digital professions (Table 3.3). The other three professions in the top 10, preschool/childcare teacher, buyer/purchasing agent, and civil engineer are roles that primarily call for non-digital skills (Table 3.4),² that nonetheless were in high demand in between January 2017 and February 2020.

Table 3.4. Skills for preschool / childcare teachers, buyer / purchasing agents, and civil engineers.

	Skill 1	Skill 2	Skill 3	Skill 4	Skill 5
Preschool / Childcare Teacher	Childhood education and development	Childcare	Child development	Child CPR	Changing diapers
Buyer / Purchasing Agent	Wholesale buying	Procurement	Supply chain management	Supplier relationship management	Supply chain planning
Civil Engineer	Civil and architectural engineering	Engineering software	Drafting and engineering design	Structural steel design	Geotechnical engineering

Source: OECD calculations based on Lightcast data.

Preschool/ childcare teacher fall under the categorisation of early childhood educators (NOC code 42202). Early childhood educators plan, organise and implement programs for children. This job usually requires completion of a two- to four-year college programme in early childhood education, or a bachelor's degree

in child development. This is reflected in the skills that are highly demanded of these professionals. Additionally, preschool/childcare teachers are often asked to have knowledge of child cardiopulmonary resuscitation (CPR), and a practical skill of changing diapers. Demand for this job is likely to keep increasing after 2022, as the Federal-provincial childcare agreement signed in November 2021 has further subsidised childcare resulting in improved affordability and accessibility of childcare programs (Government of Canada, 2022^[1]). Therefore, more parents are expected to make use of these programs, which means more childcare teachers are required.

Buyer / purchasing agents (NOC 12102) *“purchase general and specialised equipment, materials, land or access rights and business services for use or for further processing by their establishment.”* This occupation usually requires a bachelor’s degree or college diploma in business administration, commerce, or economics. Looking at the most highly demanded skills, people in this job need to have strong knowledge on the supply chain and how to plan and manage the supply chain, as well as be good at wholesale buying and procurement, which is to be expected. Although this occupation was fast growing in between January 2017 and February 2020, this trend is not expected to continue (Government of Alberta, 2022^[2]), with medium growth forecasted in between 2022 and 2024. This is reflected in the number of OJPs post-pandemic, in between January 2021 and September 2022, as buyers/purchasing agents saw a below average rate of growth in OJPs.

Civil engineers (NOC code 21300) plan, design, develop and manage projects for the construction or repair of all kinds of structures. This job requires a bachelor’s or masters civil engineering or in a related engineering discipline. Skills for civil engineers are also very much related to their professional knowledge and expertise, with them needing to be good at several aspects of engineering and designing. Most civil engineers in Alberta work in the sectors: professional, scientific, and technical services, public administration, and construction (ALIS, 2022^[3]). These three sectors were all trending upwards in between 2017 and February 2020 (see Chapter 2), which could contribute to the increased demand for civil engineers.

Ageing populations are boosting the demand for Home Health Aides in Alberta and Canada

Canada’s population is changing, and the balance between younger and older citizens is slowly shifting. In Canada as a whole, currently 19% of the population is 65 years or older (Statistics Canada, 2022^[4]). Demographic challenges are modifying the demand for skills of workers in the health, medical research and care sectors and increasing the demand for certain professions in the personal care sector. The health sector is one of the largest sectors in terms of OJPs and saw an increase of 28% in Canada in between January 2017 and February 2020, see Chapter 2. And while Alberta has one of the youngest populations in Canada, with a median age of 38.4 years, and 14.8% of the population being 65+ (Statistics Canada, 2022^[4]), the ageing population is leading to shifts in the labour market in this province as well (Government of Canada, 2022^[5]). Against this backdrop, the analysis of OJPs indicates a demand for a specific occupation within the healthcare sector that has experienced one of the largest increases: Home Health Aides.

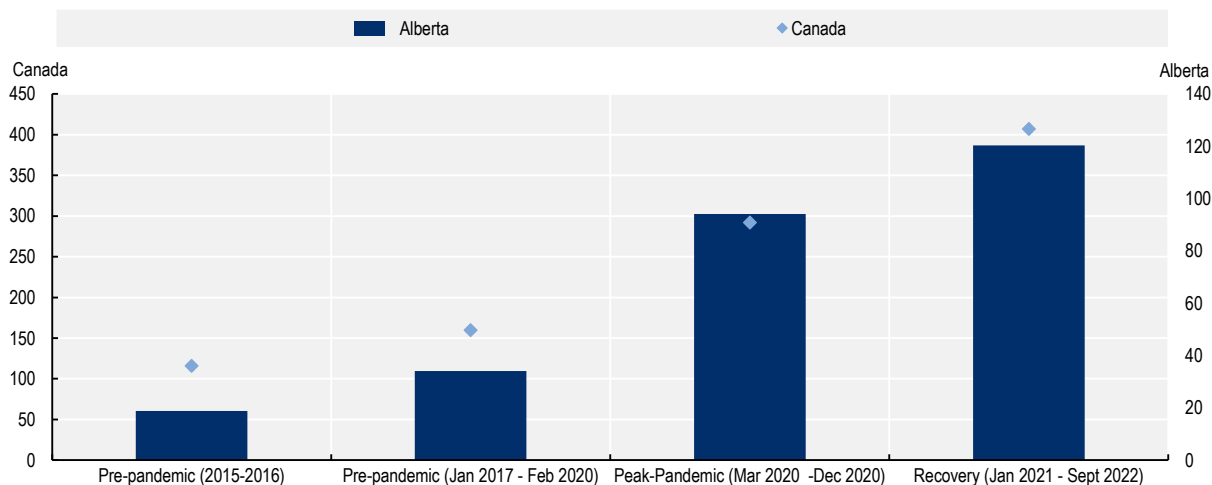
The title of home health aide is not commonly used in Canada, but based on the job description given by the US Bureau of Labour Statistics, home health aides would belong either to the group of home support workers, caregivers and related occupations (NOC 44101), or to nurse aides, orderlies and patient service associates (NOC 33102). These occupations are fulfilled by approximately 8 350 people, and 33 000 Albertans in 2022 respectively (Government of Canada, 2022^[6]). Home health aides *“provide routine individualised healthcare such as changing bandages and dressing wounds, and applying topical medications to the elderly, convalescents, or persons with disabilities at the patient’s home or in a care facility. They also monitor or report changes in health status and may also provide personal care such as*

bathing, dressing, and grooming of patient” (U.S. Bureau of Labour Statistics, 2018^[7]). According to the NOC 2021, home support workers “*provide care and companionship for individuals and families during periods of incapacitation, convalescence or family disruption and May perform routine health-related duties such as changing non-sterile dressings, assisting in the administration of medications and collecting specimens under the general direction of home care agency supervisor or nurse.*”, while nurse aides “*help with personal care tasks (such as bathing, grooming and dressing) and take vital signs and blood sugar readings to report to health professionals*” (ALIS, 2022^[8]).

The necessary certifications to be a home health aide may vary, from having some secondary school education to requiring college or courses in home support, or having followed training programmes specialised for the care of the elderly or persons with disabilities (NOC 2021). The related job of Healthcare aide requires following a standardised training by Alberta Health, which can be followed at post-secondary schools (Alberta Health, 2022^[9]). The five “skills” of greatest importance for home health aides are: basic living activities support, healthy meal preparation, geriatrics, mental health diseases and disorders, and medical support, see Table 3.2.

The analysis of OJPs in Table 3.1 shows that, in between 2017 and the beginning of the pandemic in 2020, the demand for Home Health Aides increased considerably in Alberta as compared to 2015-2016. In this reference period before the COVID-19 crisis, the number of job postings for Home Health Aides published every month in Alberta grew by 81%. Differently from the dynamics for other occupations, the analysis of OJPs Figure 3.1 shows that the volume of new job postings for home health aides has been increasing steadily over time and that the pandemic has not had any negative impact on this positive trend and, if anything, it has boosted the demand even more during the pandemic and the recovery phase that has started in 2021.

Figure 3.1. Pre-, peak and post-pandemic: Trends in average monthly OJPs for home health aides



Source: OECD calculations based on Lightcast data.

Despite being an occupation with an increasing demand as measured by OJPs, at CAD 18.53 per hour the wage received by these professionals is significantly below the average in the province, which is CAD 31.05 (AWWS, 2022^[10]). Strong demand, coupled with low wages can create severe shortages of candidates as workers may find the profession not very attractive despite the demand. Data from the Albertan Wage and Salary Survey (AWSS) 2021 confirms the existence of shortages, with 67% of employers surveyed experiencing hiring difficulties and 13% of them having their vacancies unfilled for over 4 months.

Demand for professionals in the logistics and transportation sector was increasing before the pandemic and remains strong

As seen in Chapter 2, Alberta's transport and warehousing sector is a sector that has been experiencing significant growth in the average number of OJPs per month, starting in the years before the pandemic. Unsurprisingly, evidence from OJPs shows that several occupations in the Transportation, Warehousing and Logistics areas have also been experiencing significant growth in demand, with the average number of new job postings growing steadily in between 2017 and the pre-pandemic period (up to February 2020). In particular, order processors and order entry clerks, scheduler and operations co-ordinators and dispatchers have been in high demand.

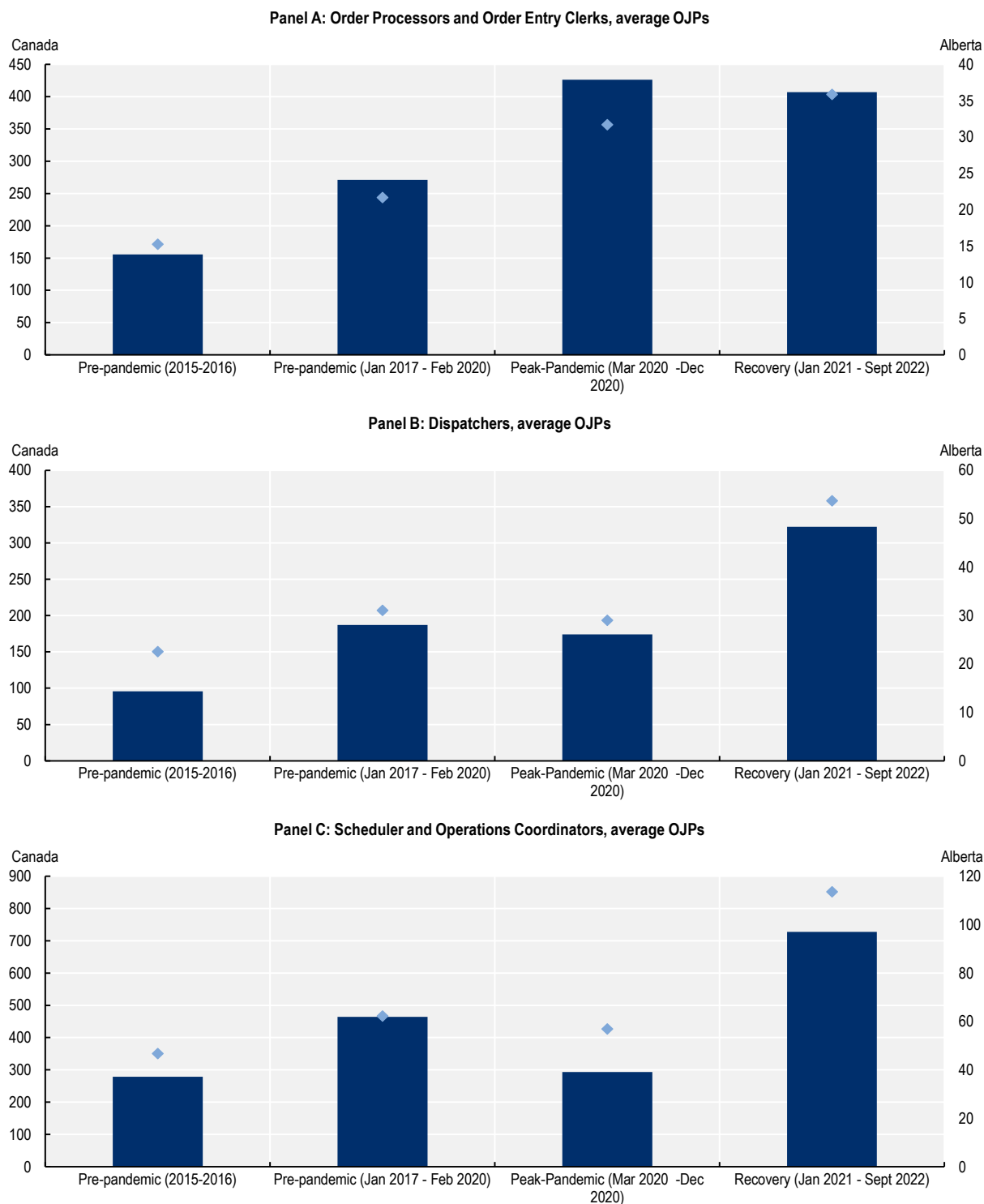
Table 3.1 shows, for instance, that the number of new job postings for Order Processors and Order Entry Clerks have been growing by 74% on average, compared to a 42% in the whole of Canada in the period of 2017-February 2020 compared to 2015-2016. Order Processors and Entry Clerks are at the end of the logistics chain and their tasks are typically to “receive, store, and issue sales floor merchandise, materials, equipment, and other items from stockroom, warehouse, or storage yard to fill shelves, racks, tables, or customers’ orders.” (U.S. Bureau of Labour Statistics, 2018^[7]).

Related to merchandise's logistics and delivery, Scheduler and Operations Co-ordinators (belonging to the category of Transportation route and crew schedulers, NOC 1526) “create and prepare routes and schedules for transportation equipment and the crews that operate them” (ALIS, 2021^[11]). OJPs for these professionals have also seen a significant increase in the demand, growing by 67% on average every month in between 2017 and the start of the pandemic.

Similarly, Dispatchers “dispatch workers according to written schedules, work orders, priorities, or protocols. They also prepare daily work schedules and activities, documents such as accident reports and tell workers about traffic problems, weather conditions, and other hazards on the route” (ALIS, 2018^[12]). The demand for dispatchers has increased significantly in recent years in Alberta as well, with an average monthly growth of 96% in the pre-pandemic period compared to the years 2015-2016.

During the peak of the pandemic, the demand for occupations in the logistics area increased or remained relatively stable, showing the key role that this sector has played during the lockdowns, allowing people to keep receiving goods even when most people were forced to remain home and social distance (see Figure 3.2). The volume of new job postings for Order processors and entry clerks, for instance, increased at the peak of the pandemic (contrary to the strong declines experiences in most occupations in that period). Demand for Dispatchers and Scheduler and Operations Co-ordinators experienced a moderate decline at the peak of the pandemic, but a very strong recovery starting in 2021, with new job postings per month almost doubling the volumes experienced in the period in between 2015-2016.

Figure 3.2. New online job postings for occupations in the area of logistics in Alberta and Canada



Source: OECD calculations based on Lightcast data.

Other occupations in the transportation and warehousing sector have been increasing before the pandemic and remained in high-demand during and after the peak of the COVID-19 crisis. Results in Table 3.1 show, for instance, that the volume of OJPs for Light Truck Deliver and Tractor-Trailer Truck Drivers increased by roughly 70% in Alberta and that the demand for Sales Delivery Drivers experienced a similar increase.

The demand for drivers has been increasing over the last few years, as an increasing number of drivers reaches retirement age (Statistics Canada, 2019^[13]). The Albertan Government has recently updated the qualifications needed to become a truck driver, starting a new training programme in 2019 and adding a grant programme to help people access this training (see Box 3.1).

Box 3.1 Becoming a truckdriver in Alberta

Mandatory Entry-Level Training (MELT)

Starting from 2019, all commercial drivers in Alberta need to obtain mandatory entry-level training (MELT) (Therien, 2020^[14]). This training is intended to make the road safer, by making truck and bus drivers more highly skilled. Training includes “a government-mandated number of training hours for in-class, in-yard and in-vehicle modules with standardised curriculums being taught at all licensed Alberta driver training schools.” (Government of Alberta, n.d.^[15]) A Class 1 MELT programme (aimed at truck drivers) takes 113 hours to complete. The average cost of Class 1 MELT is CAD 8 900 (Therien, 2020^[14]), and the Albertan Government has capped the costs at maximum CAD 10 000 (Government of Alberta, n.d.^[15]).

Driving back to work grant

The high costs for obtaining MELT can be prohibitive for people that want to become truck drivers. This could be problematic, as shortages in this occupation are pressing because many of the current drivers are reaching retirement age (Statistics Canada, 2019^[13]). Alberta’s government therefore instituted the “Driving Back to Work” grant programme. This grant helps prospective drivers to pay for their mandatory training to obtain a class 1 licence, by covering more than 90% of the cost (Government of Alberta, 2022^[16]). It is accessible for “unemployed and underemployed” Albertans, that are planning to seek full-time employment in the commercial transportation industry.

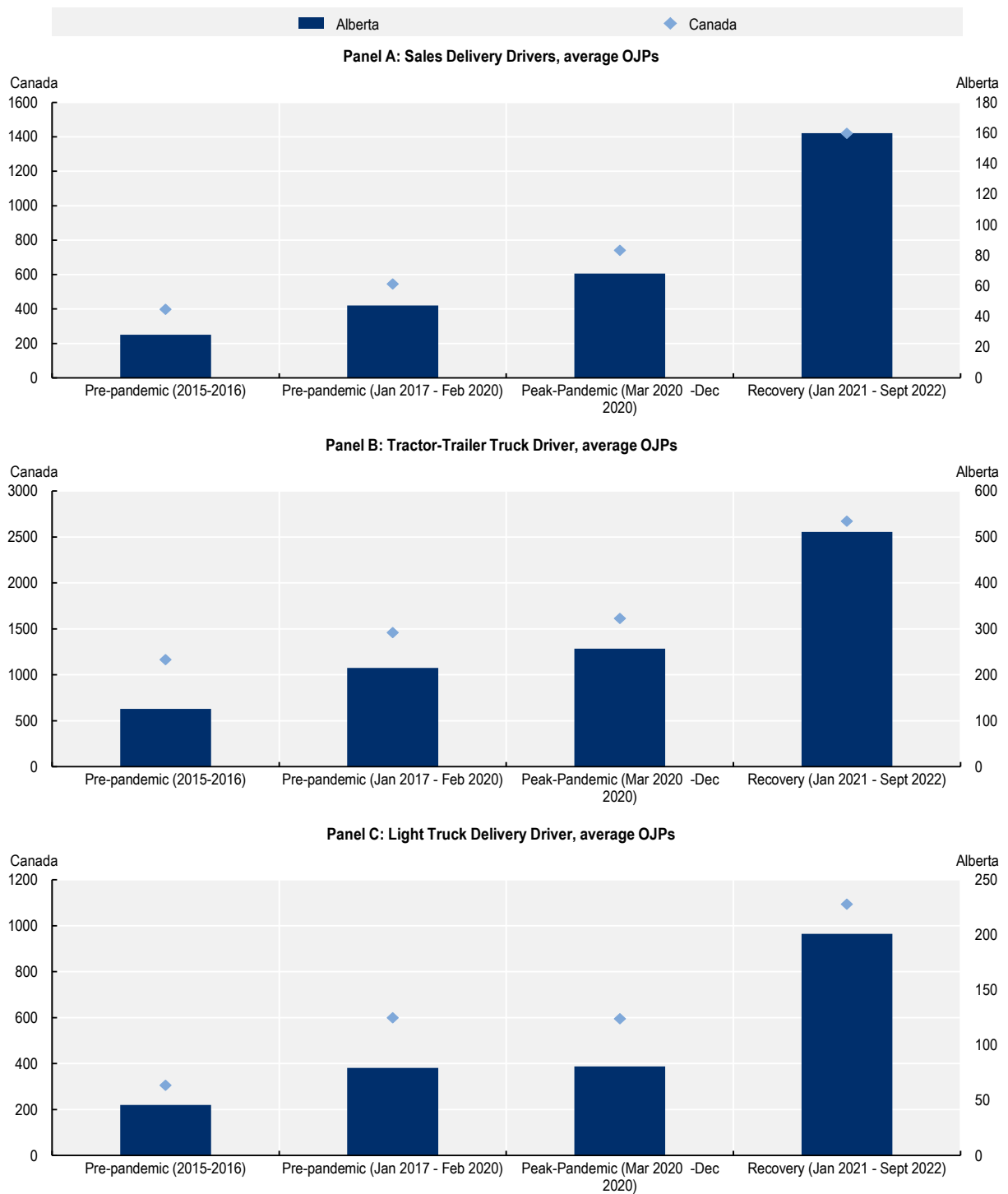
Results in Figure 3.3 show that the demand for workers in the transportation sector remained very strong during the peak of the pandemic (March to December 2020) and that it has then increased significantly in the recovery period. Labour shortages in this sector are likely behind the strong increase in the demand for workers. Those shortages, in turn, are intertwined with the recovery from the pandemic, current challenges stemming from the ageing labour force that is currently active in the transportation sector, and from increased geopolitical uncertainty which has disrupted global supply chains.

In particular, the unprecedented supply chain disruption caused by COVID-19 has had severe operational and financial consequences on many firms, with planners having to address several challenges including sudden demand drops and surges in the delivery of goods, supply shortages and inventory placement challenges. A recent report by (Attinasi et al., 2021^[17]) for the European Central Bank also highlights how: *“the decline and subsequent recovery in economic activity during the COVID-19 pandemic have been unprecedented, reflecting the massive shifts in demand and supply triggered by the closing and reopening of economies, and amid considerable monetary and fiscal stimulus and high levels of accumulated savings, especially in advanced economies. [...] Faced with that strong surge in demand, suppliers of goods worldwide have been struggling to meet the increase in orders. In addition, idiosyncratic supply chain disruptions (owing to the waves of the pandemic and adverse weather events, for instance) have also played a role, capping activity and trade growth and ultimately pushing up prices”*.

In a recent report, the Retail Council of Canada (RCC, 2022^[18]) is also anticipating that warehouse labour shortages will worsen, creating further pressure on supply chains in the near future. A combination of factors lies behind the challenges that Alberta (and Canada as a whole) are facing. First, COVID-19 created an unprecedented shift of consumers’ preferences pushing for a faster and more widespread adoption of e-commerce. Second, continuing wage inflation makes it challenging to hire warehouse workers. This creates bottlenecks and the sharp increase in OJPs is likely picking up the difficulty of firms in the sector to fill vacancies, likely having to repost the same job several times before being able to fill the vacancy.

Going forward, data seem to suggest further challenges and bottlenecks that will need to be addressed by both firms and policy makers.

Figure 3.3. Demand in the Transportation sector has been strong before but grew stronger during and after the pandemic in Alberta



Source: OECD calculations based on Lightcast data.

The peak of the pandemic: Which occupations were most affected during the turmoil of the pandemic and how did they recover?

The beginning of the year 2020 has seen one of the most unprecedented shocks to economies worldwide. Virtually all countries introduced health mitigation strategies at the onset of what would become one of the worst pandemic periods in recent human history. The pandemic, in turn, led to one of the strongest shocks to labour markets worldwide in the last century. What started as an health crisis, quickly turned into an economic crisis. In order to contain the spread of the SARS-CoV-2 governments imposed severe limitations to social contact and to the movement and travel of individuals, closing schools and other educational institutions, halting non-essential productive activities. This led to one of the largest negative shocks to economic activity in recent history, with a significant downturn in employment levels and in the demand for workers worldwide and profound economic depression. Several occupations stand out as instead having an increased level of demand, like nursing jobs. Other occupations stand out as having a larger than average decrease in demand, like welders and machinists. Trends for these occupations, and what those jobs entail are explored in this section.

The job of licensed practical nurse in Alberta saw a spike in demand during the pandemic

The nature of the COVID-19 shock, being a health emergency to start with, triggered a significant increase in the demand for specific professionals who have played a key role as first line of defence against the spread of the virus, as discussed previously in Chapter 2. Data on OJPs shows that during the peak of the pandemic Alberta's demand for home health aides (see previous section) and Licensed practical/Vocational nurses increased significantly (see Table 3.5) The average number of OJPs looking for Licensed practical/Vocational nurses increased from 35.2 per month up to 71.7. Both of these occupations employ workers who have been battling against the spread of the SARS-CoV-2 virus.

Table 3.5. Examples of fastest growing and declining demand during the peak of the pandemic in Alberta and Canada

Average monthly growth in OJPs between March 2020 and December 2020

Lightcast occupation code	Occupation title	Alberta	Canada
		Growth during the pandemic	Growth during the pandemic
31-1011.00	Home Health Aide	176%	83%
29-2061.00	Licensed Practical / Vocational Nurse	104%	78%
51-4121.00	Welder / Solderer	-65%	-20%
51-4041.00	Machinist	-36%	-60%

Source: OECD calculations based on Lightcast data.

Licensed practical nurses (NOC 3233), in particular, *“provide care for individuals, families and groups in a variety of healthcare settings. They may practice independently or as part of a healthcare team”*. Licensed practical nurses work in a range of healthcare roles (such as acute care, long-term care, community and primary health clinics, education, occupational health, public health and leadership). In 2018, there were 9 900 workers employed as licenced practical nurses in Alberta. Depending on the setting, licenced practical nurses may perform many different tasks, in many cases working with other healthcare professionals (such as registered nurses, psychiatric nurses, doctors and physiotherapists). From an education-requirement standpoint, certification requirements to access the profession in Alberta are quite stringent (see Box 3.2). (ALIS, 2018_[19])

Box 3.2. Becoming a Licensed Practical Nurse in Alberta

In Alberta, licensed practical nurses must graduate from an approved practical nursing education programme, or complete other education considered equal by the Registrar of the College of Licensed Practical Nurses of Alberta (CLPNA). Practical nursing programs combine classroom learning, lab instruction, and clinical experience in different healthcare settings.

Legislation requires licensed practical nurses who specialise to complete an approved programme or advanced certification. The CLPNA must authorise them to perform in that capacity. Specialties may include perioperative nursing/operating room, advanced orthopaedics, dialysis, immunisation or advanced foot care.

Notably, The Alberta Learning and Information Service mentions that, despite the high demand, “Completing a programme does not guarantee entrance into an occupation” (ALIS, 2018^[19]). This is partly because registration with the CLPNA is mandatory to provide professional services directly to the public, teach the practice of the profession to members or students of the profession, or supervise registered members who provide services to the public, as ordered by Alberta’s Health Professions Act and Licensed Practical Nurses Profession Regulation. Registered members who are authorised by the College may perform restricted activities specified in the Regulation and only registered members may call themselves licensed practical nurses (CLPNA, n.d.^[20]).

Since the pandemic, the number of new OJPs for Licensed practical and vocational nurses has grown (Figure 3.4).³ This increase in the demand can be partially attributed to the emergency triggered by the COVID-19 crisis but structural shortages and lack of sufficient personnel mentioned in previous chapters have also likely played an important role. Many argue that the low attractiveness of the profession contributed to the emergence of shortages that are reported in most provinces in Canada even before the pandemic. On top of a high stress working environment, workers employed in this occupation receive a wage per hour of CAD 30.17, which is slightly below the average for the province (CAD 31.05). Looking at the labour supply, the Canadian Nurses Association reported that while the number of nurses who are eligible to work grew by 1.9% in 2019, the nursing work force actually diminished by 1.5% (CNA, 2019^[21]). In Alberta specifically there were 14 805 licensed practical nurses in 2018 (Canadian Institute for Health Information, 2020^[22]), while 9 900 were employed. This adds to the idea that the job was not attractive enough to succeed in retaining nurses.

The health industry in general faces a shortage of workers, including in supporting roles like home health aides, licensed practical nurses and registered nurses. These three occupations are discussed in Box 3.3, which also provides more information on registered nurses.

Box 3.3. Home health aides, licensed practical nurses & registered nurses in Alberta

Home health aides, licensed practical nurses and registered nurses, while all highly in demand jobs in the healthcare sector, perform very different tasks. They also require different levels of education and receive different levels of remuneration.

The average number of OJPs searching for home health aides (HHA) (NOC code 44101) increased by 176% during the pandemic. As discussed previously, home health aides do not necessarily require post-secondary education, although healthcare aides need to undergo standardised training following a curriculum set by Alberta Health. Home health aides receive an average wage that is significantly below the average wage in Alberta, at CAD 18.53 per hour compared to the average of CAD 31.05. Home health aides provide care at home, and their health-related tasks are usually “*routine health-related duties such as changing non-sterile dressings, assisting in the administration of medications and collecting specimens under the general direction of home care agency supervisor or nurse.*”

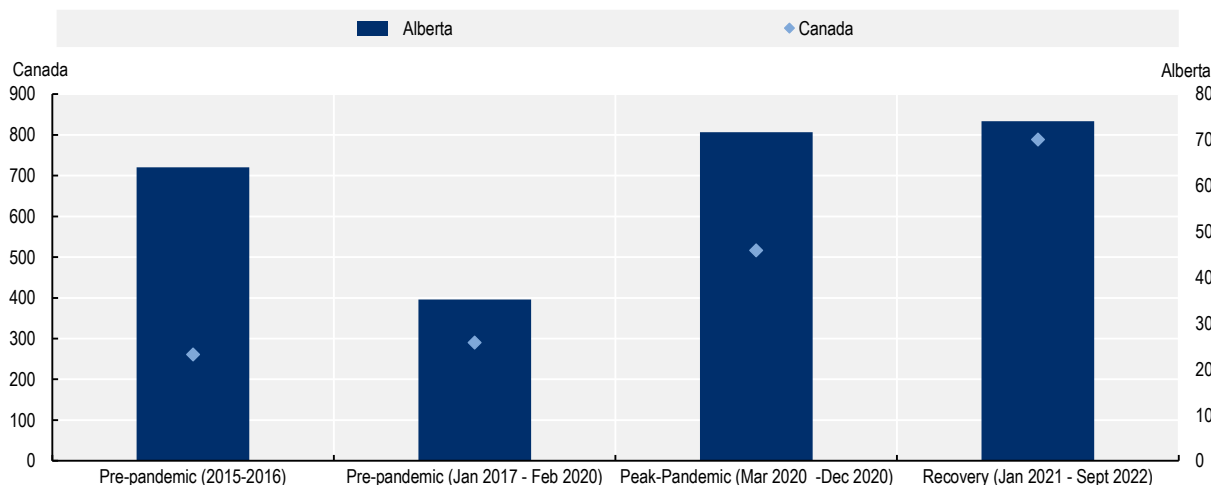
The growth in average number of OJPs searching for licensed practical nurses (LPN) (NOC code 32301) reached 104% during the pandemic. As mentioned, licensed practical nurses need to pass a practical nursing education programme, which is generally two years post-secondary education. Their average income is CAD 30.17 per hour. While the work of a LPN is generally still of a practical nature, they carry out their duties independently, and can even be in leadership roles (ALIS, 2018_[19])

The demand for registered nurses (NOC code 31101) as measured by OJPs grew by 21% during the peak of the pandemic, which is significantly less growth than the other two positions, but still considerable growth. However, the number of Albertans employed as RNs is much higher than the number of LPNs and HHAs. In 2022 Alberta had 38 900 registered nurses, compared to 9 900 licensed practical nurses and 8 350 home support workers, only some of which are home health aides (AWSS, 2022_[23]). This is reflected in the number of OJPs, which are the highest for registered nurses in each year. For instance, in 2020 there were 3 361 OJPs for HHAs, 5 975 for LPNs and 12 907 for RNs. 33% of employers looking to employ RNs in 2021 experienced difficulties finding candidates, and 15% had unfulfilled vacancies for over 4 months (AWSS, 2022_[23]). Some of this increased demand, as seen in increased OJPs, could potentially be due to burnout experienced by Registered Nurses during the pandemic.

Becoming a registered nurse requires even more education than becoming a LPN or a HHA, as it involves passing a 4-year nursing degree programme and passing a national licensing exam (ALIS, 2017_[24]). However, a registered nurse’s income is above average at CAD 46.21 per hour, unlike the income for the other two positions. At the same time, it is a very demanding position, mentally, physically and emotionally and also requires irregular working schedules.

In line with the recent trends observed in OJPs, the AWSS places licensed practical nurses among occupations that, in Alberta, face a “high demand” (AWSS, 2022_[23]). Around 55% of recruiting employers declare to have experienced hiring difficulties in Alberta and 16% of employers have vacancies for these professionals that remain unfilled for over 4 months. Against this backdrop, the Alberta Regional Occupational Demand Outlook projects employment in this occupation to increase by 3.6% by 2023, above the average in the country.

Figure 3.4. The evolution of OJPs for Licenced Practical and Vocational Nurses, pre-, peak and post pandemic



Source: OECD calculations based on Lightcast data.

Alberta’s Welders and Machinists had one of the steepest declines in the average number of OJPS during the peak of the pandemic

Among the occupations that suffered the most during the economic downturn during the pandemic in Alberta, Welders/Solderers and Machinists have seen some of the steepest declines in the average number of OJPs published monthly in between March and December 2020 in Alberta (-65% and -36% respectively),⁴ see Figure 3.5.

Machinists are typically employed by companies that manufacture or repair equipment, such as large government organisations or repair and maintenance firms. They usually set up and operate precision metal cutting and grinding machines such as lathes, milling machines, drills and grinders to make and repair products made from metals, non-ferrous materials (materials that do not contain iron) and new alloys. Machinists are part of the larger occupation “Machinists and machining and tooling inspectors” (NOC 7231) and, in Alberta, 78% of people employed in this occupational group work in the Manufacturing or in the Mining and Oil and Gas Extraction industries.

The average wage paid to Machinists is in line with the average for the province, though the wage rate for journeyman machinists varies. It generally ranges from CAD 28 to CAD 34 an hour plus benefits (2019 estimates, see (AWSS, 2022_[23]; ALIS, 2021_[11]). Apprentices earn at least 55% of the journeyman wage rate in their place of employment in the first year, which increases up to 85% in the fourth year. In order to work in Alberta a Machinist must be either a registered apprentice (see Box 3.4), an Alberta-certified journeyman, or someone who holds a recognised related trade certificate. Individuals are also allowed to work as machinists if their employer is satisfied with that the worker has the skills and knowledge expected of certified journeyman.

Box 3.4. Machinists in Alberta: Becoming one through apprenticeships

Alberta requires Machinists to acquire particular competencies and one suitable way to do so is to enrol in an apprenticeship programme (AWSS, 2022^[23]). To register with Alberta Apprenticeship and Industry Training, apprentices must find a suitable employer who is willing to hire and train them. They must also meet one of the following:

- Have an Alberta high school transcript with at least English Language Arts 10-2, Math 10-3, and Science 10, or equivalent
- Have a pass mark in all 5 Canadian General Educational Development (GED) tests

Most employers prefer to hire high school graduates and basic computer knowledge is required.

The term of apprenticeship is relatively long, summing up to 4 years (four 12-month periods) and including a minimum of 1 560 hours of on-the-job training and 8 weeks of classroom instruction each year. High school students can earn credits toward apprenticeship training and a high school diploma at the same time through the Registered Apprenticeship Program (RAP). Applicants who have related training or work experience may also be eligible for admission, credit, or certification and these credits may reduce the period of apprenticeship. At the end of the apprenticeship, machinist apprentices may take the interprovincial exam in the final period of their apprenticeship training to earn a Red Seal (certification recognised in most parts of Canada).

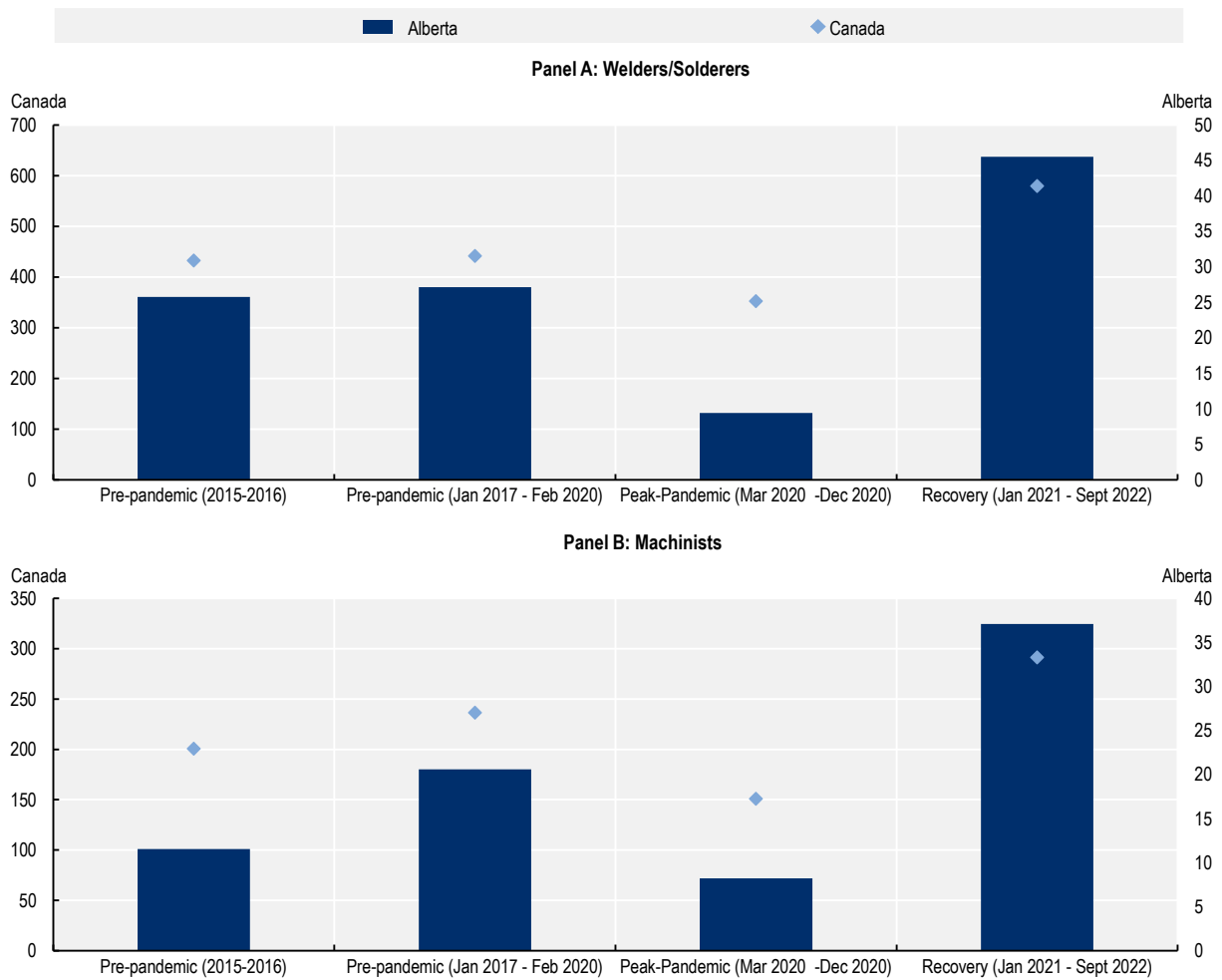
More than 18 000 Welders (NOC 7237) were employed in Alberta and this employment is concentrated in the Manufacturing and the Construction sectors (ALIS, 2020^[25]). “Welders and related machine operators” earn an hourly wage of CAD 37.56 in Alberta, but their wage rate can vary significantly depending on the experience and the tasks associated with the job. Data from the 2021 Alberta Wage and Salary Survey indicates that a welder journeyperson’s wage rate varies, but generally ranges from CAD 25 to CAD 40 an hour plus benefits (2019 estimates). Apprentices earn at least 60% of the journeyperson wage rate in their place of employment in the first year, 75% in the second and 90% in the third. Similar to the case of Machinists, Welders in Alberta also need to have developed specific competencies. For instance, to work in Alberta, a welder must be either a registered apprentice, an Alberta-certified journeyperson or hold a recognised related trade certificate. Apprenticeships for Welders are shorter than those for Machinists (in between 2 to 3 years).

The analysis of OJPs for Alberta indicates that the demand for both occupations decreased substantially during the peak of the COVID-19 crisis, with this trend likely to be related to the lockdowns and the social distancing measures, as well as the low oil prices, which affected most jobs in Alberta’s labour market. Notably, the percentual decline in 2020 was larger for Alberta than for Canada as a whole. Potentially the situation in Alberta was exacerbated by the oil prices, because the mining, quarrying, oil and gas extraction industry employs more machinists and welders in Alberta, while in other provinces welders and machinists are employed in other sectors. The demand for Machinists, however, was steadily growing before the pandemic, while that for Welders was relatively flat. Though job postings for Welders accounted for a larger volume of overall job postings.

Despite the decrease in demand during the pandemic, the demand for both welders and machinists has picked up in 2021, with a volume of new job postings that is now exceeding the pre-pandemic trends. Evidence seems to suggest the emergence of short-term labour shortages, in particular in the case of Machinists. Demand for Machinists was growing in the pre-pandemic period, and it has experienced a significant rebound in the post-pandemic period, starting in 2021. It is still unclear, however, whether such shortages will also persist in the medium and long run. Projections for Canada, for instance, seem to suggest that about 17 400 new Machinist, Machining/Tooling Inspectors, and Tool and Die Makers will be

needed over the period 2019-2028. This is due to expansion demand, which is created because more goods and services are necessary than before, and replacement demand, which occurs when previous employees leave their jobs, due for example retirement or career switches. At the same time, 18 500 new job seekers (arising from school leavers, immigration and mobility) are expected to be available to fill them (Government of Canada, 2022^[26]), leading to a surplus in job seekers.

Figure 3.5. Average monthly job postings for Welders/Solderers and Machinists in Alberta, pre-, peak and post pandemic



Source: OECD calculations based on Lightcast data.

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<https://www12.statcan.gc.ca/census-recensement/2021/as-sa/fogs-spg/Page.cfm?Lang=E&Dguid=2021A000248&topic=11>.
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- Therien, E. (2020), *Alberta announces programs to address trucking shortages, reduce financial barriers to training*, [14]
<https://globalnews.ca/news/7489043/alberta-mandatory-entry-level-training-affordable/> (accessed on November 2022).
- U.S. Bureau of Labour Statistics (2018), *2010 Standard Occupational Classification System*, [7]
https://www.bls.gov/soc/2010/2010_major_groups.htm (accessed on 2022).

Notes

¹ Annex B presents the list of occupations analysed in the chapter and the associated statistics.

² The sole exception being civil engineers who must be able to employ engineering software.

³ Notably, the volume of new OJPs for Licensed practical and vocational Nurses had been trending downwards in Alberta in the years preceding the pandemic.

⁴ It should be noted that the average number of OJPs for these two occupations is rather low (27 and 20 per month pre-pandemic respectively), adding to volatility in the trend analyses.

4 **Assessing the impact of digitalisation in Alberta through the lens of big data**

This chapter examines the impact of the digital transition on Alberta's labour market, highlighting the challenges and opportunities this presents for the province. The analysis focuses on four different groups of digital occupations. For each group, the chapter examines the trends in online job postings (OJPs) and in skills demand by benchmarking some of these results to the whole Canada, the United States and the United Kingdom. The chapter investigates the geographical distribution of the demand for digital occupations and assesses the rate at which digital skills demands are permeating Alberta's workplaces, specifically focusing on the diffusion of programming skills and advanced data analysis skills. By addressing these points, the chapter provides a comprehensive understanding of the digital landscape in Alberta's labour market.

Highlights

- Data mining analysts and business intelligence analysts were among top ten fastest-growing occupations, including non-digital occupations. These occupations are in high demand as organisations continue to collect and use more data, making these professionals highly valued. The starting number of online job postings (OJPs) for these jobs was relatively low at the beginning of the analysis (2015-2016), which could suggest that the demand for these skills and professionals has increased in recent years.
- The largest share of OJPs for digital occupations is for software developers, programmers, and engineers, accounting for 36.7% in Alberta and 40.5% in Canada. This highlights the critical importance of employees with strong technical skills in these fields. Software development, programming, and engineering are essential for businesses to develop and implement technology solutions and digital products.
- The share of OJPs for ICT technicians and data entry clerks is relatively small, at 10.2%. These professions typically require lower levels of education and may be at a higher risk of certain aspects of their jobs being automated. This could be due to advancements in technology that allow for more tasks to be automated, reducing the need for human labour in these positions.
- The demands for several management, marketing, and HR professions have changed, as they now require proficiency in using software packages, web analytics, and online media, making them digital occupations as well. These professions need to be able to understand and utilise digital technologies to effectively perform their jobs, and organisations are looking for professionals who possess these skills.
- The demand for advanced data analysis skills and programming skills is spreading across jobs five times faster than the average skill, indicating that digital skills are rapidly becoming important across different occupations and sectors. This is likely due to the increasing use of technology in all industries and the need for professionals who can analyse and utilise data to drive business decisions and growth in a variety of different roles.

The digital transition: Challenges and opportunities for Alberta going forward

New digital technologies, such as robotics, the internet of things (IoT), artificial intelligence and information and communication technologies are reshaping the way people live, work and learn (OECD, 2022^[11]). The exponentially increasing computing power of digital devices allows the development and implementation of a range of new digital technologies such as 3D printing, advanced robotic and automation. Digitalisation brings clear potential to improve the well-being of societies by boosting productivity.

Against this backdrop, digital technologies have recently found significant application in the production of goods and the delivery of services. The introduction of digital technologies in production, for instance, led to the emergence of the so called “Industry 4.0” (I4.0), or the fourth industrial revolution. In this context, recent developments in machine learning and data science allow machines to operate autonomously with little or no human supervision. Similarly, the evolution of new physical sensors that collect and process information is key to operate the Internet of Things (IoT) making second-generation industrial robotics possible. These new systems are at the core of automation developments that spilled over to a variety of productive sectors and areas of the labour market.

All these changes are poised to replace humans in some of the tasks they carry out in their jobs. This will likely free workers’ time to produce more innovation, eventually leading to further technological changes

and even more radical shifts in the way humans interact with machines in society and labour markets. However, concerns still remain as to whether the digital transition and the future of work will be inclusive for all individuals.

Assessing the impact of the digital transition on labour markets is key for policy makers to design effective labour market and education policies to support the development of those digital skills that workers will need to thrive in future 'digital' labour markets. Tracking the impact of the digital revolution on jobs and skill demands, however, is not an easy task. Data on new emerging technologies and their adoption in productive processes is difficult to find and, in most cases, this information is collected with a lag or it is aggregated at a level that is too high for policy makers to truly respond to current (and future) challenges with tailored intervention.

The timely and granular skill and technology information contained in online job postings (OJPs) can be of great help in assessing the digital skill demands coming from employers and to anticipate future challenges by identifying areas for policy intervention in a very detailed way.

This chapter tracks the evolution of the demand for digital professionals in Alberta and compares those trends with the demand in Canada as well as internationally whenever appropriate. The analysis focuses on a wide set of digital occupations and roles, spanning from computer and data analysts to data scientist and engineers, including ICT technicians and managers and specialists in the digital world. The chapter also looks into the adoption of specific technologies in productive activities by measuring the speed by which the demand for these technologies is spreading across a wider range of occupations and sectors over time.

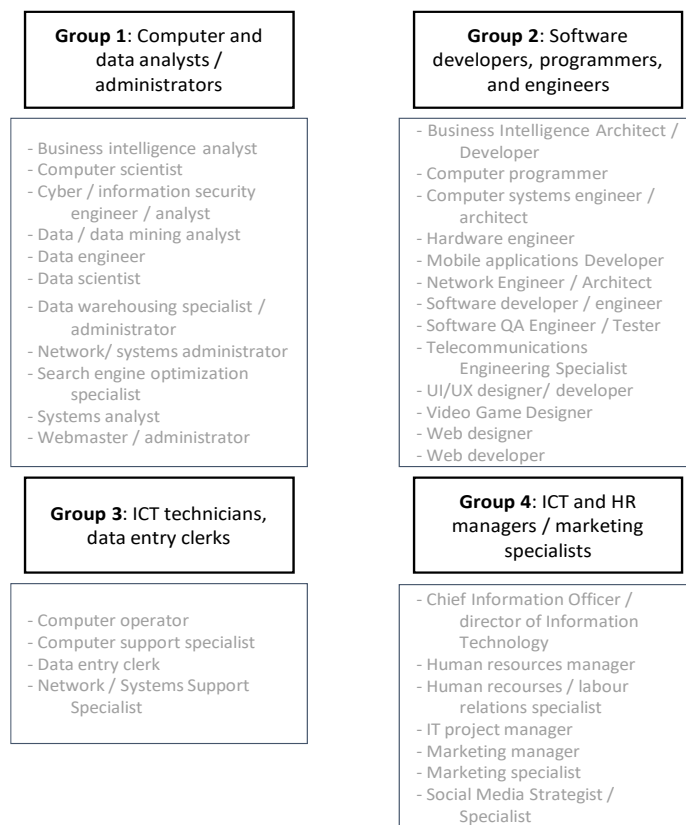
Identifying digital occupations and the volume of job postings available in Alberta

The digital occupations analysed in this chapter have been selected for the key role that they play in the digital transition with the aim to cover the different aspects of the impact of the digital transition on Alberta's labour market (OECD, 2022^[1]). Data scientists, software developers and programmers are the most prominent roles at the core of the *development* of new digital technologies and the *use of data* throughout enterprises. Similarly, ICT technicians and managers play a key role in the *deployment* of digital tools and technologies and are examined in this chapter. Lastly, jobs that *traditionally were not seen as digital*, have increasingly been making use of digital technologies, notably, HR and marketing managers and specialists have become digital professionals in the last decade.

Figure 4.1 presents the list and grouping of digital occupations that will be analysed in this chapter. To ease comparison and simplify visualisation between Alberta and Canada, occupations are grouped into four broad categories.¹ However, as Figure 4.1 shows, additional occupations have been included within each occupational group. The groups are the following:

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

Figure 4.1. Categorisation of selected digital occupations



Source: Authors' own work.

The computer and data analyst/administrator occupational group encompasses roles such as systems analysts and database administrators. This particular grouping is made as a result of their common reliance on data as a central aspect of their daily work tasks. For instance, systems 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_[2]). Database designers and administrators, instead, “design, develop, control, maintain and support the optimal performance and security of databases” (ILO, 2016_[2]).

The group of software developers, programmers, and engineers comprises occupations that are at the forefront of developing new software and hardware. For instance, UI/UX designers/developers² 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. Optimise website performance, scalability, and server-side code and processes (...)” (U.S. Bureau of Labour Statistics, 2010_[3]). 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_[2]).

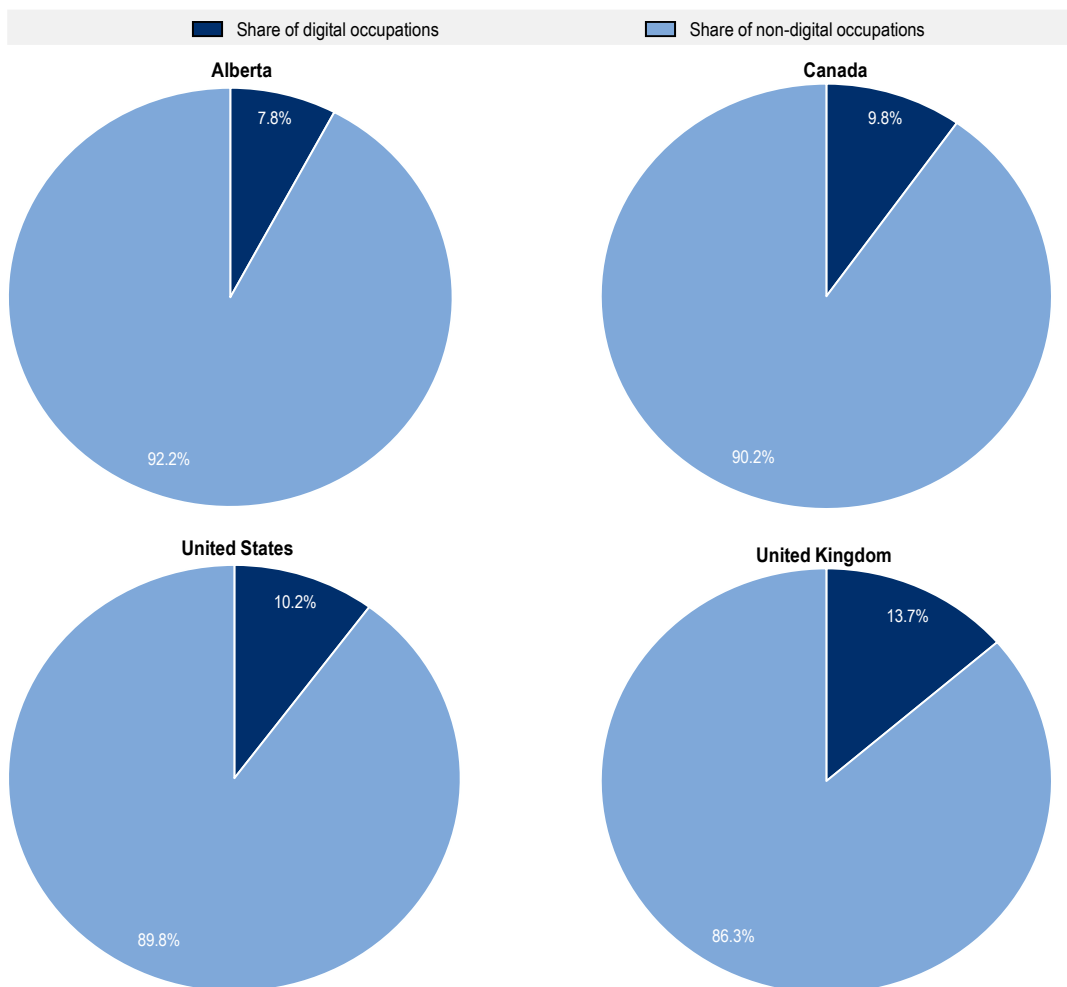
The third group comprises ICT technicians and data entry clerks. Occupations in this group are focused on the use of digital technologies, but typically have lower entry requirements than the rest of groups. Data entry clerks “enter coded, statistical, financial, and other numerical data into electronic equipment, computerised 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_[2]). Other occupations in this group are computer operators, network support specialists, and ICT operations technicians. The 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^[2]).

The fourth and last group examined in this chapter pools together ICT and HR managers / marketing specialists. This group was traditionally not considered to be digital professionals, but due to the changing nature of their tasks can increasingly be considered digital. 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”. (ILO, 2016^[2])

The share of digital occupations in online job postings represents a non-negligible part of the demand in Canada at 9.8% in between January 2015 and September 2022. This share is slightly lower for Alberta with 7.8% but not very distant from the country average. While these jobs are a lower percentage of the total number of occupations, digital occupations and especially the jobs in groups 1 and 2 receive higher average wages. For instance, the average hourly wage in Alberta in 2021 was CAD 31.05, while a systems analyst earned CAD 45.60, a software engineer/designer earned CAD 45.2, and a computer programmer earned CAD 41.29 (AWSS, 2022^[4]).

Figure 4.2. Share of OJPs in digital occupations over total OJPs in Alberta, Canada, the United States and the United Kingdom

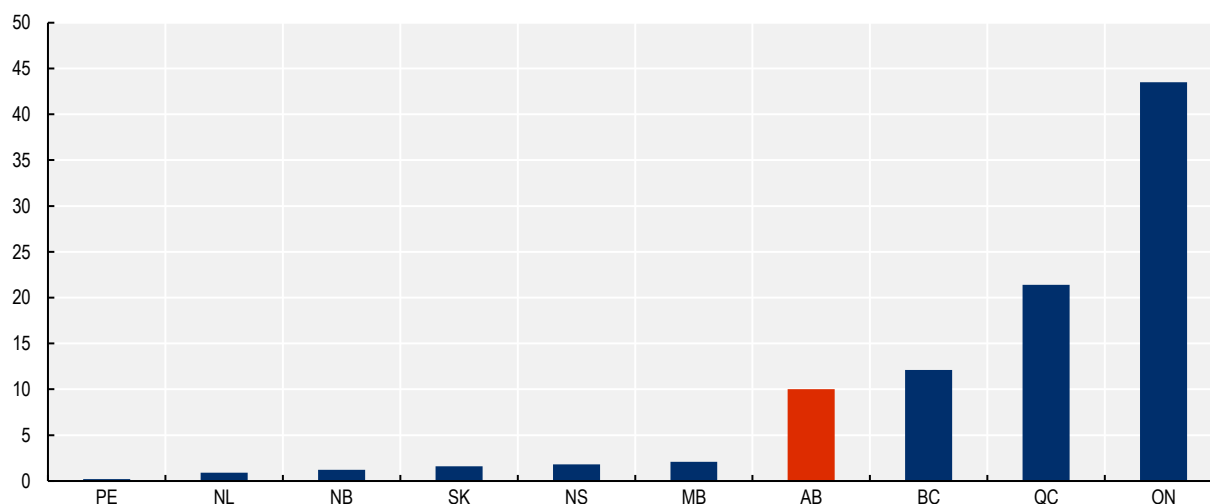


Note: Averages are calculated for the years in between January 2015 and September 2022.

Source: OECD calculations based on Lightcast data.

When comparing the relative position of Alberta against that of other provinces in Canada, analyses by ICTC and StatsCan show that Alberta lies among the most productive provinces by GDP in the ICT sector (Herron and Ivus, 2021^[5]). However, Ontario remains the dominant ICT province in Canada, with an estimated GDP contribution to the total Canadian economy of approximately CAD 43.5 billion in 2020. Alberta ranks 4th in Canada by its ICT contribution to GDP with approximately one-quarter of the ICT GDP in Ontario (Figure 4.3).

Figure 4.3. ICT sector output by province (in billion Canadian dollars), 2020

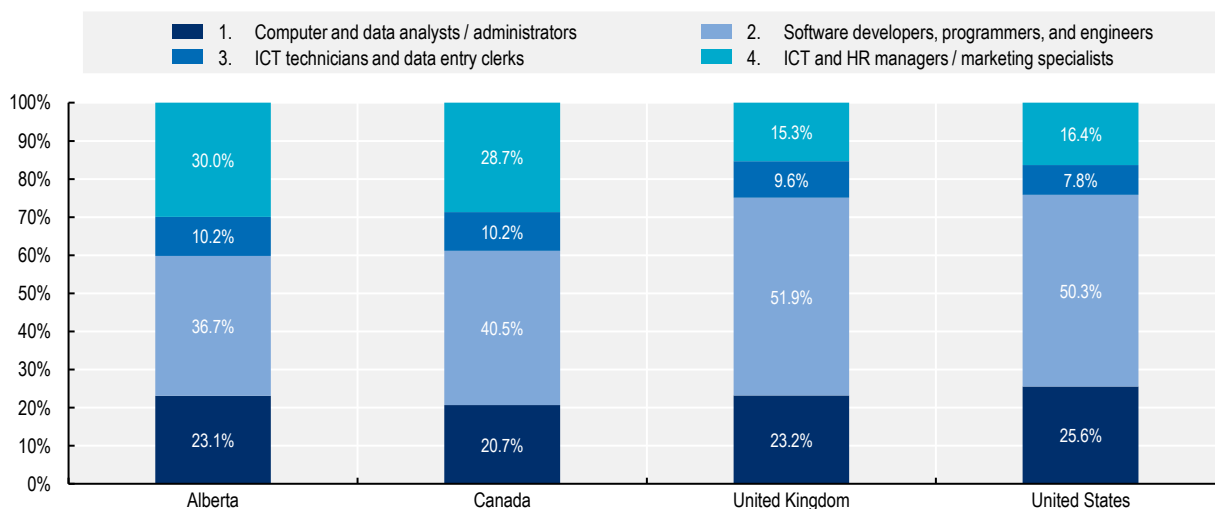


Notes: Values are expressed in billions of CAD and estimated, definition of the ICT sector differs from the definition used in this report. The provinces in order are: Prince Edward Island, Newfoundland and Labrador, New Brunswick, Saskatchewan, Nova Scotia, Manitoba, Alberta, British Columbia, Quebec, and Ontario.

Source: Herron and Ivus (2021^[5]), Digital Economy Annual Review 2020, <https://www.ictc-ctic.ca/wp-content/uploads/2021/07/ICTC-Annual-Review-2020-EN.pdf>.

Figure 4.4 breaks down the proportion of job postings (OJPs) in digital occupations into the four broad groups defined in (OECD, 2022^[1]). Over the period from 2015 to 2022, the largest share of job postings in digital occupations is found in Group 2 in both Alberta (36.7%) and Canada (40.5%) as well as in the United Kingdom and United States. This is in line with recent research by ICTC that indicates that roles such as software developers, data scientists, and full-stack developers are driving ICT growth in Alberta (Cutean and McLaughlin, 2019^[6]). In particular, surveys of Alberta employers confirm significant demand for software developers, with over 60% of employers ranking this occupation as in-demand (Cutean and McLaughlin, 2019^[6]). Other critical roles such as machine learning engineers are also in demand due to recent advancements in Alberta's AI landscape and ongoing investment in the economy. For example, in early 2019, the Alberta Government announced a CAD 100 million plan to attract AI-based tech companies and further solidify the province's position in the AI space.

Figure 4.4. Breakdown of selected digital occupations by broad occupational groups



Note: The shares are calculated as the average share over the selected time period: January 2015 – September 2022.

Source: OECD calculations based on Lightcast data.

Group 4 represents the second largest share of OJPS regarding digital occupations, both in Alberta and in Canada. This is driven in particular by the demand for IT project managers and HR labour specialists is large in both Alberta and Canada. Demand for these professions is a considerably smaller share in the United Kingdom and the United States, where the more technical roles of group 2 (i.e. developers and programmers) and of group 1 (i.e. computer and data analysts) are relatively more prevalent.

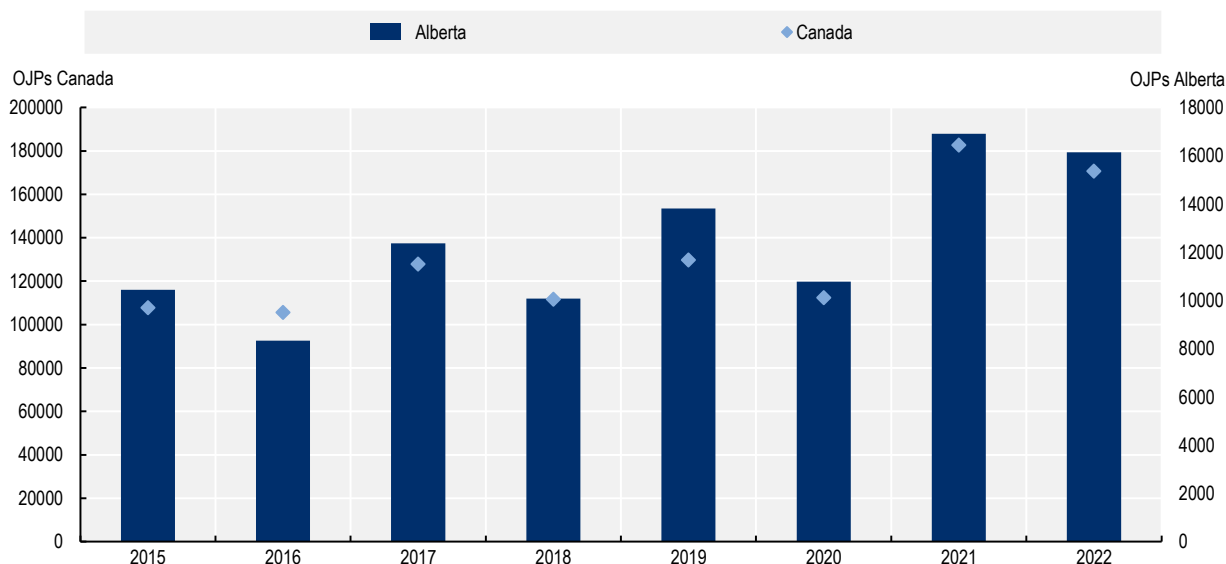
Group 1, the group that includes professionals that are focused on data work, such as computer and data analysts / administrators also represent a large share of total OJPs in digital occupations in Alberta (23.1%) and Canada (20.7%). Here the difference between Canada and the United Kingdom and the United States is less pronounced, meaning that the importance of professionals that are focused on data is similar in these countries.

Group 3: computer operators, computer support, network support and data entry jobs are the smallest part of online digital job postings, as they account for 10.2% of online job postings in Alberta, and in Canada. This is in line with the United Kingdom and the United States, although the demand is slightly lower in the United States at 7.8%.

Looking at how the number of OJPs for digital occupations has evolved over the years, it stands out that 2021 and 2022 had considerably more OJPs for digital occupations than the pre-pandemic years and the year 2020 (Figure 4.5). The decrease in the number of digital occupations in 2020 is unexpected as digital occupations are often easier to perform while working from home. It is surprising that, at the same time, there were non-digital occupations that were in high demand during the start of the pandemic, as been described earlier in Chapters 2 and 3.

Furthermore, the decrease in the number of digital occupations is rather small, and in 2021, still during the peak of the pandemic, it increased again. However, there is a small decrease in 2022 both in Alberta and in Canada as a whole, which might partially be because only OJPs in between January and September 2022 are available, which means that occupations with high seasonality and high demand in the summer are included. Besides that, as discussed in Chapters 1 and 2, demand for jobs that require a high school diploma or no diploma noticeably increased in 2022, and these jobs are often not digital, but part of more traditional sectors such as retail, construction and hospitality.

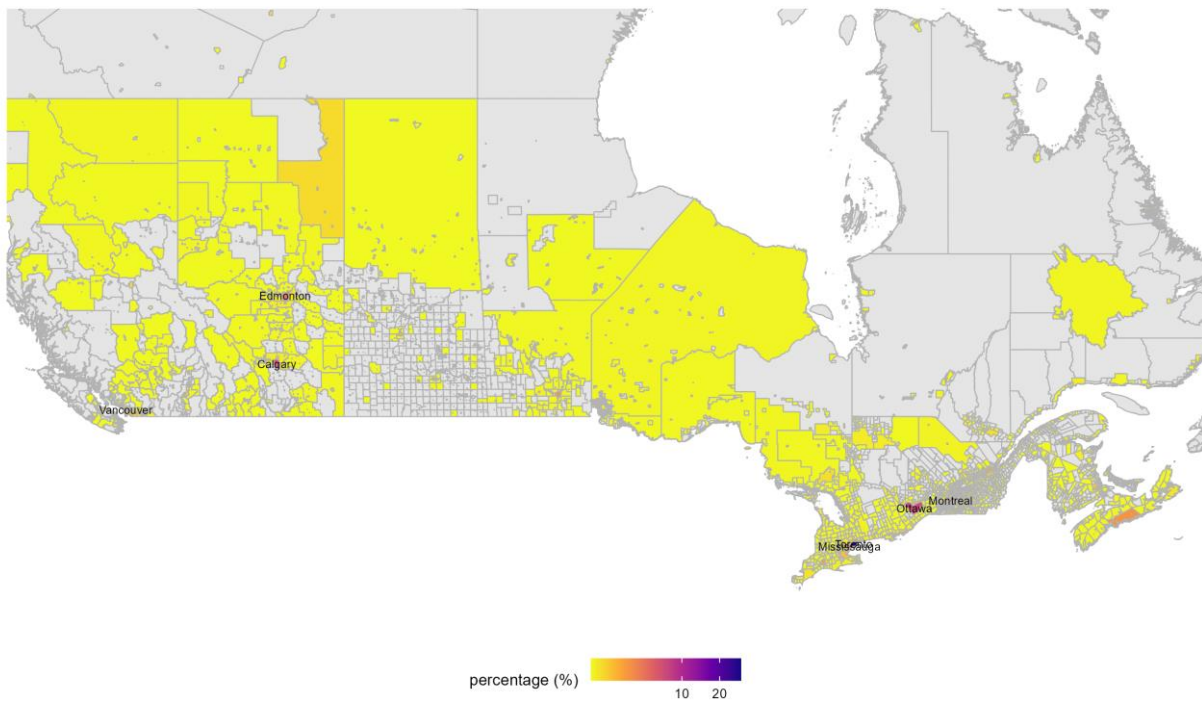
Figure 4.5. Number of OJPs for digital occupations



Source: OECD calculations based on Lightcast data.

The geography of Alberta's demand for digital occupations

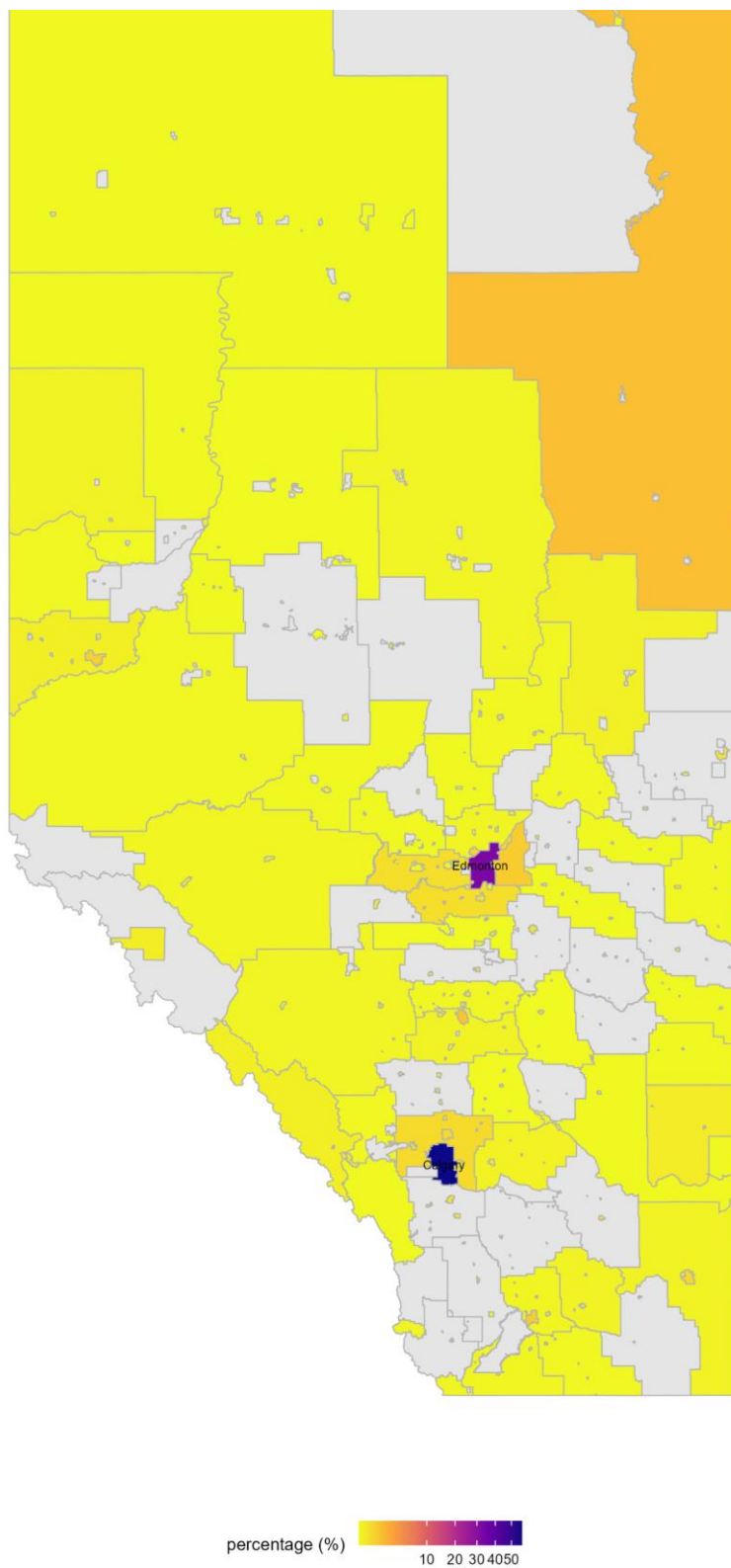
The data in Figure 4.6 indicates that job postings for digital occupations are not restricted to major cities like Ottawa, Montreal, Toronto, and Vancouver but are also present in Alberta. In particular, Calgary and Edmonton have a high concentration of digital occupations' job postings, with 40% and 30% respectively. This pattern is consistent with what was observed in chapter 1 for all occupations. Additionally, the specialised municipality "The Regional Municipality of Wood Buffalo" in north-eastern part of Alberta, which is known for its mining industry, has around 10% of digital occupations' job postings. Notably, the use of digital technologies and data analysis is making its way into the mining sector. Digital technologies, in fact, can help improve efficiency, productivity, and decision-making in the mining industry. For instance, digital tools such as autonomous equipment, predictive maintenance, and simulation models can help reduce downtime and optimise production processes. Additionally, data analysis can provide insights into resource management, geology, and environmental impact, among other areas. The presence of digital occupations' job postings in Wood Buffalo region, which is known for its mining industry, further supports the significance of digitalisation in this industry. Overall, these findings also demonstrate a heightened demand for digital professionals in Alberta.

Figure 4.6. Distribution of digital occupations in Canada in January 2015 – September 2022

Note: Grey areas indicate non-available information. Names are shown for areas with higher share of job postings.

Source: OECD calculations based on Lightcast data. Digital boundary file adapted from Statistics Canada (2022^[7]) <https://www12.statcan.gc.ca/census-recensement/2021/geo/sip-pis/boundary-limit/limites/index2021-eng.cfm?year=21>. This does not constitute an endorsement by Statistics Canada of this product.

Figure 4.7 Distribution of digital occupations in Alberta in January 2015-September 2022



Note: Grey areas indicate non-available information. Names are shown for areas with higher share of job postings.

Source: OECD calculations based on Lightcast data. Digital boundary file adapted from Statistics Canada (2022^[7]) <https://www12.statcan.gc.ca/census-recensement/2021/geo/sip-pis/boundary-limités/index2021-eng.cfm?year=21>. This does not constitute an endorsement by Statistics Canada of this product.

In the following section, the trends for specific occupations within each group will be highlighted. The occupations were selected based on their representation in job descriptions, the trend in the number of job postings they experienced, and the availability of a sufficient number of job postings. Unlike in Chapter 3, however, occupations that had only a few job postings are not automatically excluded from the analysis, as they can serve as examples of the rapid growth of digital occupations in recent years. However, it will be noted if the number of job postings for a certain year is particularly low to ease the interpretation of the results.

Trends in online job postings for group one of the digital professionals

The demand for data mining analysts and business intelligence analysts has been rapidly growing pre-pandemic

The adoption on new digital technologies across a wide variety of businesses has triggered the demand for different kinds of professionals in the digital field. As an example, the demand for data analysts and administrators, in charge of analysing, interpreting, and displaying data using, in many cases, business intelligence tools, has been on the rise across most developed economies.

The analysis of the evolution of OJPs in Alberta in the period between January 2015 and September 2022 Figure 4.8 shows that the demands for data mining analysts, business intelligence analysts, and cyber security professionals have recorded the fastest growth rates, with a particular acceleration in recent years, after the COVID-19 crisis. In the case of data mining analysts, OJPs increased by an average of 104% per month in the period in between 2017 and the beginning of the pandemic relative to the period in between January 2015 and December 2016. Notably, the strong demand for these professionals in Alberta outpaced the demand in Canada as a whole in the period examined. Data mining analysts and business intelligence analysts are even among the top 10 fastest-growing occupations which were discussed in Chapter 3.

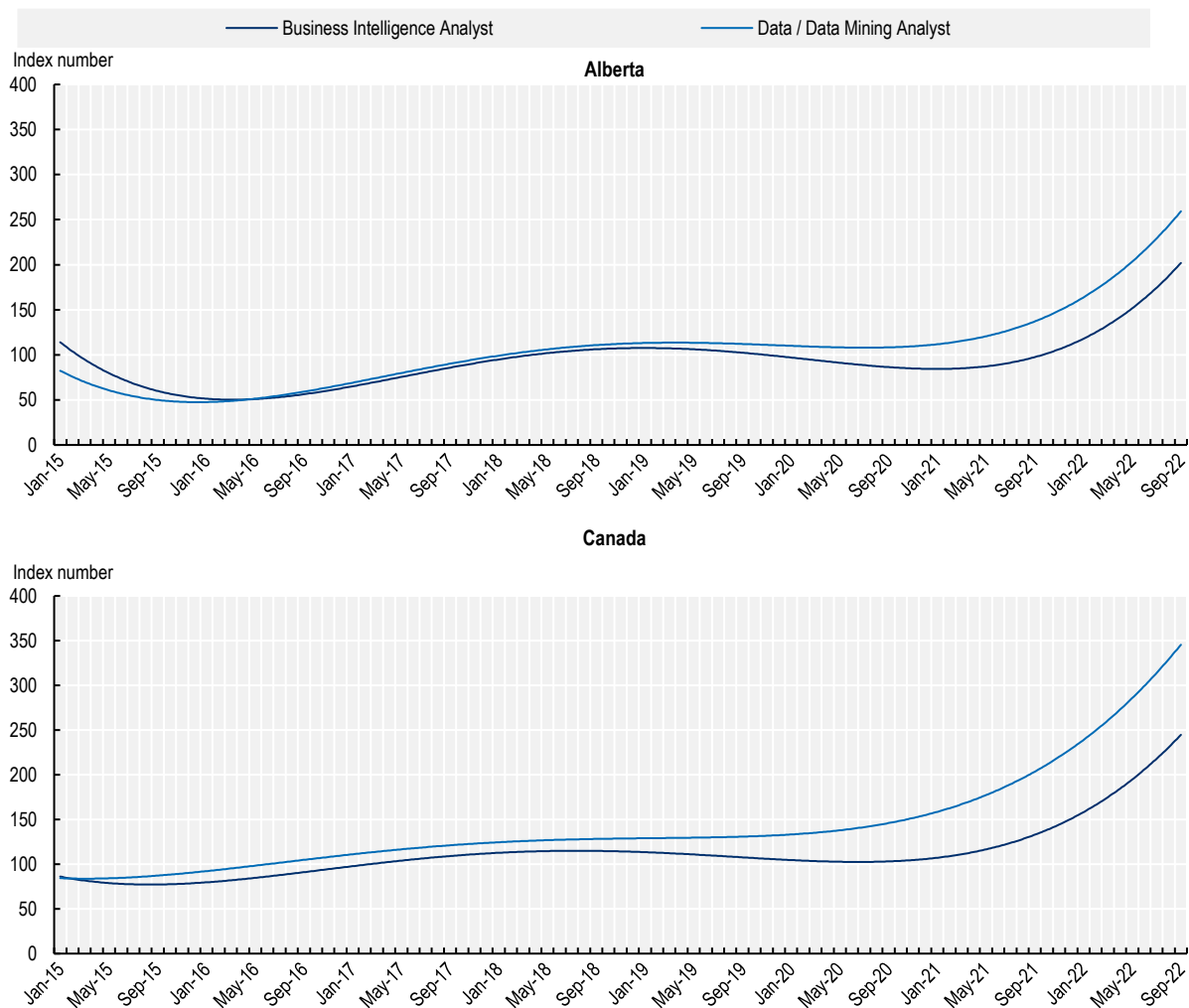
The high demand for data mining analysts in Alberta is driven by the massive increase in data production and the potential for the digital economy to utilise it. The Digital Revolution has made data more readily available, making data mining analysts crucial for businesses. The role of a data mining analyst involves analysing large data sets to uncover patterns and relationships between variables, and using those patterns to make predictions. According to the Alberta Learning Information Service (see (AWSS, 2022^[4]), data mining analysts are considered an “emerging” occupation in Alberta, potentially evolving from existing occupations like econometricians or statisticians, or arising due to changing consumer needs and technological advancements.

While the analysis of OJPs shows that data miners are in increasing demand in Alberta’s labour market, further evidence (AWSS, 2022^[4]) shows that this not an entry-level position and that employers generally prefer applicants who have several years of related experience. The minimum academic requirement is a bachelor’s degree in data science, data analytics, computing science, statistics, computer engineering, or another highly quantitative field. A graduate degree (master’s or doctoral) usually is required for higher-level positions. A doctoral degree (PhD) may also be required to conduct independent research.

Similar to data-mining analysts, the job of business intelligence analysts (within the NOC category 4136, Market Research Specialists) has experienced a significant growth in demand in the pre-pandemic period. This upcoming trend extends to Alberta (and to a lesser extent to Canada as a whole) where the number of available job postings published for those roles each month increased by an average of 71% in the period in between 2017 and the months preceding the COVID-19 crisis (February 2020), (46% in Canada in the same period). Business intelligence analysts are professionals in charge of “*producing financial and market intelligence by querying data repositories and generating periodic reports and of devising methods for identifying data patterns and trends in available information sources*” (U.S. Bureau of Labour Statistics,

2018^[8]). These specialists have become key figures, especially in medium to large enterprises that are particularly interested in researching the market perception and potential of a brand, product, or service, identifying factors that may enhance acceptance of their brand, product, or service and determining the nature and size of market segments.

Figure 4.8. Trend evolution of OJPs for data mining analysts and business intelligence analysts in Alberta and Canada



Note: Polynomial trends calculated on the standardised index number of monthly OJPs in Jan 2015=100 for both Alberta and Canada for the period in between January 2015 and September 2022.

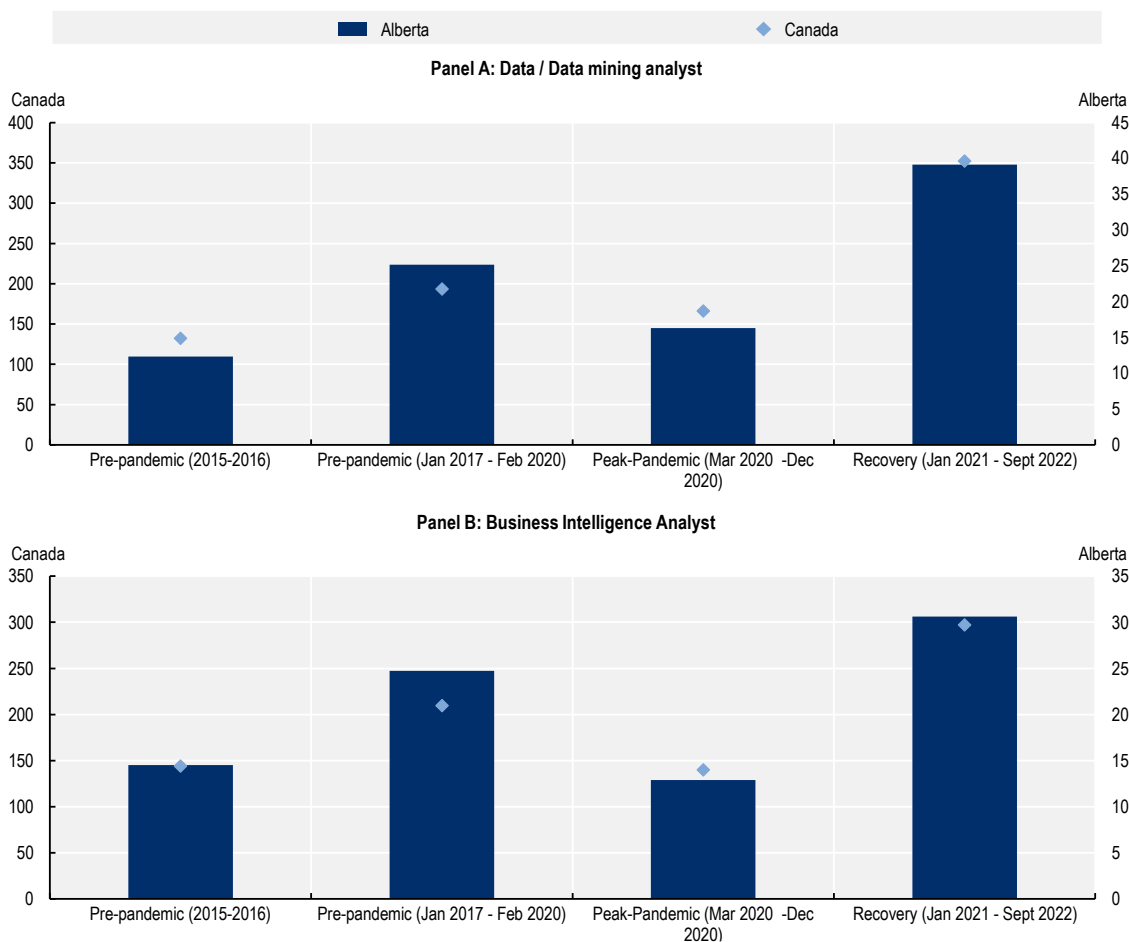
Source: OECD calculations based on Lightcast data.

Alberta has no specific academic qualifications requirements to enter the occupation. However, computer skills and a degree or diploma in marketing are definite assets as well as degrees in marketing, statistics, and social research methods (AWSS, 2022^[4]). The occupation is not regulated in Alberta, but the Marketing Research and Intelligence Association (MRIA) offers a voluntary Certified Marketing Research Professional (CMRP) designation to members who meet the required qualifications and are able to demonstrate competency and mastery of theoretical and practical knowledge in marketing research (MRIA, 2022^[9]).

Regarding remunerations, data from the 2021 Alberta Wage and Salary Survey shows that workers employed in the occupational category encompassing Business Intelligence Analysts and Market Research Specialists (namely Business development officers and marketing researchers and consultants) receive a wage that is well above the average for the province (CAD 49.95) (ALIS, 2022_[10]). The highest paid professionals in this area can be found in the Transportation and Warehousing as well as in the Oil and Gas Extraction sectors, with average annual wages of up to more than CAD 150 000 in both sectors.

Results in Figure 4.9 show the evolution of the average number OJPs per month in the period in between 2015 and September 2022. The figure depicts the dynamics before, during and after the COVID-19 crisis hit Alberta’s (and Canada) economy. The analysis shows the significant increase in the volume of OJPs for both Data Mining Analysts (+104%) and Business Intelligence Analysts (+76%) up until the end of February 2020. A strong contraction, however, followed during the peak of the pandemic³ (March 2020 until December 2020) with the number of job postings for both occupations almost halving (both in Alberta and in Canada as a whole). For context, the average decline in OJPs for all jobs with above average demand pre-pandemic was 11.7%. Preliminary evidence on the recovery period shows a very strong rebound of the demand for both occupations, with a number of OJPs that exceeds the volume in the pre-pandemic period. While part of this result is attributable to the strong recovery experienced by both Alberta and Canada in the aftermath of the COVID-19 crisis, results also show that the growth dynamics already taking place before the pandemic for these occupations have resumed in Alberta’s post-pandemic labour market and that shortages are likely to emerge as a consequence in case the supply of experienced workers in these occupations were not to meet the increased demand.

Figure 4.9. Pre-, peak and post-pandemic: Trends in average monthly OJPs for data and business intelligence analysts

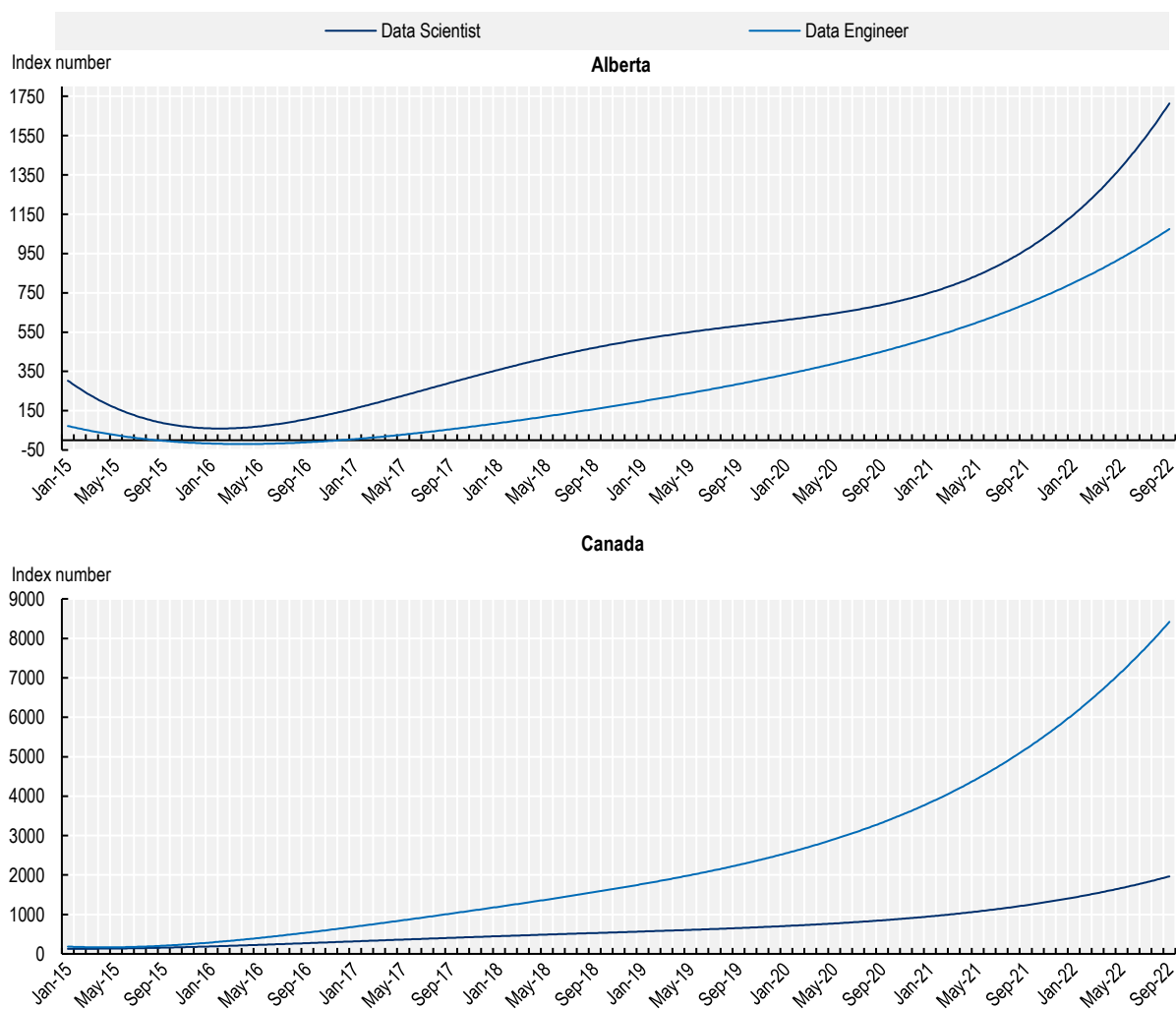


Source: OECD calculations based on Lightcast data.

Data scientists and data engineers are amongst the occupations with the fastest rate of growth across digital occupations

The growth in job postings published online for data scientists and data engineers far outpaced that of other occupations in the same group. At the same time, the number of OJPs in the first year was too low to be considered for the top-growing occupations in Chapter 3. The tasks performed by data scientists and data engineers are quite similar to those performed by data analysts. Analyses in Figure 4.10 present the trends in OJPs for these two occupations, highlighting their particularly rapid growth.

Figure 4.10. Evolution of OJPs for data scientists and data engineers in Alberta and Canada



Note: Polynomial trends calculated on the standardised index number of monthly OJPs in Jan 2015=100 for both Alberta and Canada for the period in between January 2015 and September 2022.

Source: OECD calculations based on Lightcast data.

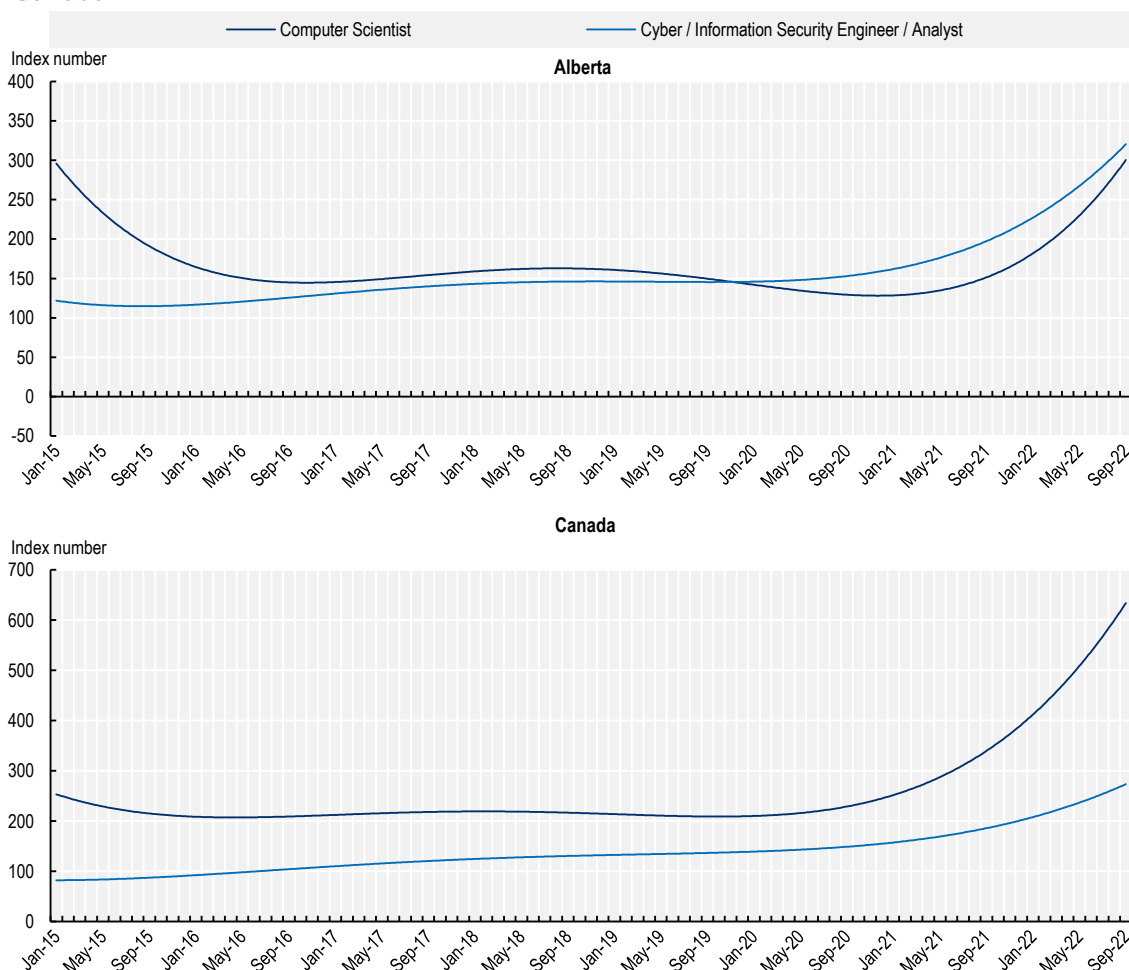
Results show that job postings published online for data scientists and data engineers in Alberta have grown almost exponentially, starting from a handful of postings in 2015 to approximately 130 and 80 new job postings in the first nine months of 2022 respectively. While the growth was significant in Alberta, it was even more pronounced in Canada as a whole, note the difference in axis. Interestingly, the demand for data scientists grew more quickly in Alberta, while in Canada as a whole the growth for data engineers was more pronounced. The increase in demand suggests that advances in machine learning and artificial intelligence have created a market with a large need for these types of professionals.

Data scientists, data engineers as well as data mining analysts are still an emerging occupation in Alberta, it is difficult to trace all their traits and specificities in official labour market statistics. They, however, belong to the broader occupational group of “Database analysts and data administrators” (NOC 2172). Wage analysis for this occupational group in Alberta shows that professionals employed in this occupation in Alberta receive, on average, CAD 45.35 per hour, a wage that is significantly above the average in the province (CAD 31.05 per hour). The wage paid to professionals employed in this category can be one of the signals of its robust demand as employers may struggle to find qualified professionals in this area.

Demand for Computer Scientists and Cyber Security Professionals has been trending upwards in Alberta

Among the various computer and data related occupations in group 1, particular shortages have been reported in the area of cyber security (World Economic Forum, 2022^[11]) across a variety of countries. As firms and businesses use more data and digitise their production processes, also the demand for cyber security professionals has been increasing, outpacing the aggregate demand across the rest of occupations in a variety of countries (OECD, forthcoming). In particular, the expansion in the demand for digital-related occupations across labour markets is a key driver behind the increase in the demand for cyber security professionals as firms adopt new digital technologies that are potentially threatened by software vulnerability, attacks and malwares.

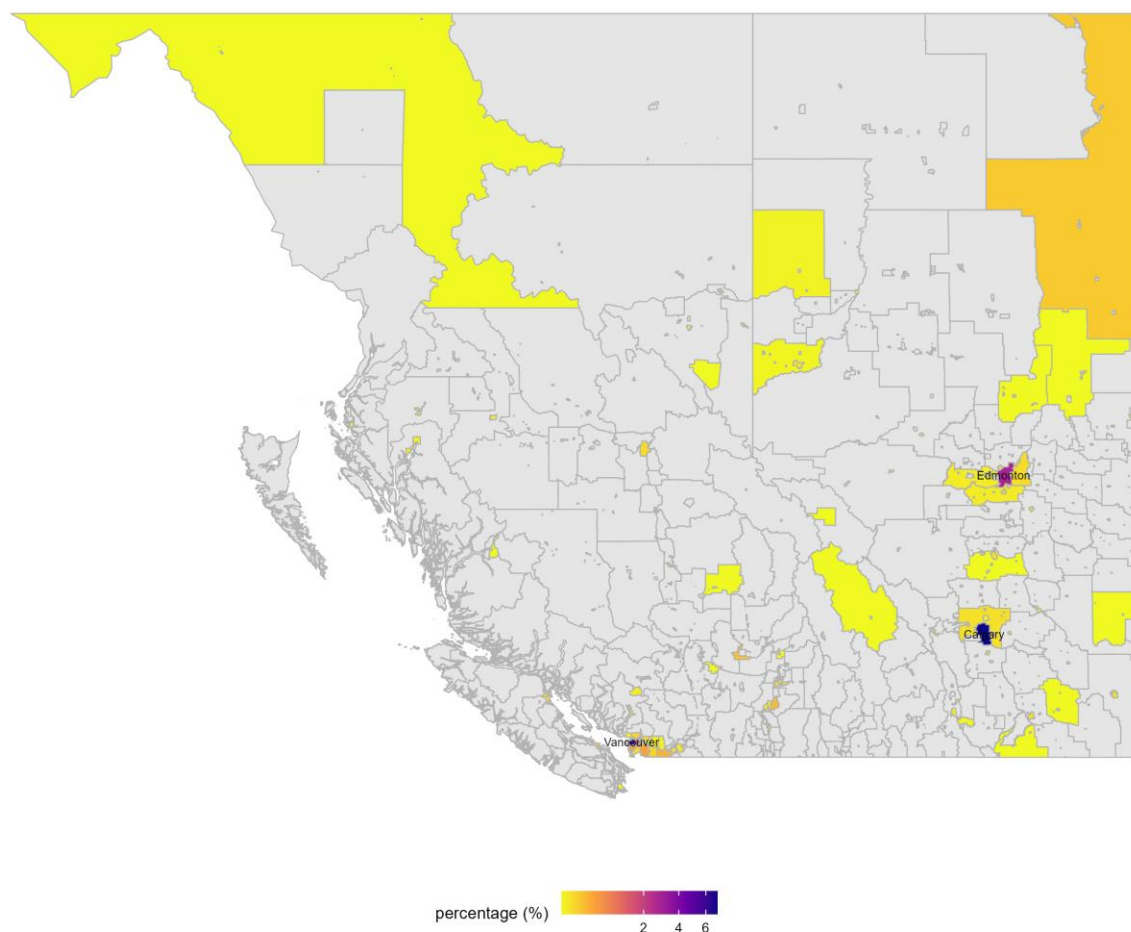
Figure 4.11. Evolution of OJPs for computer scientists and cyber security professionals in Alberta and Canada



Note: Polynomial trends calculated on the standardised index number of monthly OJPS in Jan 2015=100 for both Alberta and Canada for the period in between January 2015 and September 2022. Note that the number of OJPs for computer scientists in Alberta in 2015 is limited, skewing the trendline.
 Source: OECD calculations based on Lightcast data.

In Alberta, although to a lesser extent than in the rest of Canada, new OJPs for cyber security engineers and analysts have also been on the rise, going from about 300 OJPs in 2015 to more than 500 new jobs posted in Alberta in 2021. Notably, while the cluster Toronto-Mississauga-Markham makes roughly 40% of the OJPs for cyber security workforce in Canada, Edmonton and Calgary also represent important hubs for the demand of cyber security professionals with a higher geographical concentration of cyber security jobs than in the neighbouring British Columbia (Figure 4.12).

Figure 4.12. Distribution of cyber security job postings (2015-2022) in Alberta and British Columbia



Note: Grey areas indicate non-available information. Names are shown for areas with higher share of job postings.

Source: OECD calculations based on Lightcast data. Digital boundary file adapted from Statistics Canada (2022^[7]) <https://www12.statcan.gc.ca/census-recensement/2021/geo/sip-pis/boundary-limités/index2021-eng.cfm?year=21>. This does not constitute an endorsement by Statistics Canada of this product.

Skill requirements for occupations in the group of Computer and data analysts / administrators

Table 4.1 analyses the skill bundles (the set of skills that are most relevant in employers' demands across OJPs) associated to the occupations of data analysts / administrators.⁴ Results show that 'data warehousing' skills (i.e. the process of collecting and managing data from different sources to provide meaningful business analyses) are very relevant across job requirements for group 1 occupations that are focused on data: Data mining analysts, data engineers and database administrators in Canada. This result

reflects the increasing importance that the collection of raw data (in particular the data collected from consumers' demand or shipping routes) is having across all sectors, pushing firms to find new solutions to store and analyse those data for marketing strategies or production processes. Related to this trend, 'data visualisation', an interdisciplinary field that deals with the graphic representation of data, is also becoming essential to analyse massive amounts of information and make data-driven decisions based on them. This knowledge area is also particularly relevant for data mining and analysts who need to be able to convey complex statistics in clear and succinct data visualisations to managers and decision-makers within firms.

The ability to analyse big data with new statistical tools also plays a central role in the tasks carried out by data scientists in Canada and Alberta. The words 'big data' usually refer to large, complex datasets, mostly arising from new and unstructured data sources such as those collected by smartphones, mobile applications as well as from interconnected devices used in production (OECD, 2022_[1]). Compared to traditional data, big data are more voluminous, implying that specific software and statistical methods need to be used to analyse them.

Machine learning and artificial intelligence are the key complementary knowledge areas to big data and information contained in OJPs indicates that they are highly relevant in jobs where the knowledge of big data is also important (i.e. computer and data analysis occupations). Finally, the analysis of the employers' demand in Alberta (Table 4.1) also shows the increasing relevance of open-source platforms and software libraries such as Tensorflow.⁵

Data available on the typical qualification requirements mentioned across OJPs for both data engineers and data scientists indicate that employers in this area usually seek candidates with a bachelor's degree in computer science. In the case of data scientist, a master's degree is also typically mentioned as a potential entry requirement in the profession.

For the computer occupations, which are also part of the first group of digital occupations, cyber security professionals require a rather specific skill bundle that sets them apart from most of the other computer occupations. Data from online job postings reveal, for instance, that employers in Canada seek cybersecurity professionals with a strong knowledge of information security and network security, as well as of IT management. Along with these very specific technical skills, cybersecurity professionals are also expected to know cyber security standards, guidelines and best practices to manage cybersecurity risks in firms and organisations. One example is the demand, across a wide variety of OJPs for cybersecurity professionals, of NIST Cybersecurity Framework (a set of guidelines published by the US National Institute of Standards and Technology (NIST)) aimed at mitigating an organisation's cybersecurity risks by providing a taxonomy on cybersecurity outcomes and a methodology to assess and manage them. Information contained in OJPs (Table 4.1) also indicates that bachelor's degree in computer science is the most typical educational requirement across all computer occupations, data analysts and administrators.

Table 4.1. Skill bundle for occupations within the group of computer and data analysts and administrators

Computer and data analysts / administrators	Skill 1	Skill 2	Skill 3	Skill 4	Skill 5	Typical qualification level demanded
Business Intelligence Analyst	Business intelligence	SQL databases and programming	Microsoft power bi	Data warehousing	SAP	Bachelor's
Computer Scientist	Machine Learning	Tensorflow	Data Science	Artificial Intelligence	Distributed Computing	Bachelor's / BS in Computer Science
Cyber / Information Security Engineer / Analyst	Nist Cybersecurity Framework	Network Security	Information Security	Microsoft Certified Professional Azure	IT Management	Bachelor's / BS in Computer Science

Computer and data analysts / administrators	Skill 1	Skill 2	Skill 3	Skill 4	Skill 5	Typical qualification level demanded
Data / Data Mining Analyst	Data Visualization	Data Mining	Data Analysis	Microsoft Power Bi	Data Warehousing	Bachelor's / BS in Computer Science
Data Engineer	Data Warehousing	Distributed Computing	Big Data	Apache Hive	Java	Bachelor's / BS in Computer Science
Data Scientist	Data Science	Machine Learning	Apache Hive	Tensorflow	Big Data	Bachelor's / BS in Computer Science
Data Warehousing Specialist	Data management	IT management	Extraction	Data storage	Data transformation	Bachelor's
Database Administrator	Data warehousing	SQL databases and programming	Scripting	Data dictionary systems	Unix platforms	Bachelor's
Network / Systems Administrator	Network protocols	Network configuration	General networking	Systems administration	Virtual machines	Bachelor's / BS in Computer Science
Search Engine Optimization Specialist	Web analytics	Online research	Online marketing	Semrush	Media strategy and planning	Bachelor's
Systems Analyst	IT Management	Java	Middleware	SAP	Oracle	Bachelor's / BS in Computer Science
Webmaster / Administrator	Web design	Web content	Web development	Web analytics	Vue.js	Bachelor's

Note: Skills in the table's columns are ordered by their relevance for the occupation at hand. Skill relevance score are inferred by applying natural language processing (NLP) algorithms to the analysis of online job postings for Canada. The ranking is based on the cosine similarity between each skill keyword vector representation and the vector representation of the occupation (details are provided in Annex D). Source: OECD calculations based on Lightcast data.

Trends in online job postings for group two of the digital professionals

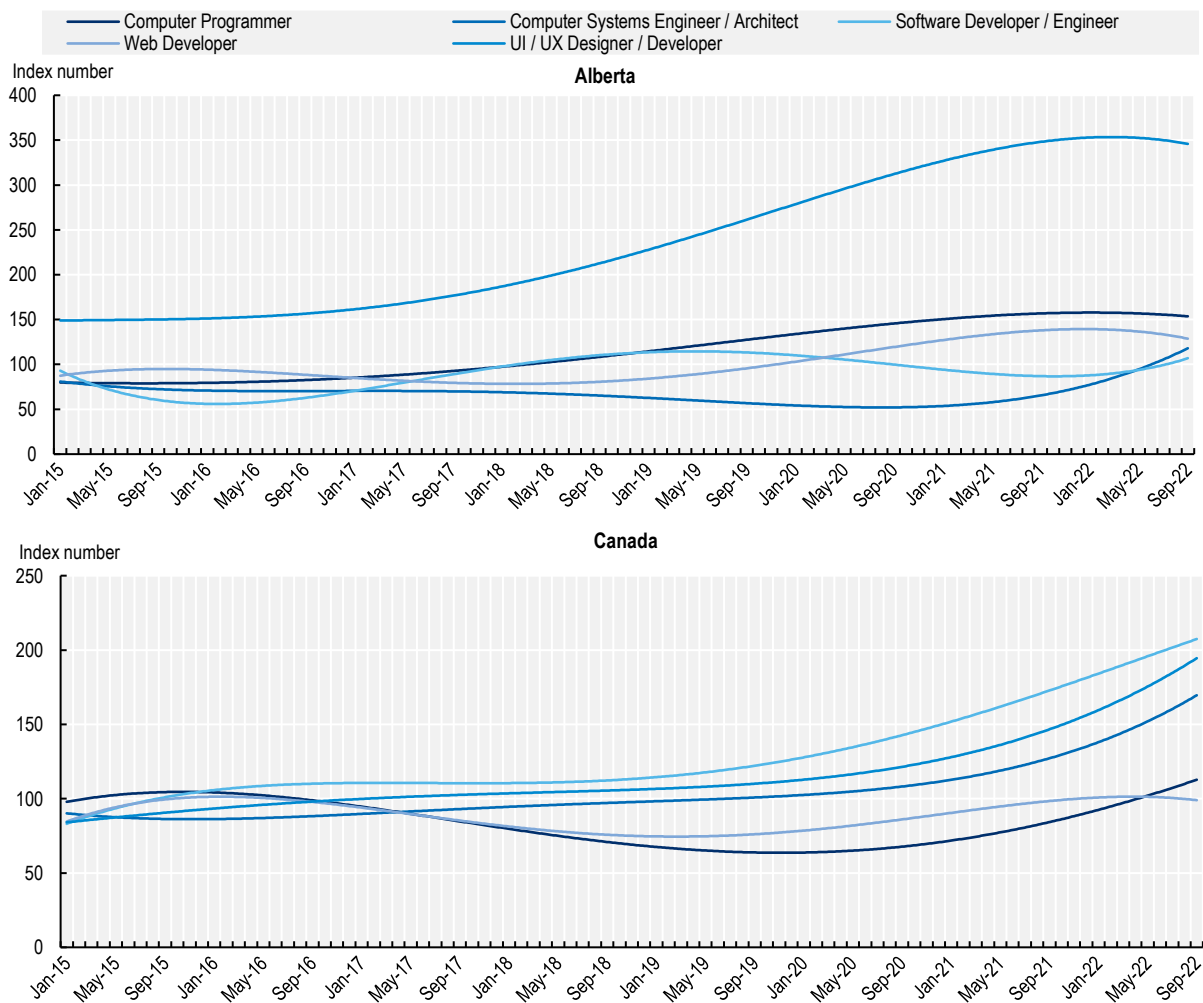
Software developers, programmers and engineers concentrate a high volume of online job postings in Alberta

A relatively large share of OJPs for digital occupations in Alberta (and in Canada) seek hiring software developers, programmers or engineers. When disaggregating the demand into finer-grained occupations and roles, data from job postings shows that the bulk of the Albertan demand across these occupations concentrates in vacancies for software developers and engineers as well as computer systems engineers/architects.

Software engineers⁶ design and work on software used in applications, operating systems, information warehouses, databases, and telecommunications. Alberta's labour market employs approximately 4 700 software engineers with an employment outlook (+2% over the next 5 years) which is above that of the average occupation in Alberta. Data from the Albertan Wage and Salary Survey (AWSS) confirm the significant demand for these professionals in Alberta, signalling also that professionals in this category earn significantly more than the average worker in Alberta (CAD 45.20 per hour compared to the average CAD 31.05) (AWSS, 2022_[4]). Also, 41% of employers surveyed by the AWSS in the last 2 years reported to have hired a software developers. Some 34% indicated to have struggled to find candidates with adequate skills and qualifications to fill the jobs and 19% of employers had reported unfilled vacancies for more than 4 months.

A relatively smaller number of job postings are opened in Alberta for professionals working specifically with web applications (web developers) or with user interfaces and experience (UI/UX designers or developers). While smaller in size, these occupations have recorded very fast rates of growth in the Alberta online labour market (see Figure 4.13), outpacing the growth (though not the volume) of other digital occupations in the same group. Their growth is also faster in Alberta than in Canada as a whole.

Figure 4.13. Trends in OJPs for software developers, programmers, and engineers



Note: Polynomial trends calculated on the standardised index number of monthly OJPs in Jan 2015=100 for both Alberta and Canada for the period in between January 2015 and September 2022.

Source: OECD calculations based on Lightcast data.

Interestingly, on the one hand most of the skill requirements of digital occupations in Table 4.2 are rather technical, spanning from Bitbucket – a Git-based source code repository written in Python- to Typescript, free and open-source programming language developed and maintained by Microsoft. On the other hand, (less digitally-related) skills such as design thinking, online marketing, advertising skills as well as creative design are knowledge areas shown to be particularly relevant for new and emerging occupations such as web designers, developers, video game designers and UI/UX experts. This suggests the growing importance of hybrid skill sets also in technical and narrow occupations like those in the digital world. Knowledge of online marketing, for instance, is particularly important for web designers who are often in

charge not only of the technical development of webpages, but also of their functioning as tools for e-commerce activities and advertising. Similarly, design thinking (a non-linear, iterative process that is used to understand users, challenge assumptions, redefine problems and create innovative solutions to prototypes) is a key high-level cognitive skill for User Interface and User Design developers who are tasked to understand how individual interact with webpages and applications in order to make them more agile and responsive to users' needs.

Analysis of the information contained in OJPs also shows that several occupations in the group of software development and programming professionals require the knowledge of Java. Java is a general-purpose programming language and computing platform that allows users to run code on all platforms that support Java without needing to recompile the code. Knowledge of this programming language, which has become the standard in the industry, is particularly relevant for computer systems engineers and architects as well as software developers and engineers. Java is also relevant for web developers and computer programmers who also require it extensively along with knowledge of Bootstrap (an open and free HTML, CSS and JS toolkit that is used by web developers and computer programmes to create responsive website designs quickly and effectively).

When analysing the typical demand for qualifications, most – if not all- vacancies for software developers, programmers and engineers demand at least a bachelor's degree in computer science. Some occupations, in particular web developers and computer programmers also mention (to a lesser extent) an associate's degree as entry requirement for the profession while a master's or even a doctorate degree can be required to access jobs as an hardware engineer.

Table 4.2. Skill bundles of software developers, programmers and engineers

Software developers, programmers and engineers	Skill 1	Skill 2	Skill 3	Skill 4	Skill 5	Typical qualification level demanded
Business Intelligence Architect / Developer	Software development tools	Force.com platform	Salesforce platform skills	SQL databases and programming	Cloud solutions	Bachelor's
Computer Programmer	Software Quality Assurance	Middleware	Bootstrap	Java	Web Servers	Bachelor's / BS in Computer Science or Associate's degree
Computer Systems Eng. / Architect	Java	Cloud Computing	Firmware	Distributed Computing	Middleware	Bachelor's / BS in Computer Science
Hardware Engineer	Firmware	SDN	Schematic Diagrams	Border Gateway Protocol	Software Quality Assurance	Bachelor's / BS in Computer Science Or Doctorate/Master's
Mobile Applications Developer	Android development	iOS stack	Mobile development	Java	Software quality assurance	Bachelor's or BS in Computer Science
Network Engineer / Architect	IT management	General networking	Microsoft certified professional Azure	IT automation	Distributed computing	Bachelor's
Software Developer / Eng.	Java	Bootstrap	Version Control	Software Quality Assurance	Bitbucket	Bachelor's / BS in Computer Science
Software QA Engineer / Tester	Software Quality Assurance	Test automation	Software development principles	Java	Programming principles	Bachelor's

Software developers, programmers and engineers	Skill 1	Skill 2	Skill 3	Skill 4	Skill 5	Typical qualification level demanded
Telecommunications Engineering Specialist	General networking	telecommunications	Network configuration	Virtual local area networks	Product data hub PDH	Bachelor's or Higher Secondary Certificate
UI / UX Designer / Developer	User Research	Design Thinking	Bootstrap	Software Quality Assurance	Web Development	Bachelor's / BS in Computer Science
Video Game Designer	ZBrush	Animation and game design	Unity 3D	Epic unreal engine	Character design	<i>unknown</i>
Web Designer	Web Development	Multimedia	Online Marketing	Online Advertising	Creative Design	Bachelor's
Web Developer	Web Development	Bootstrap	Typescript	Java	Version Control	Bachelor's / BS in Computer Science or Associate's degree

Note: Skills in the table's column are ordered by their relevance for the occupation at hand. Skill relevance score are inferred by applying natural language processing (NLP) algorithms to the analysis of online job postings for Canada. The ranking is based on the cosine similarity between each skill keyword vector representation and the vector representation of the occupation (details are provided in Annex D). For video game designers, not enough information is known to assess the necessary degree.

Source: OECD calculations based on Lightcast data.

Trends in online job postings for group three of the digital professionals

The demand for ICT supporting roles has experience more rapid growth in Alberta than in Canada

ICT occupations span a large set of different roles which go from routine jobs to managerial positions in charge of managing the work of IT teams within firms. All these roles respond to the ICT needs of businesses in different way, but they are all key for different reasons.

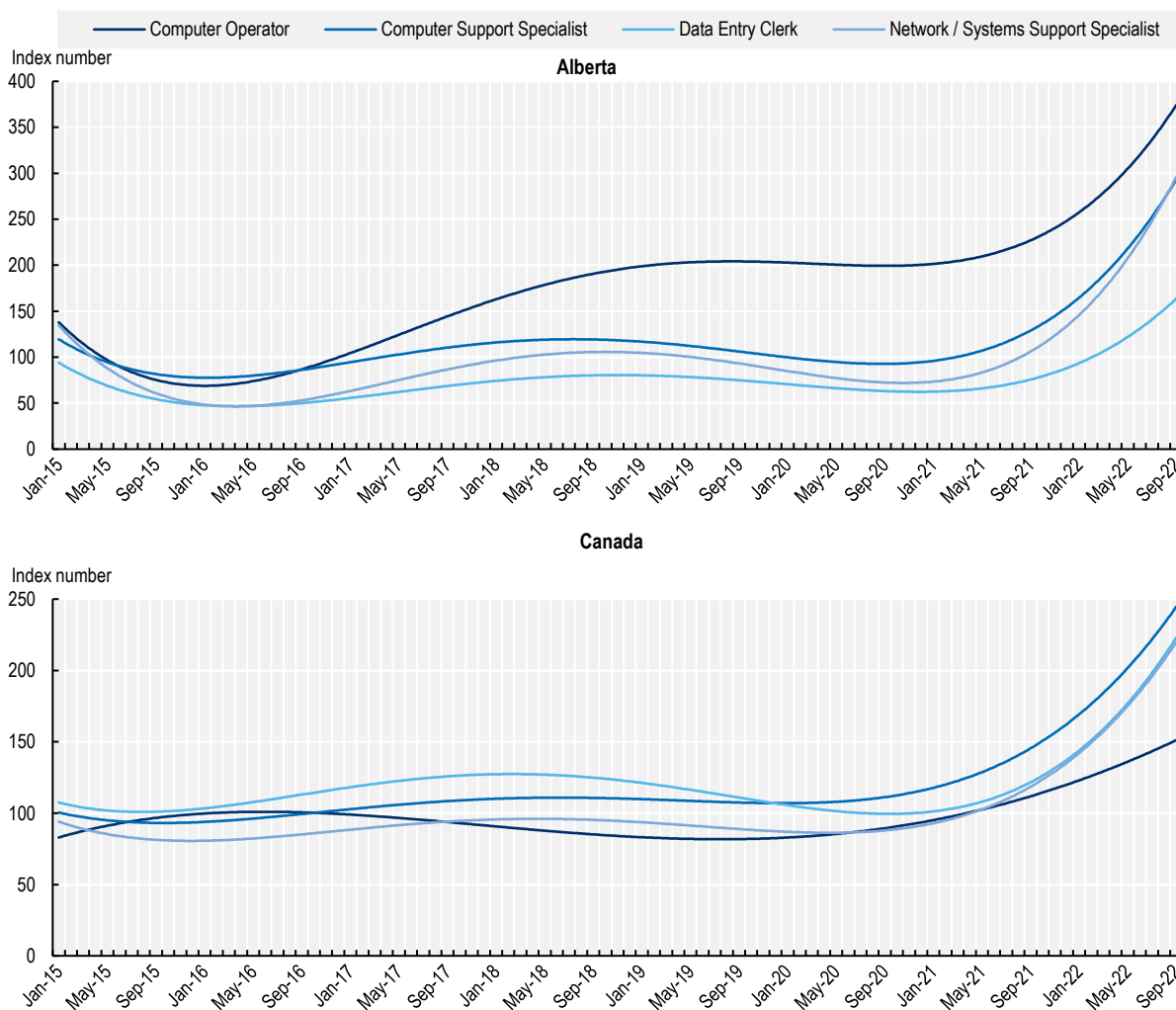
Among digital occupations with a relatively “routine intensive” set of tasks, computer support technicians provide support for the deployment and maintenance of computer infrastructure and web technology. They also contribute to the diagnosis and resolution of technical problems. As mentioned, although 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 (OECD, 2022^[1]). 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.

The analysis of the trends in OJPs shows that the demand for data entry clerks has shown a relatively modest growth rate in between 2015 and September 2022 (Figure 4.14) when compared to other digital professions, including the other ICT technicians of group three, especially in Alberta. The slow pace by which the demand for these professionals has expanded may reflect the automation of several of the tasks carried out by workers in these occupations. Increasingly, for instance, software is able to autonomously detect problems in a computer and suggest ways to fix them to their users. The expansion in the use of cloud technologies, chatbots and artificial intelligence is also likely playing a role in the profession, where smaller-scale computer issues are typically dealt using pre-defined solutions suggested by automated interactive support tools.

The rate of growth for digital professions in the group of ICT technicians and data entry clerks is lower in Canada than in Alberta. This holds for all occupations in the group, except for data entry clerks. The difference is most pronounced for computer operators, as the number of OJPs for this position nearly tripled in Alberta in between January 2015 and September 2022, while it increased by around 50% for

Canada as a whole. At the same time in absolute terms the number of OJPs for this job are very low, both in Alberta (30 OJPs in 2021) and in Canada as a whole (150 in 2021). Computer operators “prepare and operate computer hardware systems to process business, scientific, engineering, or other data, according to operating instructions, and observe the operation of computers which include, but are not limited to, mainframes, minicomputers, and networks of personal computers, ensuring usage as efficiently as possible.” (ERI, 2023_[12]).

Figure 4.14. Trends in OJPs for ICT technicians and data entry clerks



Note: Polynomial trends calculated on the standardised index number of monthly OJPs in Jan 2015=100 for both Alberta and Canada for the period in between January 2015 and September 2022.
 Source: OECD calculations based on Lightcast data.

Among the skills requested of computer support specialists (Table 4.3), the analysis of OJPs indicate that the knowledge of web servers as well as of general IT management skills (i.e. the ability to monitor and administer an organisation’s information technology systems including its hardware, software and networks) are amongst the most typically demanded skills by employers in Canada. Computer operators similarly need to be able to administer hardware, but the skills that are required are more hands-on such as printer repair and being able to fix desktops.

Skills that are required for the position of data entry clerk are very different from the rest of the skills in this group. Skills like typing and dictation are of the greatest importance for this role, further demonstrating why the tasks performed by this role are at risk of automation.

Table 4.3. Skill bundles of ICT technicians, data entry clerks

ICT technicians, data entry clerks	Skill 1	Skill 2	Skill 3	Skill 4	Skill 5	Typical qualification level demanded
Computer Operator	Hands-on desktop fixes	Remedyforce	Configuration management	Printer repair	Electrical problem diagnosis	Higher Secondary Certificate
Computer Support Specialist	Help Desk Support	Technical Support	IT Management	Middleware	Web Servers	Bachelor's
Data Entry Clerk	Typing	Dictation	Office Management	Business English	Telephone Skills	Higher Secondary Certificate
Network / Systems Support Specialist	Network configuration	General networking	Network protocols	SDN	Systems administration	Bachelor's

Note: Skills in the table's columns are ordered by their relevance for the occupation at hand. Skill relevance score are inferred by applying natural language processing (NLP) algorithms to the analysis of online job postings for Canada. The ranking is based on the cosine similarity between each skill keyword vector representation and the vector representation of the occupation (details are provided in Annex D).

Source: OECD calculations based on Lightcast data.

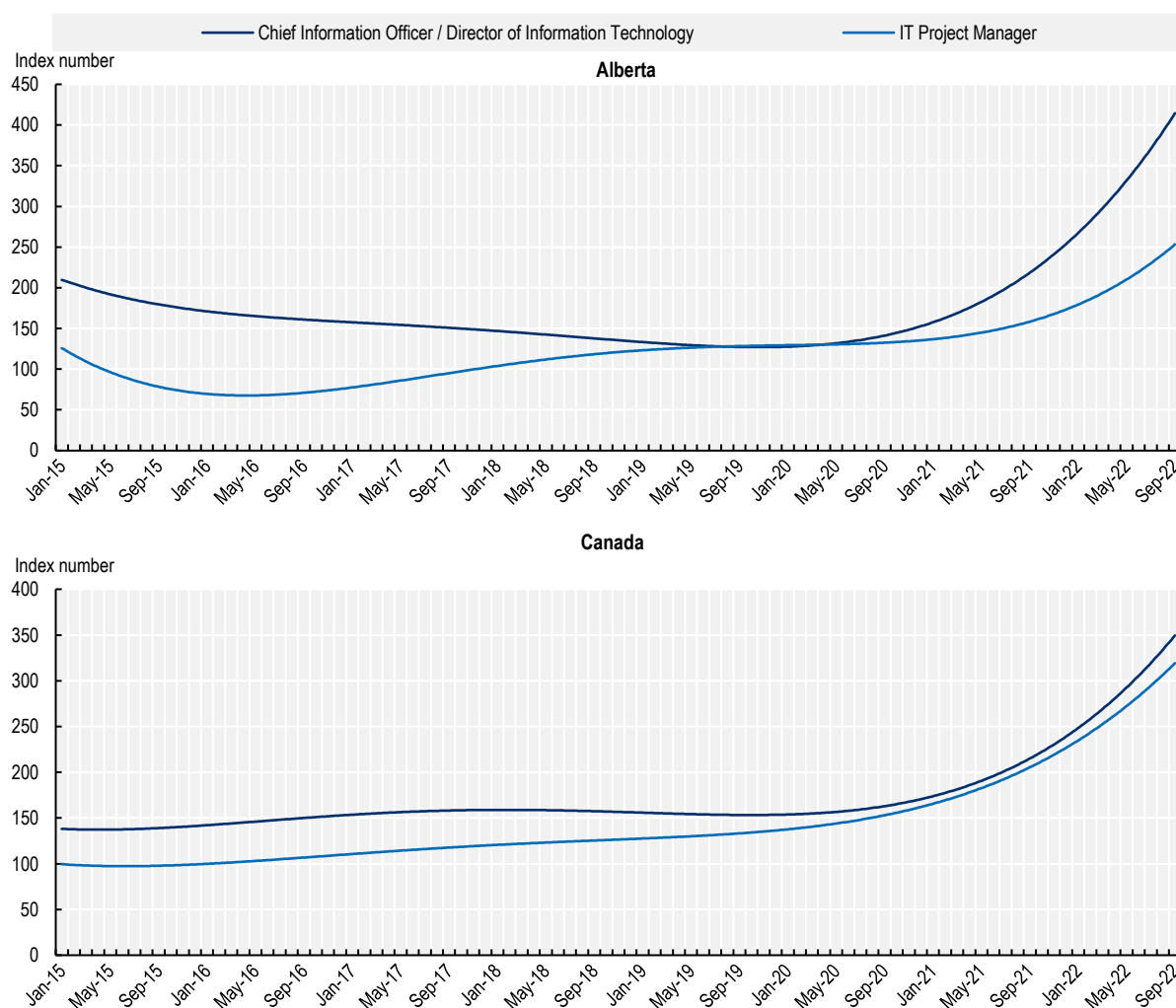
Trends in online job postings for group four of the digital professionals

Demand for managerial roles as well as for HR and marketing professionals has been steadily increasing, and rapidly growing since mid-2020

Results in Figure 4.15 show that new vacancies for managerial roles in the digital sphere, such as Chief Information Officers / directors of IT (CIOs) and IT project managers have increased significantly both in Canada and in Alberta. New vacancies for both positions have been steadily growing in the Albertan and Canadian labour markets but have especially increased rapidly starting from the second half of 2020 after a plateau in early 2020. In absolute terms, the number of OJPs for IT project managers went from around 590 OJPs in 2020 to around 950 in 2021.

The pandemic boosted the use of online activity in ways that are likely to keep persisting post pandemic, such as the use of teleworking, e-commerce, e-health and e-payments (OECD, 2020_[13]). This increased use of technology also establishes a need for firms and people to use increasingly sophisticated digital solutions (OECD, 2020_[13]). IT project managers “*manage, co-ordinate, and establish priorities for complete life-cycle of Information Technology projects including the planning, design, programming, testing, and implementation of solutions designed to meet the project requirements.*” (ERI, 2023_[14]). The role of IT project manager is therefore especially useful when companies need to navigate their increasingly digitalised environment or need to develop IT solutions to their customer's problems.

Figure 4.15. Trends in OJPs for managerial roles



Note: Polynomial trends calculated on the standardised index number of monthly OJPs in Jan 2015=100 for both Alberta and Canada for the period in between January 2015 and September 2022.

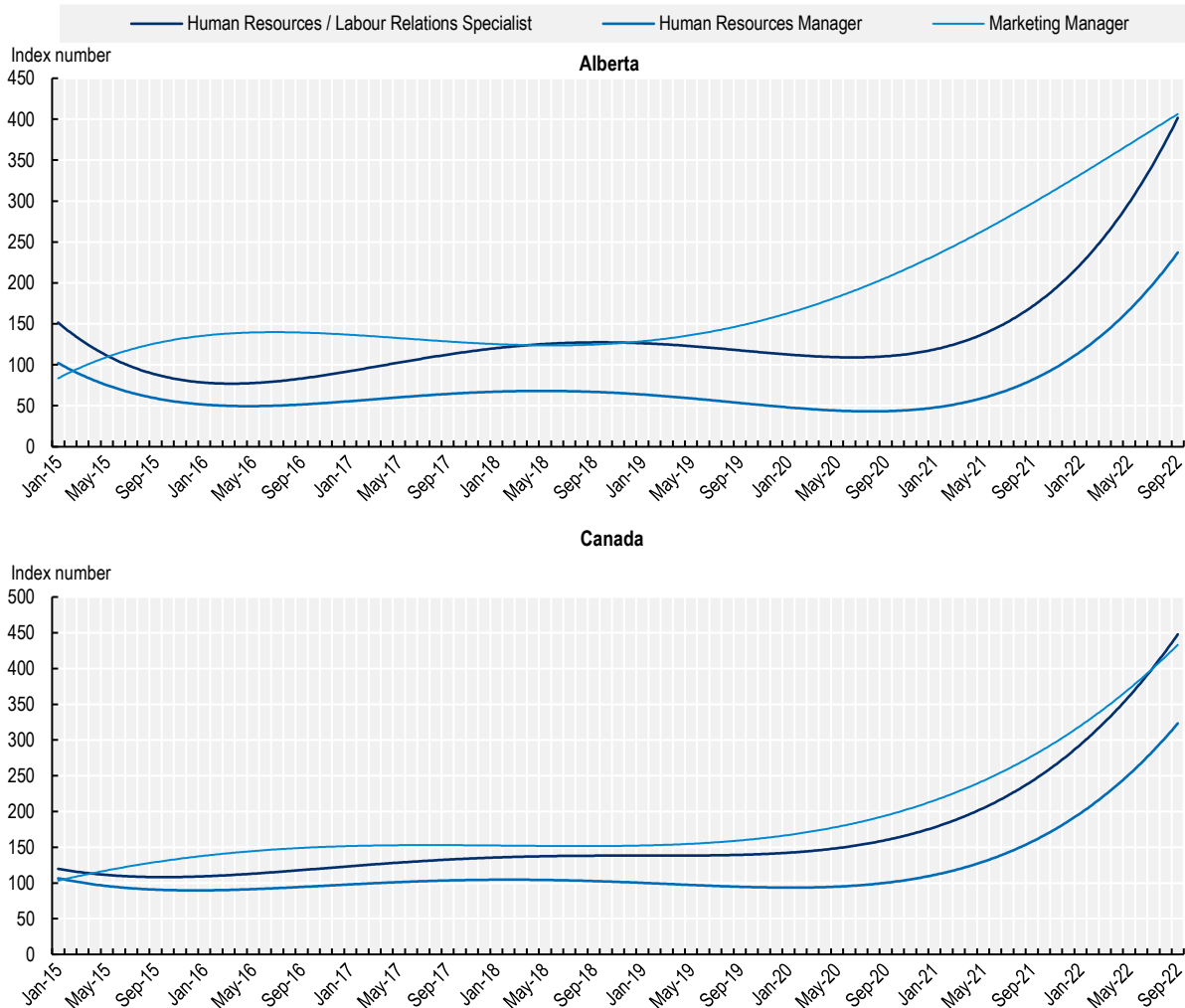
Source: OECD calculations based on Lightcast.

The demand for HR and marketing professionals has followed a similar pattern to that of the managerial functions. This expansion in demand partially reflects the notable changes within certain occupations that are becoming much more digitised. For instance, while the volume of new job postings for marketing managers has increased notably (Figure 4.16) the profession has also changed qualitatively over time in the type of skills that are required, as will be discussed in the next subsection. It is fair to say that, with the advent of internet and of e-commerce, marketing roles have also become much more 'digital', as marketing activities have shifted from traditional channels (newspapers and traditional advertising) to the internet.

The growth in OJPs for HR professionals followed a similar pattern in both Alberta and Canada. These kinds of jobs have traditionally been classified as non-digital jobs that are tasked with for instance recruitment, employee development, performance management and employee retention. But these days, those aspects of HR increasingly use digital components (Mazurchenko and Maršíková, 2019_[15]). So while the tasks of HR professionals are for instance still to "select or help to select the most qualified applicants, develop, implement, evaluate, and administer a total rewards structure that includes compensation, pensions, benefits and employee assistance programs, and to define performance standards consistent

with the organisation’s mission, culture, environment, strategy and structure.” (ALIS, 2022^[16]), HR professionals make use of digital tools to perform them.

Figure 4.16. Trends in OJPs for HR and Marketing roles



Note: Polynomial trends calculated on the standardised index number of monthly OJPs in Jan 2015=100 for both Alberta and Canada for the period in between January 2015 and September 2022.

Source: OECD calculations based on Lightcast data.

The skill requirements found through the analysis of OJPs further demonstrates why these management, marketing and HR professions can now be considered digital occupations. In terms of qualifications, all occupations in this group typically require a bachelor’s degree, but rarely a bachelor’s in computer science.

Chief Information Officers / directors of IT are usually required to have strong managerial and strategic thinking skills but that those traits merge strongly with more technical skills. Agile management skills (i.e. practices that include requirements discovery and solutions improvement through the collaborative effort of self-organising and cross-functional teams) or Waterfall Development Process (i.e. the sequential development process that flows like a waterfall through all phases of a project such as analysis, design, development, and testing) are very relevant for Chief Information Officers along with the knowledge of Software Quality Assurance tools. IT project managers similarly need to have technical knowledge about software development technologies, principles and quality assurance, mixed with managerial skills.

Online marketing, web analytics, online advertisement skills as well as the software Pardot are among the top 5 most relevant skills for marketing managers and marketing specialists, signalling the key relevance of digital skills for these professions. Pardot, which changed its name to “Salesforce Marketing Cloud Account Engagement” in 2022, is an online marketing automation platform, which can for instance help their users to track customer behaviours and create digital marketing campaigns (Salesforceben.com, 2022_[17]).

Both types of HR professionals are required to know how to use SAP Successfactors, which is a cloud-based platform that has been developed to assist with human capital management (SAP Press, 2019_[18]). HR managers additionally need to possess non-technical skills such as employee relations and business consulting / strategy. While for human resources / labour relations specialists the knowledge of SAP SF is supplemented with needing to know Human resource management systems, PagerDuty and Ultipro. “Human resource management systems” is a general term that refers to any “*software applications that are used to store employee information and support various human resource functions* (SHRM, 2022_[19])”. UltiPro is a particular human resource management system, as is SAP Successfactors. By contrast, PagerDuty is a tool that alerts teams whenever incidents occur anywhere in their business process (Harris, 2017_[20]).

Table 4.4. Skill bundles of ICT and HR managers / marketing specialists

ICT and HR managers / marketing specialists	Skill 1	Skill 2	Skill 3	Skill 4	Skill 5	Typical qualification level demanded
Chief Information Officer / Director of IT	IT Management	Waterfall Development Process	Software Quality Assurance	Business Solutions	Budget Management	Bachelor's / BS in Computer Science
IT Project Manager	Software development methodologies	IT management	Software development principles	Software quality assurance	Waterfall Development Process	Bachelor's
Marketing Specialist	Online Marketing	Advertising	Web Analytics	Marketing Management	Online Advertising	Bachelor's
Marketing manager	General marketing	Media strategy and planning	Marketing strategy	Online marketing	Pardot	Bachelor's
Social Media Strategist / Specialist	Social media tools	Media strategy and planning	Online marketing	Sprout Social	Content development and management	Bachelor's
Human resources / labour relations specialist	Human resource management systems	PagerDuty	SAP Successfactors	Payroll services industry knowledge	UltiPro	Bachelor's
Human Resources Manager	Employee Relations	SAP Successfactors	Business Consulting	Employee Training	Business Strategy	Bachelor's

Note: Skills in the table's columns are ordered by their relevance for the occupation at hand. Skill relevance score are inferred by applying natural language processing (NLP) algorithms to the analysis of online job postings for Canada. The ranking is based on the cosine similarity between each skill keyword vector representation and the vector representation of the occupation (details are provided in Annex D).

Source: OECD calculations based on Lightcast data.

How quickly are digital skill demands permeating Alberta's workplaces?

Assessing how digital skill demands increase in intensity and diffuse across different occupations and sectors is key to understanding the speed by which the digital transition is changing workplaces and, in turn, key to anticipating future possible bottlenecks and shortages in the labour market. Digital skills might be crucial for the digital occupations in the four groups that were just discussed, but increasingly they have also become important in many more jobs that are not traditionally digital occupations.

The granularity of the information contained in OJPs allows to pin down where and when specific digital technologies have been demanded by employers and to understand whether those technological demands are spreading from narrow sets of occupations to an increasing number of sectors and workers. When discussing the speed of diffusion of digital skill demands, for instance, it is evident that the knowledge of how to use social media, spreadsheets or even email was not mainstream 10 to 15 years ago. Nowadays, instead, a vast majority of workers (regardless of the sectors they are employed in) are familiar with at least some of these digital technologies and use them in their jobs.

To put it differently and making a broad example, the frequency and the importance/relevance with which the knowledge of digital spreadsheets (for instance MS Excel) is required by employers has not only increased in its absolute frequency (i.e. the number of times it is mentioned) but it is also, and perhaps more importantly, required in a wider range of different jobs from the service sector (i.e. to handle requests from customers) to manufacturing (i.e. to analyse shipping of products) up to the healthcare sector (i.e. to keep track of patients' records). The digital landscape is changing fast and many digital technologies that were 'niche' just some years ago, are now starting to permeate a wider range of jobs across different sectors.

The analysis below uses machine learning indicators (see Box 4.1) to crunch the information contained in OJPs to track the speed by which different types of (digital) skill demands have been spreading across occupations in the Alberta's labour market over the period in between 2015 and 2022.

As labour markets evolve rapidly, the intensity of skill demands changes over time. Each skill analysed in the database of online job postings may increase its diffusion across workplaces (if it is mentioned in a wider variety of jobs) or decrease it (if it is mentioned in a narrower set of jobs). The measure of speed of diffusion for digital skills presented below is an index of the diffusion of the skill at hand compared to average speed of diffusion across all skills analysed in the data. This empirical approach allows, for instance, to assess whether (and how much) a specific digital skill (say social media) has been diffusing faster than the average skill.

Box 4.1. Assessing the pace of the digital skill demands diffusion using machine learning

The text contained in online vacancies can be fed to NLP algorithms that transform the semantic information contained therein into mathematical vectors that can be understood and analysed by a machine (see Annex C). Those mathematical vectors (which are meant to retain the meaning of the words they represent) occupy a specific place in a mathematical high-dimensional space, this latter commonly referred to as a ‘graph’.

It is then possible to assess when vectors in a graph are connected with each other (when keywords co-occur in a specific job vacancy) or disconnected (when they never co-occur in the same vacancy). In graph theory, the “eigenvector centrality” and the “local clustering coefficient” are two measures that are commonly used to assess the influence of a node in a network or, in other words, to measure the degree and quality of connections of a keyword with the rest of words in the text under exam.

Originally, these measures were developed by researchers in Google and used in the PageRank algorithm to quantify the importance of the connections among web pages based on the textual/semantic information contained in it. The same measures can, however, be used to capture the number of connections that a skill keyword has with other skills as well as the ‘quality’ of those connections across job postings, where higher-quality connections are those with other skills that are also highly connected to the rest of the skills across job requirements. This paper uses the linear combination of the eigenvector centrality and the local clustering coefficient (see Annex D) to measure how well-connected (i.e. pervasive) each skill is in the labour market in a specific point in time. This, in turn, allows to calculate the change in the extent of such connections over time (i.e. the “diffusion index”), and to unveil whether a certain skill has become more or less connected (i.e. more or less pervasive) during the period under exam. These measures are used to indicate whether skills are diffusing across jobs and at what speed.

Source: OECD (2022^[1]), Skills for the Digital Transition: Assessing Recent Trends Using Big Data, <https://doi.org/10.1787/38c36777-en>.

The diffusion of the demand for Advanced Data Analysis skills

In the last decade, the use of interconnected devices, the expansion of e-commerce and of the use of internet led to the creation and exponential collection of data at a large scale. Every day, humanity generates an incredible two and a half quintillion bytes of data (OECD, 2022^[1]) where Google alone processes more than 20 petabytes of data, which includes around 3.5 billion search queries. These already astonishing figures are poised to increase in the future as more and more digital devices connect to the internet.

It does not come as a surprise, therefore, that firms and businesses consider data (and their analysis) a source of extraordinary value. In order to make the most of such wealth of information, new digital professionals are increasingly tasked to make sense of large sets of information and “advanced data analysis skills” such as big data, machine learning, data science and visualisation have been on the rise in the demand of employers across different sectors. Analyses based on survey of employers carried out by ICTC in Alberta confirms that the majority of Albertan’s businesses interviewed expressed the expectation of a substantial scale-up in the adoption of digital technologies, accelerating demand for digitally-skilled workers such as data scientists (Cutean and McLaughlin, 2019^[6]).

Figure 4.17 tracks the intensity with which advanced data analysis skills have been required over time in a wide range of different occupations over the period in between 2015 and 2022. Results in Figure 4.17 indicate that the demand for advanced data analysis skills has been diffusing across Alberta’s occupations

and sectors up to 4.6 times faster than the demand for the average skills, signalling that the demand for these skills has increased in a broad range of job roles across Alberta's workplaces.

The demand for data science and machine learning skills has spread particularly fast in Alberta's labour market, diffusing at a speed that is almost 5.6 times faster than the demand for the average skill. Notably, the knowledge of data science entails the use of mathematical methods, processes, algorithms, and information systems to extract knowledge and insights from noisy, structured and unstructured data. Data science, hence, is at the core of the development of artificial intelligence (AI), one of the priorities in Alberta's digital strategy in 2019, and it leverages algorithmic techniques to analyse data and produce outputs that mimic human intelligence.

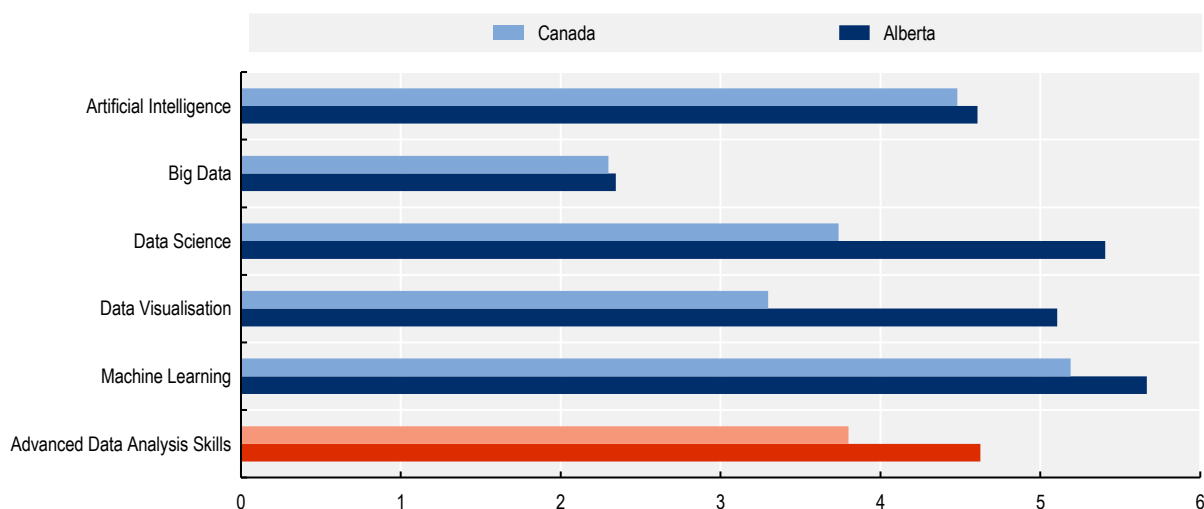
In addition, it is noted that data science is becoming prominent in a variety of different sectors, and notably, that digital occupations within the healthcare sector are forecasted to grow substantially over the next years. Employers in Alberta expect that the increase in demand for roles like data scientists will be intertwined with the emergence of technological developments and the milestones among key subsectors like health tech and biotech. In this context, data visualisation skill demands have also been spreading fast in Alberta, diffusing around 5 times faster than the average skill demand. These results suggest the increasing importance of being able to summarise and provide context to the large volume of data that firms are constantly ingesting so that managers and businesses in general can understand complex patterns and take informed decisions based on the visualisation of large amounts of information.

The rapid adoption of AI in the workplace (in Alberta the speed of diffusion is more than 4.6 times faster than the average demand for skills) also creates the potential of productivity gains, which this technology can bring to firms and society but also fears that workers may be significantly displaced in their jobs and obliged to face painful transitions to different roles. In recent years, a lively debate has emerged as to whether AI should be treated differently from 'traditional' automation technologies that perform narrow routine tasks.

Several commentators argue that AI, differently from more traditional automation technologies, is making significant progress in replicating a particular aspect of intelligence, namely 'prediction', this latter being central to decision making and an essential aspect of high-skilled jobs in the healthcare or business sector. New examples, showing the ability of AI to perform such tasks, are being developed at a fast pace. GPT-3 is, for instance, one of the most sophisticated AI-powered Natural Language Processing (NLP) algorithm to this date. The current version of GPT-3 (Chat GPT) is able to answer complex medical questions and to correctly identify a disease from the simple description of its underlying symptoms, even suggesting the necessary treatment for the disease at hand. Notably, GPT-3 capabilities are transversal, ranging from its ability to write new software code to that of programming mobile applications or to autonomously produce poems and journal articles when prompted with a few lines of text (OECD, 2022^[1]).

The recent narrative underlines that the increasing ability of machines to perform cognitive tasks as effectively as humans is poised to have an enormous impact on the way services are delivered, products are manufactured and innovation itself is created. This poses several challenges for countries, policy makers and workers. One major challenge stems from the need for individuals to develop adequate digital and cognitive skills to interact with AI. AI, in fact, does not operate in a vacuum and much of its potential is determined by how well humans are able to interact with it by supplying the correct inputs and understanding the outputs that are produced in return. Similarly, individuals will need to be trained on how to detect biases, fakes and mistakes that could result from the misuse of AI. In the context of Alberta, the rapid adoption of AI across workplaces calls for careful monitoring of how this technology will reshape the demands for workers and skills across workplaces. It is imperative for professionals to be educated on ethics in data governance, analytics and AI technologies. While benefits are largely expected for Alberta's society and economy, policy makers will need to support individuals, in particularly those with low digital skills, to develop digital-relevant skills that enables them to interact with AI-powered technologies.

Figure 4.17. The speed of diffusion of advanced data analysis skill demands in Alberta and Canada



Note: Values on the horizontal axis represent the speed by which the examined skill has been diffusing in the overall labour market (captured by online job postings) relative to the average skill. A value of 5, for instance, means that the examined skill has been diffusing 5 times faster than the average. The speed of diffusion is calculated using the eigenvector centrality and local clustering coefficient measures as detailed in Annex D.

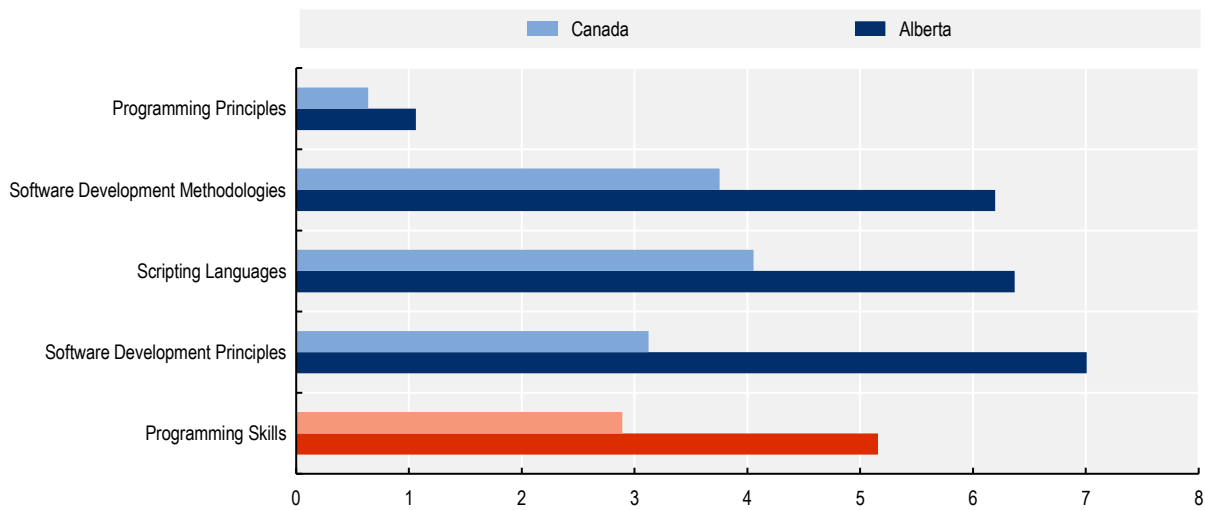
Source: OECD calculations based on Lightcast data.

The diffusion of the demand for Programming skills

Programming skills encompass a variety of different aspects related to the creation, management, and use of software code (OECD, 2022^[11]). Among the skills grouped under this label, results in Figure 4.18 analyse the speed of diffusion of skills demands in specific areas:

1. programming principles (i.e. the basic principles of programming),
2. software development principles (i.e. the set of recommendations that engineers should follow during programme implementation to write clear and maintainable code),
3. software development methodologies (i.e. the processes used in software development that define the strategies and phases used to organise and write the software code, encompassing different approaches such as Agile, Waterfall or Lean),
4. scripting languages skills (i.e. the knowledge of specific computer languages that can be used to give instructions to other software, such as a web browser, server, or standalone applications as many of today's most popular coding languages are scripting languages, such as JavaScript, PHP, Ruby, Python, and several others)

Figure 4.18. The speed of diffusion of programming skill demands



Note: Values on the horizontal axis represent the speed by which the examined skill has been diffusing in the overall labour market (captured by online job postings) relative to the average skill. A value of 5, for instance, means that the examined skill has been diffusing 5 times faster than the average. The speed of diffusion is calculated using the eigenvector centrality and local clustering coefficient measures as detailed in Annex D.

Source: OECD calculations based on Lightcast data.

Results in Figure 4.18 show that the demand for scripting languages skills permeated Alberta's labour market more than six times faster than the average skill demand in the period between 2015 and 2022. Similarly, skills demands in the area of software development principles and software development methodologies diffused across occupations and job roles up to 7 and 6.2 times faster than the average skill demand. While the demand in the area of programming principles seems rather limited compared to the other skills, it is still permeating the labour market one time faster than the average skill. These results are in line with the expectations of employers in Alberta. Surveys of Albertans businesses (ICTC) indicate, for instance, that Software developers are at the top of the in-high demand occupations, with more than 60% of employers reporting shortages for these professionals (Cutean and McLaughlin, 2019^[6]). Such demand is not concentrated in a narrow sector, but it is reported to have spread across a variety of sectors, including- notably- healthcare. In particular, surveys run by ICTC indicate that key changes ranging from electronic file management to AR/VR assisted remote surgeries, and even advancements in the biotech sector are spurring the demand for digital professionals, notably including software developers. These professionals are also expected to grow in demand in clean-tech sector (43% of employers interviewed rank software developers in high demand) but similar (or even more severe) shortages are reported in the digital media industry (Cutean and McLaughlin, 2019^[6]).

All in all, it is clear that both programming skills and advanced data analytics skills are rapidly gaining importance in both the Albertan and Canadian labour market. Of course, these skill sets are just snapshots of the larger digitalisation movement, but the fact that both these skill sets are diffusing five times faster than the average skill can be seen as evidence that digital skills are in high demand for many kinds of jobs within all kinds of different sectors.

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Notes

¹ The groupings are stem from the OECD publication *Skills for the Digital Transition: Assessing Recent Trends Using Big Data* (OECD, 2022_[11]) and are expanded for this report.

² These fall under the six-digit SOC category of web developers.

³ The period in between March 2020 and December 2020 is here considered the peak of the pandemic consistently with the recovery in total employment experienced in 2021 (see Figure 1.1 in Chapter 1). Data on OJPs show that, by January 2021, the volume of job postings in Canada recovered to its pre-pandemic levels and that the most intense impact of the crisis was felt in between March and December 2020 (see Figure 1.2 in Chapter 1).

⁴ The skill relevancy scores are calculated following the methodology that is explained in Annex C.

⁵ TensorFlow is an open-source platform that allows to operate machine learning and artificial intelligence in a variety of different contexts.

⁶ Included in the NOC 2173, Software engineers and designers.

5 Insights on the challenges faced by youth in Alberta

This chapter explores Alberta's youth labour market by focusing on youth-accessible online job postings (YAPs). YAPs are identified using text-mining techniques applied to job postings that contain specific key words in the job title, like trainee or intern, or that require a maximum experience of one year or less, signalling that youth should be able to apply for these positions. The chapter examines the evolution of YAPs over time, highlighting changing trends. The chapter investigates YAPs across various sectors and career areas, revealing where the opportunities for young individuals may be found. The chapter analyses the required qualifications and degree requirements found in YAPs, and provides insights on what contract types are typically offered to youth. It delves into the transversal and technical skills demanded in the main career areas for youth, identifying the key competencies needed for success. Career transition and retraining pathways are also discussed, outlining potential routes for career advancement and skills development.

Highlights

- The dual shock of the COVID-19 pandemic and the collapse in oil prices in March and April of 2020 severely impacted the province's labour market. This shock was even more pronounced for young Albertans, resulting in an average rate of youth unemployment of 24% in 2020, an increase of 11 percentage points with respect to the average for 2019 (12.6%). More generally, youth unemployment rates in Alberta have been typically above those for Canada as a whole, signalling the importance to develop strategies to ease youth's transition from school to work.
- Leveraging thousands of OJPs advertised in Canada and Alberta, results in this chapter suggest that the pandemic had a disproportionate impact on the demand for jobs accessible for youth, likely due to a higher representation of young people in industries heavily affected by the COVID-19 crisis. However, the demand for youth-accessible jobs started to recover as the economy reopened.
- The main sectors offering jobs for youth are retail trade; mining, oil and gas; professional activities and construction. The retail sector saw an expansion of demand for entry-level positions in 2016 and 2017 while the demand for youth-accessible jobs in the construction sector has consistently grown at a higher rate than the rest of the labour market, indicating strong demand for young workers in recent years.
- The recent expansion in the Alberta's labour-market demand for young workers, is characterised by a significant increase in job postings requiring a high-school or no diploma. The demand for workers in typically low-skilled career areas (i.e. construction or maintenance or repair and installation) has experienced significant growth. However, this result may also respond to the shortage of qualified workers and the need for employers, who are willing to hire, to relax some of the strict education requirements in their job offers. Among the largest career areas with the strongest demand for youth there are sales, education and training and engineering.
- A mix of technical and transversal skills are sought by employers hiring young workers. Among the transversal ones, organisational and problem-solving skills are particularly relevant across a variety of career areas. Technical skills, however, heavily depend on the career area. Accounting and finance software skills are important for jobs in finance, while the knowledge of MS office and productivity tools are particularly relevant in education and training careers. Knowledge of drafting and engineering design are key in engineering careers.

Youth labour market in Alberta after the pandemic

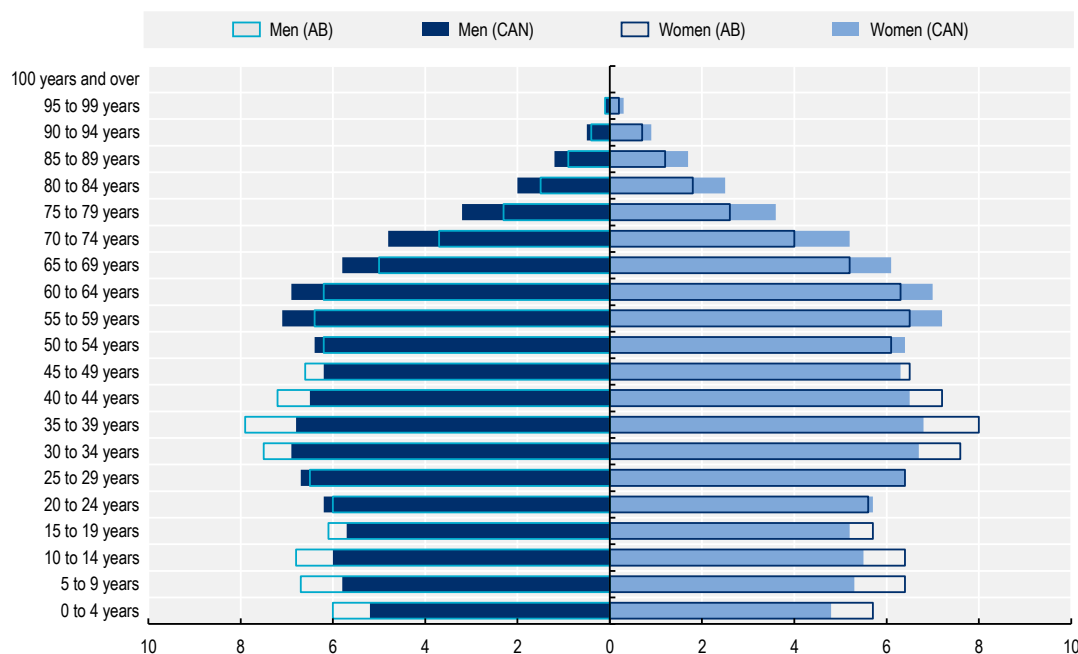
Young people have been particularly affected by the COVID-19 shock across the world. Youth unemployment¹ surged dramatically in OECD countries at the beginning of the pandemic, with hours worked by young people decreasing by 26%, almost twice as much as the observed decrease for prime-aged and older workers (15%) (OECD, 2022_[1]). Although most of the lost ground has been recovered during the last two years, the recovery of young people's employment lags behind that of older adults. The disruption in school-to-work transition programs, such as apprenticeships and work-based learning, due to the economic uncertainty and financial difficulties faced by employers, has made it harder for young people to transit from education to the labour market in recent years (OECD, 2022_[1]).

The challenges faced by youth in the current context are of particular relevance for Alberta as it is the Canadian province with the youngest population with a median age of 38 years (in the country as a whole

the median age reaches 42 (Statistics Canada, 2022^[21]). Some 31% of Alberta's population is aged 24 years or below, while this share for Canada as a whole is, on average, nearly 28% (Figure 5.1).

Figure 5.1. Population distribution in Canada and Alberta – 2021

Share of population per age cohort and gender in Canada (CAN) and Alberta (AB)



Note: According to Statistics Canada, "gender refers to an individual's personal and social identity as a man, woman or non-binary person (a person who is not exclusively a man or a woman). [...] Given that the non-binary population is small, data aggregation to a two-category gender variable is sometimes necessary to protect the confidentiality of responses provided. In these cases, individuals in the category "non-binary persons" are distributed into the other two gender categories".

Source: Statistics Canada (2022^[3]), 2021 Census of Population. <https://www12.statcan.gc.ca/census-recensement/2021/dp-pd/prof/index.cfm?Lang=E> (accessed 6 July 2023).

As pointed out in Chapter 1, the dual shock of the COVID-19 pandemic and the collapse in oil prices in March and April of 2020 severely impacted the province's labour market. This shock was even more pronounced for young Albertans. The labour force participation rate for people aged 15 to 24 decreased severely at the onset of the pandemic from 65% in February 2020 (its average level since 2017) to 49% in April 2020 (Statistics Canada, 2022^[41]). This sudden reduction in the share of young people participating in the labour market (-16 percentage points) was larger than that for the country's average (-13 percentage points) in the same period, suggesting more challenges for Alberta's youth to remain in the labour market amid the pandemic. Despite a sharp recovery – the youth participation rate was about 64% in October 2020 – it still remained below the pre-pandemic levels up until the beginning of 2022.

Youth unemployment in Alberta peaked at 30.9% in May 2020, a figure that is more than double the rate in February 2020 (14.4%). High youth unemployment persisted through 2020 as shown by the average youth unemployment rate of 24% for the year, which represents an increase of 11 percentage points respect to the average for 2019 (12.6%). In the same period, the average unemployment rate for the population in Alberta aged 25 or over increased 3.5 percentage points, from 6.1% in 2019 to 9.6% in 2020 (Statistics Canada, 2022^[41]). This result partly responds to a higher representation of young people in sectors highly affected by the pandemic (e.g. retail trade or accommodation and food services), as well as

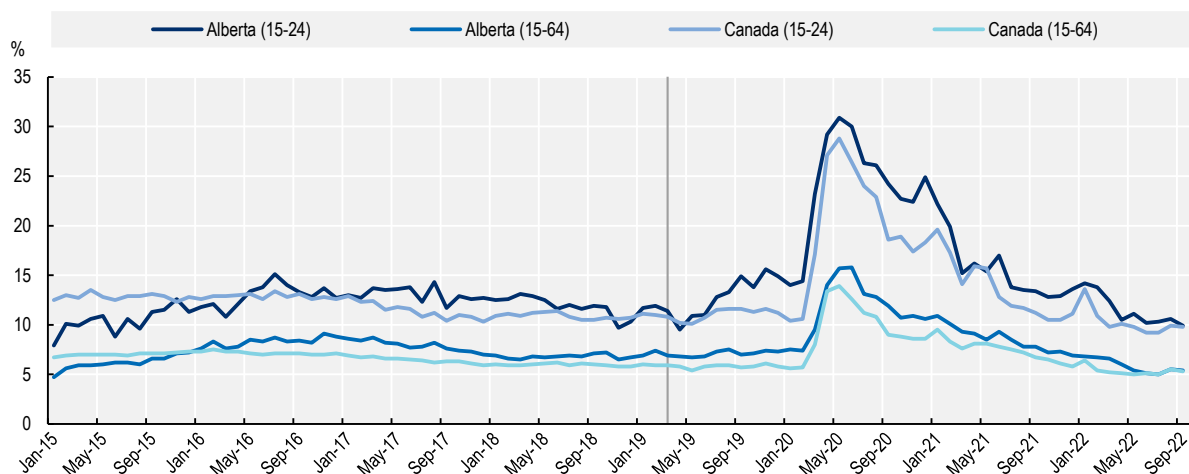
because young people are often the first workers to be laid off when companies need restructuring (Statistics Canada, 2021^[51]).

While the pandemic has certainly represented an unprecedented negative shock to Alberta's labour market, the total and youth unemployment rates in Alberta have been typically above those for Canada as a whole since January 2016 (see Figure 5.2). Notably, the unemployment rate for Albertans aged 15 to 24 significantly deteriorated even before the start of the pandemic, going from 11% in June 2019 to 15% in December 2019.

The relevance of the mining, oil & gas extraction sector in the province's economy – representing nearly 27% of the annual GDP of Alberta (Government of Canada, 2022^[61]) – can contribute to explain this result. Recent evidence about the dependence of Alberta's employment on oil prices volatility shows that the employment in oil & gas, professional services, construction, and accommodation and food services is especially sensitive to oil price fluctuations (Scheer et al., 2022^[71]). Consequently, low global oil prices in 2019 could have contributed to the surge in youth unemployment in key sectors for Alberta's employment generation, such as accommodation and food services and construction (along with retail trade they are the top youth employers in the period 2015-2022).²

Figure 5.2. Unemployment rate per age cohort and area

Percentage of labour force – seasonally adjusted



Note: The vertical line reflects the declaration of COVID-19 as pandemic (March 2020).

Source: Statistics Canada (2022^[81]), Table 14-10-0287-01, Labour force characteristics, monthly, <https://doi.org/10.25318/1410028701-eng>.

In this context, designing effective ways to support youth to transition from school to work is a priority. Amid a rapidly ageing population, youth represent an untapped pool of new talent struggling to find good quality jobs. Since the length and quality of the schooling that individuals receive is one of the factors directly affecting the school-to-work transition, it is fundamental for education systems to ensure that individuals can build the skills that are currently needed in the labour market by firms and employers.

However, many analyses aiming to support youth to transition from school to work have been focusing on the supply side of education addressing, for instance, issues related to the quality of education as a driver for smoother transitions. On the contrary, analyses of the demand side, focusing on the availability of jobs for young people and their main characteristics (i.e. the demand for skills, education, experience in jobs that are plausible for younger people) are relatively scarcer and tend to be outdated and too aggregated

for policy makers and stakeholders to receive timely and granular insights that supports policies and innovations in this front.

Online job postings (OJPs)³ can provide insights about current demands of occupations and skills in Alberta, with a particular emphasis on those jobs that are more accessible for young people with little or no work experience.

Tracking Alberta’s demand for youth workforce using OJPs

Leveraging thousands of OJPs advertised in Canada and Alberta between January 2015 and September 2022, this chapter focuses on identifying those job postings that are more plausible to be offered to young people either because they are part of school-to-work transition programs or because the experience required is low. The granularity of the data allows for tracking the labour market demand that is more accessible to the youth workforce and to identify the sectors and occupations where most of those positions are advertised, their accompanying skill demands, and the conditions offered (i.e. full-time or part-time), among other characteristics.

Classifying youth-accessible online job postings

Identifying job postings accessible to people aged between 15 and 24 years represents a significant challenge since OJPs do not include information that directly signals that a job is specifically looking for people in a determined age range. In order to achieve this result, this chapter develops a classification rule based on two complementary criteria, exploiting i) the information contained in the job title of each job posting and ii) the maximum work experience required in the description of the job posting.

First, using job titles, this chapter selects OJPs that contain keywords associated with jobs that are likely to be accessible (or targeting) young people such as entry-level programmes. For instance, OJPs including, in any part of the title, at least one keyword such as “Student”, “Trainee”, “Traineeship”, “Apprentice”, “Apprenticeship”, “Intern”, “Internship”, “Co-op” (from co-operative education), “Graduate” or “Entry Level” have been classified as youth-accessible jobs.⁴ A description of these programmes is provided in Box 5.1.

As a complementary criterion, this rule also selects, from the remaining OJPs, those job offers explicitly seeking people with a maximum experience of one year or less. Explicitly mentions of a maximum number of years of experience in an OJP can be a strong signal from employers that they are looking for low-experienced, and likely young, individuals for entry-level positions.⁵ For simplicity, from now on, the OJPs selected in the steps above will be named YAPs (youth-accessible postings).

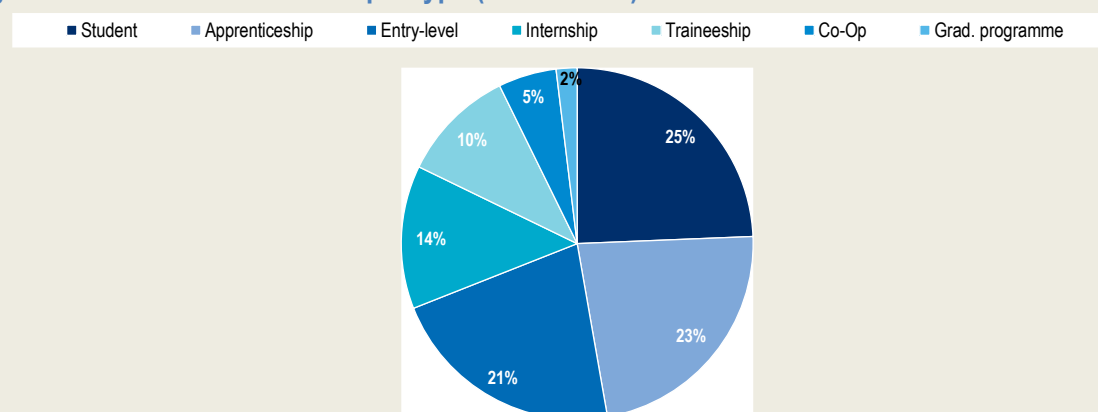
Box 5.1. Types of school-to-work transition programmes for classifying in YAPs

The keywords considered in this chapter to select youth-accessible postings refers to programmes or learning strategies aiming to ease the transition from school to work. Since differences between these programmes can be very specific, this box aims to provide a description of them:

- **Apprenticeship:** Long-term training programmes aimed at building practical abilities to perform specific skilled jobs. Apprenticeships build knowledge by applying skills directly to the work under the guidance of experience employees. Apprenticeships can be an alternative to or complementary to formal education (i.e. college careers) often allowing people to earn credits toward a degree.
- **Internship:** A temporary (often seasonal) opportunity to learn the context in which an industry, role or company operates. Internships allow individuals to explore employees' responsibilities and roles while performing supportive tasks. As interns are typically still in college or high school when they finish their internship, these programmes are usually part-time.
- **Traineeship:** One-or-two-years programmes focus on developing general skills for young professionals (typically between 16 and 24 years). Unlike apprenticeships, they allow individuals to explore a wider range of roles inside the company. They also differ from internships since they are aimed at people who already graduated or are in final stages of their studies.
- **Co-operative Education (Co-op):** A programme for combining formal education and work experience during the time in school. Co-op programs can alternate classes and full-time work by semesters or can offer classes and part-time work in parallel. They usually imply that a person works for long periods (years) in the same company. Responsibilities can increase as studies progress.
- **Other categories:** Other categories include **student** positions (monitor, assistant, etc.), **graduate programmes** (scheme similar to internships but focus on individuals with tertiary degree) and **entry level** positions (jobs designed for recent graduates that typically do not require prior experience).

Figure 5.3 shows the distribution of these programmes in the total amount of YAPs in Alberta between 2015 and September 2022. Student positions and apprenticeships accounts for 48% of YAPs.

Figure 5.3. Distribution of YAPs per type (2015 – 2022)



Source: OECD calculations based on Lightcast data.

Source: Online sources including (Indeed, 2022^[9]), (Indeed, 2021^[10]), (ApprenticeshipUSA, 2022^[11]) and (Indeed UK, 2022^[12]).

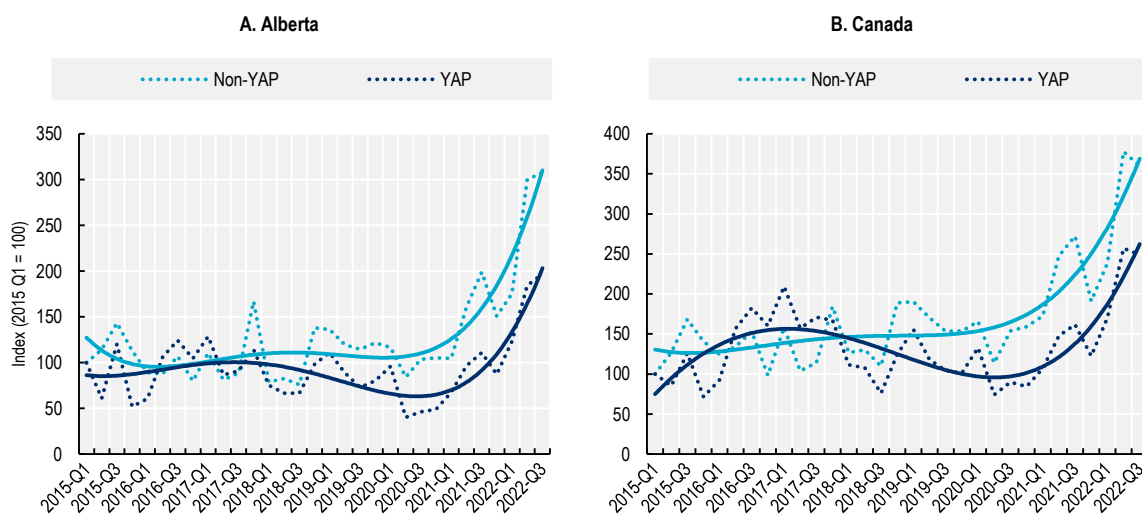
Tracking youth-accessible postings in Alberta

The labour-market demand in Alberta and Canada, tracked by the quarterly amount of OJPs advertised, shows a divergence in trends between YAPs and non-YAPs during the period preceding the pandemic (2015-2019). Whilst non-YAPs remained stable in this period, youth-accessible postings increased in 2016-2017 but started a decreasing trend in 2018 that extended until late 2020 (Figure 5.4). Notably, however, the large shock to labour markets induced by the pandemic led to an inversion in this trend. Both YAPs and non-YAPs in both Alberta and Canada started to grow positively in 2021-Q1 as the Canadian and Albertan economies started to recover the lost ground during the pandemic, boosted by a strong household demand and higher oil prices.

The different trends of YAPs relative to the rest of OJPs in the pre-pandemic period can be attributed to two reasons. On the one hand, during 2016 and 2017, the demand for YAPs in some sectors in Alberta (i.e. retail trade) increased significantly while non-YAPs remained stable (Figure 5.6, Panel A). This sector-specific trends contrast with the overall economic situation in the province, as GDP shrunk by 3.6% in 2016 following a negative shock in oil prices in 2014 and 2015.⁶ In that year, unemployment worsened as most of the economic sectors saw a marked loss of jobs, with the notable exception of key sectors for youth employment, such as retail trade and educational services (Statistics Canada, 2022^[4]), which, instead, expanded the demand for YAPs.

Figure 5.4. Evolution of youth-accessible postings

YAPs aggregated at a quarterly level. Standardised index (dotted line) and trend (solid line)



Note: Polynomial trends calculated on a standardised index (Q1 2015 = 100) for the quarterly count of job postings. This index shows the evolution in the demand for a given profession or group of professions in comparison to this quarter.

Source: OECD calculations based on Lightcast data.

On the other hand, YAPs advertised in Alberta in 2019 remained below 2015 levels, while the rest of online job postings passed that threshold in the same year. This divergence can be traced back to differences in employment creation across main sectors and the importance of youth employment on each of them. Specifically, the healthcare and social assistance sector – the top employer in Alberta – led the employment creation in the province for 2019, offsetting the job losses in the construction and oil and gas sectors (Government of Alberta, 2020^[13]). This dynamic, however, did not fully apply for youth employment. The construction sector, for instance, experienced a significant decrease in youth employment (Statistics Canada, 2022^[4]), as well as in the number of YAPs (Figure 5.6, Panel D), which is partially associated to

uncertainty about oil prices and investment decisions in the oil sector that affected both residential and non-residential construction subsectors (BuildForce Canada, 2020_[14]). This decrease was nearly five times higher than the youth employment increase in the healthcare sector (Statistics Canada, 2022_[4]).

More recently, the COVID-19 pandemic represented a major shock for YAPs in Alberta. Figure 5.4 (Panel A) shows that the province's YAPs between 2020-Q2 and 2020-Q4 represented less than half the number of YAPs in 2015-Q1, the lowest levels since that date, while non-YAPs showed a more moderate decrease. These results suggest that the pandemic disproportionately impacted the demand for jobs more accessible for youth, most likely due to a higher representation of young people in industries heavily affected by the COVID-19 crisis, as pointed out in different studies (OECD, 2021_[15]) and (Statistics Canada, 2021_[5]).

Alberta's labour market rebounded after the 2020 crisis. As the economy reopened, the unemployment rate started declining and by July 2022 it reached the lowest levels in recent years (Figure 5.2), signalling a strong recovery as well as increasing pressures to find new talent. Figure 5.4 shows an unprecedented increase in the amount of both YAPs and non-YAPs positions with the volume of OJPs in Alberta for 2022-Q3 representing three times the volume in 2015-Q1. In addition, the recent spike in oil prices, as a consequence of the global energy crisis, has likely contributed to the recovery of labour market's demand.

Youth-accessible postings across economic sectors

The overall trends of jobs accessible for youth in Alberta depend, to some extent, on differences in the demand across economic sectors. Figure 5.5 and Figure 5.6 provide an in-depth analysis of the demand across the sectors that show the highest average number of YAPs in the province between 2015 and 2022.

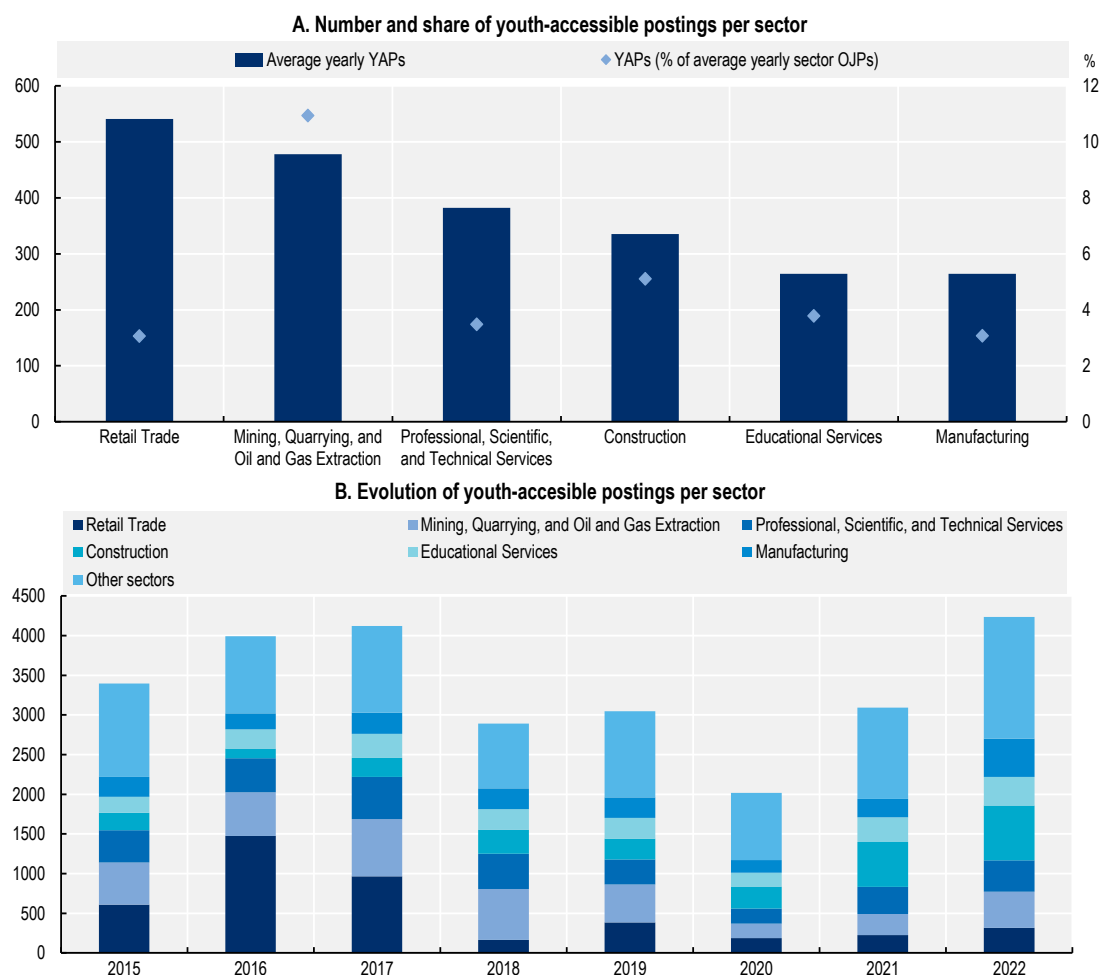
Retail trade is the top youth employer in Alberta according to official employment figures (Statistics Canada, 2022_[4]), which is confirmed by the analysis of OJPs as the sector accounts for approximately 16% of the YAPs. The demand for youth-accessible jobs in retail trade experienced a significant increase in 2016 and 2017, with YAPs in the second semester of 2016 representing nearly three times those advertised in the first semester of 2015 (Figure 5.6, Panel A). This result is in line with expansion plans from key employers in the sector, as some of the YAPs advertised in this period are from companies that reportedly made investments and generated a large number of jobs across Canada in these years (see Newswire Cision (2016_[16])). After the pandemic, both YAPs and non-YAPs in retail trade have increased consistently with the strong demand shown in Alberta's labour market. However, this increase has been stronger in non-YAPs, while YAPs remain below the levels seen in 2015.

The oil and gas industry is a significant source of youth-accessible employment opportunities, ranking second in importance in Alberta. The sector accounts for approximately 14% of youth accessible postings (as shown in Figure 5.5, Panel B). The demand for both YAPs and non-YAPs has been affected by recent oil price fluctuations. Both saw a substantial rise in the first half of 2021 (Figure 5.6, Panel B) due to a rebound in international prices as the economy recovered post-pandemic and the impact of the global energy crisis. However, YAPs in Q1 2022 were only slightly higher than in early 2015 (when Alberta's oil and gas sector faced the 2014-2015 oil price shock), while non-YAPs in the same period were nearly 2.5 times the level seen at the beginning of 2015.

Vacancies in both YAPs and non-YAPs have risen, and employment figures show that the oil and gas sector saw a significant increase in total employment in 2021 and 2022, reaching levels seen in 2019. However, youth employment has not kept pace and remains lower compared to employment in other age cohorts (Statistics Canada, 2022_[4]). This mismatch between youth employment and demand, as indicated by the number of YAPs relative to employment figures, reinforce the claims of reported shortages in the sector. Companies are facing difficulties hiring and retaining employees, particularly for entry-level positions, leading to declined projects and recruitment from other provinces (Government of Canada, 2022_[17]).

Figure 5.5. Youth-accessible postings per economic sector (2015-22)

Economic sectors with the highest number of YAPs



Note: The economic sectors selected represent nearly 70% of the YAPs including this information. 18% of the job postings classified as YAPs do not include information about the economic sector. Data is available until 22 September.

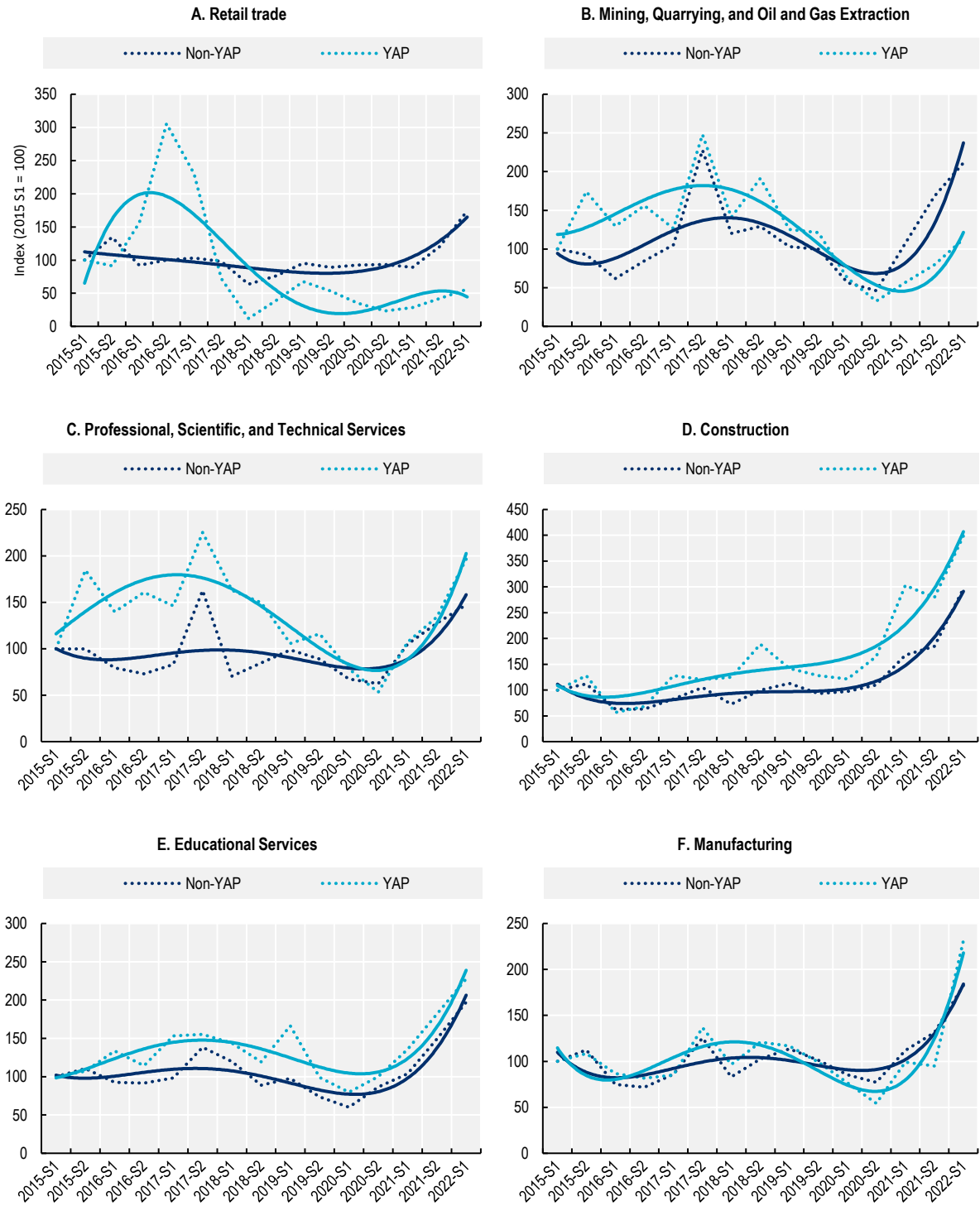
Source: OECD calculations based on Lightcast data.

Construction is one of the most important employers of young people in Alberta. This sector accounts for nearly 9% of all employees aged 15 to 24, according to official statistics (Statistics Canada, 2022^[4]). Similarly, YAPs in this sector represented almost 10% of the total number of youth-accessible job postings advertised in the province during 2015 and 2022. In contrast with most of the other sectors, YAPs in construction have consistently grown at a higher rate than the rest of OJPs since the first semester of 2017 (Figure 5.6, Panel D), suggesting a strong demand for youth workforce in recent years.

As previously mentioned, the decrease in YAPs in 2019 was associated with poor youth employment outcomes in the construction sector due to high oil price volatility and uncertainty that affected both residential and non-residential projects (BuildForce Canada, 2020^[14]). However, after the COVID-19 pandemic, OJPs in construction experienced unprecedented growth. YAPs in the first half of 2021 for the construction sector were four times higher than in early 2015, while non-YAPs were about three times higher. This contrasts with modest increases in youth employment in the sector in recent years, which have, instead, remained below 2019 levels. This suggests that workforce shortages have limited the growth of youth employment in the construction sector despite strong demand.

Figure 5.6. Evolution of YAPs in selected sectors

YAPs aggregated at a semester level. Standardised index (dotted line) and trend (solid line)



Note: Polynomial trends calculated on a standardised index (2015 S1 = 100) for the biannual count of job postings. This index shows the evolution in the demand for a given profession or group of professions in comparison to this quarter.

Source: OECD calculations based on Lightcast data.

Overall, most of the top-six sectors with the highest number of youth-accessible postings show unprecedented increases after the pandemic in Alberta's labour-market demand as high energy prices have played a significant role in strengthening economic recovery (Government of Canada, 2021^[18]). In the short term, labour shortages could continue to represent a challenge for Alberta's employment and economic growth, as it was in 2022 (Government of Alberta, 2022^[19]).

In the medium term, the link between oil prices and the labour market could imply major challenges for the province's labour market. Since the transition out of non-renewable energies have emerged as a priority in the global agenda, a decreased and more volatile global oil demand is likely to put jobs across different economic sectors on risk (Scheer et al., 2022^[7]). This is particularly relevant for Alberta's youth that will face this transition in the next years. In that sense, it is paramount to support programs to ease the transition away from oil-dependence. For instance, plans aiming to build transversal skills in youth for strengthening individuals' resilience to change (i.e. cognitive, communication and organisational skills) can contribute to more successful reskilling programs in the future.

Characterising Alberta's potential demand for youth workforce

The previous section addressed the evolution in the demand for YAPs in Alberta suggesting the existence of important dynamics over time and key differences across economic sectors. This section aims to explore in greater detail the information provided in the full text of OJPs, using this rich information to characterise the professional profile required by enterprises when advertising a youth-accessible postings. For this purpose, this section explores the qualifications and degrees that are generally more required by employers across all the profiles posted online, and the type of contracts offered by companies hiring youth. This section also provides a full analysis of the skill bundles typically required in YAPs to characterise what types of skills are demanded in jobs that are accessible to youth in Alberta.

The evolution over time of YAPs by required qualifications and degrees

The composition of required qualifications and degrees in Alberta's YAPs does not differ significantly from the results for the total amount of OJPs in the province (shown in Figure 1.4 in Chapter 1). Figure 5.7 shows that job postings requiring a bachelor or college degree as a minimum qualification represented, on average, 50% of YAPs in Alberta for the period preceding the pandemic (2015-2019), while 41% of them required high school education.⁷ Approximately 5% of YAPs were seeking for a candidate with at least master's degree.

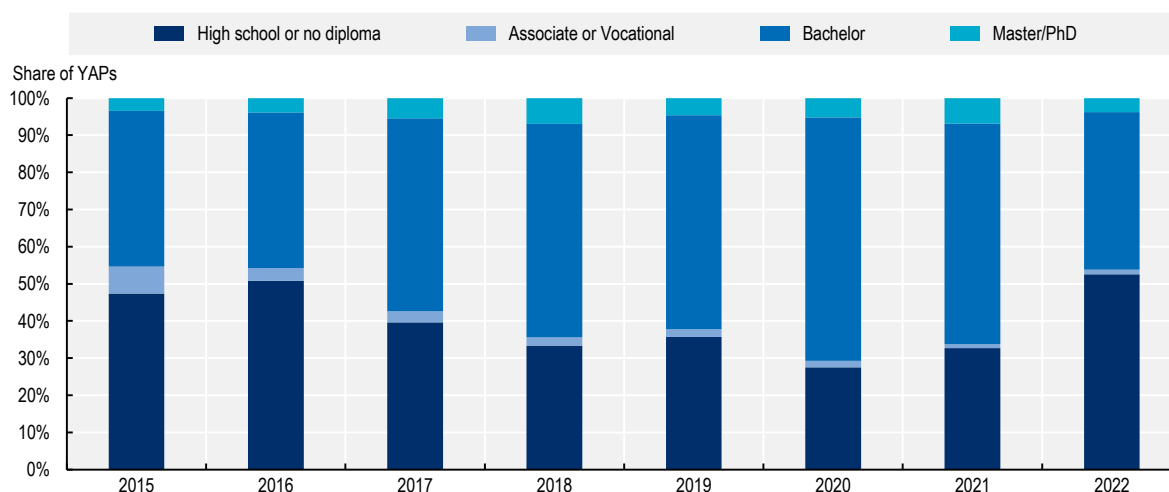
The effect of the pandemic on the demand for young workers was heterogeneous across individuals with different education levels. The average number of quarterly YAPs requiring at least a high school certificate in 2020 decreased by approximately 50% relative to the level in 2019. For YAPs requiring at least a bachelor or college degree this decline was nearly 25%. These results are consistent with the fact that on-the-job training schemes that do not require bachelor's degrees, such as apprenticeships, are likely to be more affected by mobility restrictions and lockdowns in 2020. This kind of programmes, in fact, heavily rely on practical and hands-on training to build specific skills (Indeed, 2022^[9]), which did not fit well the "remote working" arrangements that were put in place to overcome the negative effects of the lockdown restrictions (especially in blue-collar jobs). As a result, according to official data (Statistics Canada, 2021^[20]), the number of new enrolments in apprenticeships programs in Alberta decreased 34% in the 2019-2020 period, 5 percentage points higher than that for Canada as a whole (29%).

The post-pandemic period led to a strong recovery of the demand for young professionals with significantly larger differences across educational levels than in the pre-pandemic period. Mirroring the results for the total amount of OJPs in Alberta, also YAPs requiring lower education certificates or degrees grew much faster in 2021 and 2022 than the rest of YAPs. Specifically, youth-accessible postings requiring high school

certificate grew 51% in 2021 and tripled in 2022, while those requiring bachelor grew 15% and 78% respectively in those two years. This result implied a change in the composition of YAPs qualification requirements. In 2022, YAPs requiring high school certificates accounted for more than half of the YAPs for the first time since 2016. This change can be linked to both the high demand in sectors typically demanding low-skilled workers (i.e. construction) and the shortages of qualified workers that Alberta is facing recently in different industries (Business Council of Alberta, 2022^[21]) which may have forced some employers to broaden their qualification requirements to include workers with lower qualifications.

Figure 5.7. Composition of youth-accessible postings per education level

Shares calculated on the average number of quarterly YAPs per year



Note: The category “High school or no diploma” consists of OJPs that ask for a minimum of 10 to 12 years of education. “Associate or Vocational” is defined as 13 to 14 years of education. One reason to group associate degrees and vocational studies together is that the former are typically more ‘specialisation-focused’ than other degrees and much of the learning is specialised technical or vocational coursework. “Bachelor” is either a bachelor at a university or at a college, which both take 15 to 16 years of education. Requiring 17+ years of education leads to the classification “Master/PhD”. For 2022, data is available until September.

Source: OECD calculations based on Lightcast data.

Type of contracts in OJPs for youth

The type of contract offered in OJPs is one signal that can be used to assess the quality of the jobs offered by enterprises to youth. This section examines two important aspects of YAPs contracts: job stability⁸ (permanent or temporary) and hours of work (full-time or part-time⁹). Especially when they are not voluntarily sought by applicants, temporary jobs arrangements are often indicators of inferior quality as compared to permanent positions, raising concerns about the quality of these positions (ILO, n.d.^[22]).

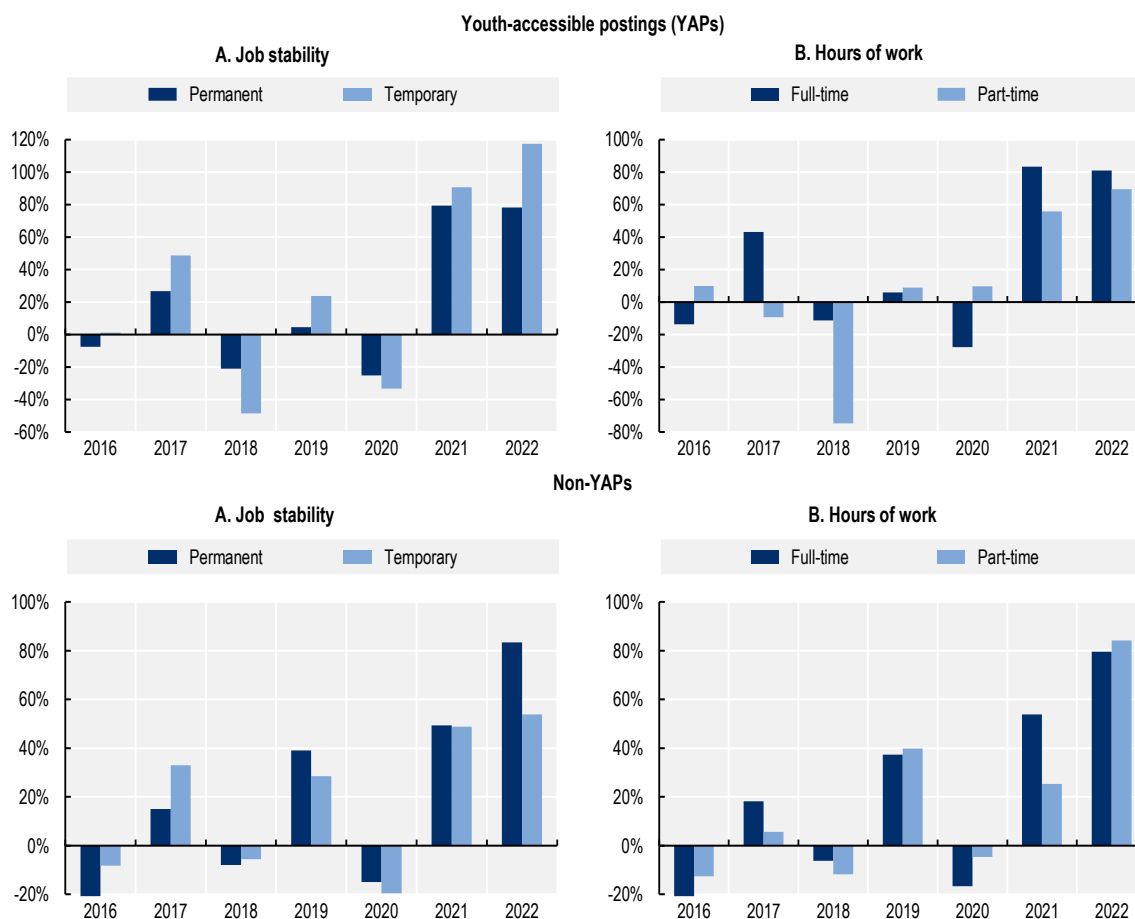
Figure 5.8 shows the annual growth rate of the average number of quarterly YAPs and non-YAPs in Alberta during the period between 2015 and 2022. Following the increase in the positions offered in the retail trade sector in 2017, both YAPs and non-YAPs showed a significant increase in the number of OJPs offering permanent and temporary contracts, with a higher increase in the latter (Figure 5.8, Panel A). Besides, in that year, full-time contracts increased in both types of OJPs while part-time contracts remained relatively more stable (Figure 5.8, Panel B). However, in 2018 the demand in the retail sector decreased significantly (Figure 5.5), which is likely to explain the decline in all types of YAPs contracts, especially those with temporary and part-time arrangements.

More recently, the unprecedented expansion in Alberta’s labour market demand after the pandemic has shown some differences between the type of contracts offered in YAPs and the rest of OJPs. Specifically,

temporary contracts for YAPs have grown faster while in non-YAPs permanent contracts have taken the lead. This result suggests that youth are likely to have faced more challenges to find quality jobs recently.

Figure 5.8. Annual rate of growth of OJPs per type of contract offered

Rate of growth of the average number of quarterly OJPs per year



Note: In the period between 2015-22, on average, 40% of YAPs (30% of non-YAPs) have missing values. Data available until September 2022.
Source: OECD calculations based on Lightcast data.

Skills demanded in main career areas for youth

Technological and demographic changes are constantly reshaping labour markets across the world. For instance, new developments in artificial intelligence (AI) and automation are expected to affect the employment prospects of low skilled workers employed in routinary occupations – some of which will be likely replaced by robots- but also workers in non-routinary and high-level cognitive jobs that require more specific skills, such as drafting, coding, text analysis, among others.¹⁰ In this context, a lifelong learning¹¹ approach is key for individuals to adapt and succeed in such a changing environment. Building transversal skills that facilitates future reskilling or develop key technical skills that meet enterprises' needs require constant learning in different stages of life.

In the specific case of youth, career guidance and orientation contribute to lifelong learning by providing information to young people on the different occupations, skills and knowledge required in the labour market. These programmes ease the transition from school to work by helping young individuals to realise

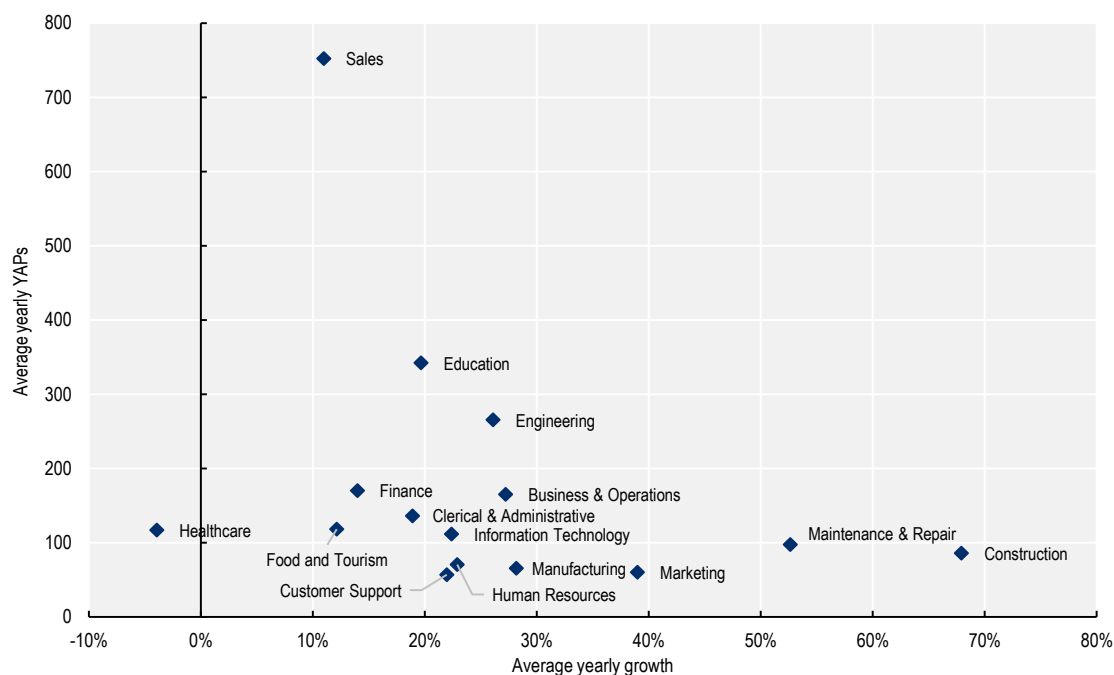
how their long-term life objectives match with present and future employers' needs (OECD, 2021^[23]). For this purpose, it is essential to have timely and granular information that contributes to characterise professional profiles according to employers' specific needs in different career areas.

The information contained in online job postings allows to extract the detailed skills, technologies and technical knowledge required by firms in professional profiles that are more accessible and relevant for youth. This section investigates these skill demands by focusing on broad occupational categories that are more likely to be accessible to youth in Alberta. The analysis below leverages the Lightcast classification that aggregates job postings into 27 different career areas (see Box 2.1 in Chapter 2).¹²

Figure 5.9 compares the average yearly number of YAPs and the average yearly rate of growth by career area for the period 2015-22. Out of 24 different career areas available in the data for Alberta, three areas emerge as the most accessible for youth: i) sales, ii) education and training, and iii) engineering, with more than 250 YAPs published per year and an average growth rate ranging between 10% and 30%. This result is in line with the overall evolution of YAPs per economic sector in Figure 5.6, where retail trade, education services and mining, quarrying and oil and gas extraction, are the main sectors that advertise YAPs. Differently from education and training and engineering careers, it is worth noticing that the sales sector has experienced a relatively weaker growth in the period in between 2015 and 2022 (11%), probably associated to the rapid expansion of e-commerce after the pandemic. In contrast, the demand in the education and engineering sectors has grown at a much faster pace, with average yearly growth rates of around 25% in the period in between 2015 and 2022.

Figure 5.9. Evolution of career areas in Alberta

Average yearly number of YAPs and growth rate for the period 2015-22



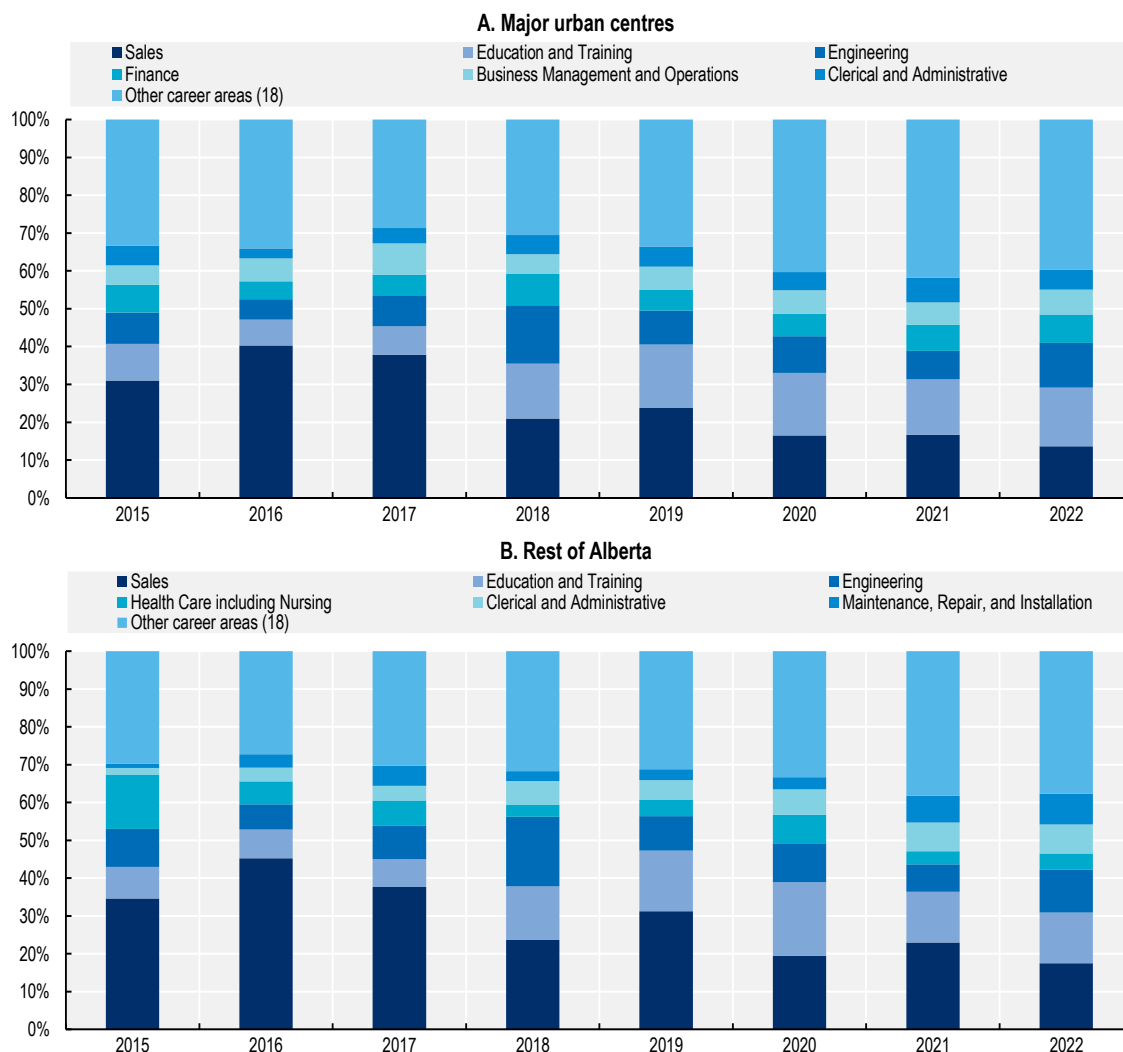
Note: The figure shows the 15 career areas with the highest average number of YAPs.

Source: OECD calculations based on Lightcast data.

Finance; business, management and operations; and clerical and administrative complete the top six career areas with strongest demand for youth in Alberta. These areas show an average number of YAPs ranging between 130 and 170 and yearly growth rates around 15% and 30%. Specifically, the business, management and operations area has grown at an average rate of 27% per year. This area includes occupations such as order pickers and warehouse workers, typically hired in logistics companies that are likely to have faced an increase in demand as a result of the expansion in e-commerce during and after the pandemic.

Figure 5.10 offers a complementary view, as it shows the evolution of each career area’s share over the annual number of youth-accessible postings divided in two groups: major urban centres (Calgary and Edmonton service regions¹³) and rest of Alberta. Even though the first group represents 80% of YAPs posted (as these areas are the main economic centres in the province), this geographic classification is also relevant to assess how the demand for professionals in different career areas has evolved in less populated areas of Alberta.

Figure 5.10. Distribution of YAPs per service region groups and career areas



Note: The group “major urban centres” includes Edmonton and Calgary service regions. This figure excludes those job postings that do not specify a career area. They represent, on average, 39% of the data in major urban areas and 40% in the rest of Alberta.

Source: OECD calculations based on Lightcast data.

Information from job postings suggest that these groups share a similar composition of YAPs. The three main career areas in Alberta (sales, education and training, and engineering) account for 50% of the youth-accessible postings between 2015 and 2022 in both major urban areas and the rest of Alberta. Specifically, in 2016 and 2017 the sales area represented approximately 40% of YAPs in both groups, which is likely to be linked with the high demand in the retail trade sector for these years (see Figure 5.5). However, in the years following this unprecedented high demand the yearly shares of the sales area has continuously decreased, especially in the major urban areas where demand represented only 14% of YAPs advertised in 2022.

The share of the education and training area has increased in recent years in both groups, representing in 2022 nearly 16% of YAPs in major urban areas and 13% in the rest of Alberta. As shown before in Figure 5.6 (Panel E), YAPs in the educational services sector have increased in most of the period of analysis (only affected during the pandemic), which contrasts with a stable, or even decreasing, trend in non-YAPs in the years preceding the pandemic. An in-depth look to the job titles of YAPs in this sector shows that employers seek for student assistants, monitors and students for co-operative education programmes (Co-Op), as discussed in more detail below and shown in Table 5.1.

Nevertheless, Figure 5.10 also shows some differences between the two groups. In major urban centres, finance; business, management and operations; and clerical and administrative are also among the top career areas demanded. They account for an additional 17% of YAPs posted in Calgary and Edmonton service regions. Job titles in these areas include accounting students, entry level insurance sales agents, warehouse workers, order fillers/pickers, among others. In contrast, in the rest of Alberta, healthcare; clerical and administrative; and maintenance, repair and installation career areas are more relevant (Figure 5.10). These three areas represents an additional 16% of YAPs posted in this group. Examples of job titles in these areas include graduate nurses, (entry-level) laboratory technicians, shop technicians and administrative assistants. In both groups, the shares of these areas have remained stable across years.

This section focuses on Alberta as a whole and explores the province's main career areas, providing information at this aggregation level about the mix of professional and technical skills typically relevant in these positions. Job requirements often pool together both technical and professional/transversal skills. Several technical skills are usually at the core of a profession. Young professionals in finance, for instance, typically require specialised knowledge in accounting, taxes and capital management; while people working in sales require knowledge of merchandising, sales management and retail industry.

Transversal skills are, instead, not related to a particular job or discipline, being used across different work settings. They, in fact, play a great role in strengthening individuals' resilience to change in labour markets but typically they are not the core of the skill requirements of any occupation. The OECD provides a methodological approach to identify skills with a higher degree of transversality across different occupations applying machine learning and mathematical tools to the analysis of texts contained in OJPs (OECD, 2021^[23]). Figure 5.11 uses a selection of key transversal skills (i.e. leadership, organisational, communication, analytical, etc.) to show (Panel A) their relevance for each one the main career areas for youth-accessible jobs in Alberta (see Annex C for more detail on the relevance assessment).

Figure 5.11 (Panel B) also shows the five technical skills with high relevance scores for YAPs in each career area. Since these skills are very specific for each career area, their relevance scores tend to be higher (ranging between 0.3 and 0.6) than in the case of transversal skills. Interestingly, however, the way occupations bundle (i.e. demanded in conjunction) transversal and technical skills can determine, to some extent, their returns in the labour market. Recent research shows, for instance, that transversal skills are typically associated to higher wage returns in particular in occupations where technical skills are also very relevant (OECD, 2021^[23]).

The sales area is among the largest pool of opportunities for youth, accounting for 27% of the YAPs in Alberta between January 2015 and September 2022. According to the Lightcast Occupation Taxonomy, some of the main occupations for youth in this group includes retail store managers/supervisors, sales

representatives and retail sales associates. A close look into the job titles of these YAPs reveals that employers looking to fill positions in those occupations seek, among other more qualified professionals, also entry level sales representatives, assistants to store managers and sales trainees. Table 5.1 shows in detail the main occupations demanded in YAPs per career area in 2021 and provides examples of job titles.

When looking at the transversal and technical skills that young people need in YAPs in sales, Figure 5.11 (Panel A) indicates that their importance is similar to the skills required for all the other job openings advertised in this field. Leadership and organisational skills are particularly relevant for sales occupations while teamwork is the least relevant transversal skill across youth-accessible positions.¹⁴ When turning to the technical skill requirements, job descriptions highlight the relevance of knowledge about retail industry, sales and store management practices, being these particularly relevant for young candidates to access sales jobs (Figure 5.11, Panel B). It is important to notice that the relevance score of knowledge about the retail industry differs between YAPs and the total OJPs, which suggest that this skill is more required in senior positions as expected.

Jobs in the education and training career area represent nearly 12% of YAPs in Alberta. This professional area include positions in charge of planning, managing and providing education services and learning support services (O*NET, 2016^[24]), something that facilitates the advertisement of job offers for students in positions aimed to support teaching activities. Table 5.1 shows some of the main occupations plausible for youth in this area, including university administrators, college professor/instructors and vocational education instructors. More specifically, job titles show a high demand for student monitors, summer students and articling students for law schools.

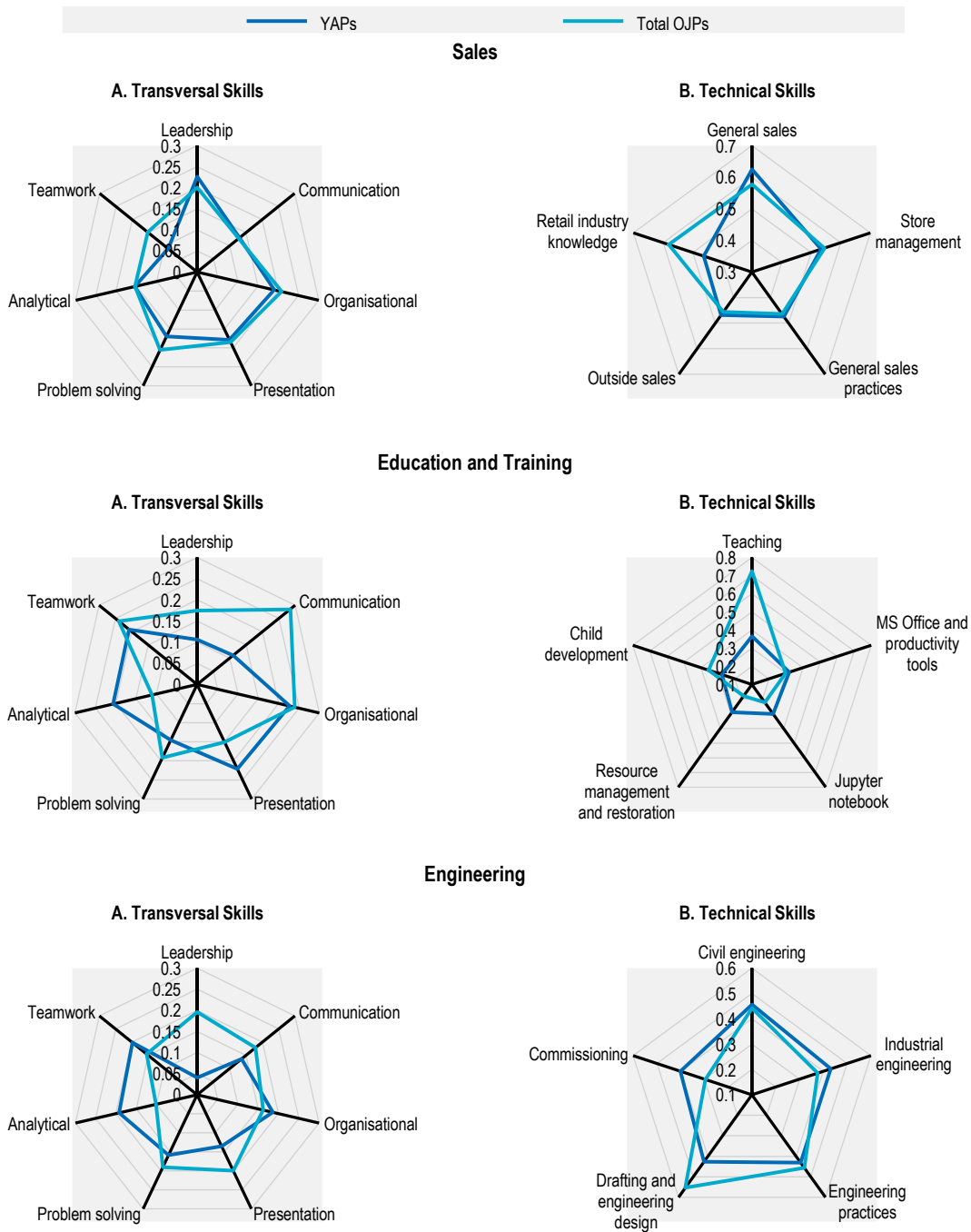
Organisational, presentation and analytical skills are relatively more relevant than the rest of transversal skills for these roles aiming to support research and teaching activities in schools, universities and other education institutions. In contrast, when comparing YAPs with all the OJPs advertised in this area, communication skills become more relevant, as this is likely to be one of the key skills required for more experienced professors and instructors in academic institutions (Figure 5.11, Panel A). More specific (technical) skills for these positions include teaching knowledge; productivity tools, such as Microsoft Office and Google Docs; as well as coding tools such as Jupyter Notebooks, that is widely used in the academia to create, teach and share data projects, including machine learning and data visualisation.

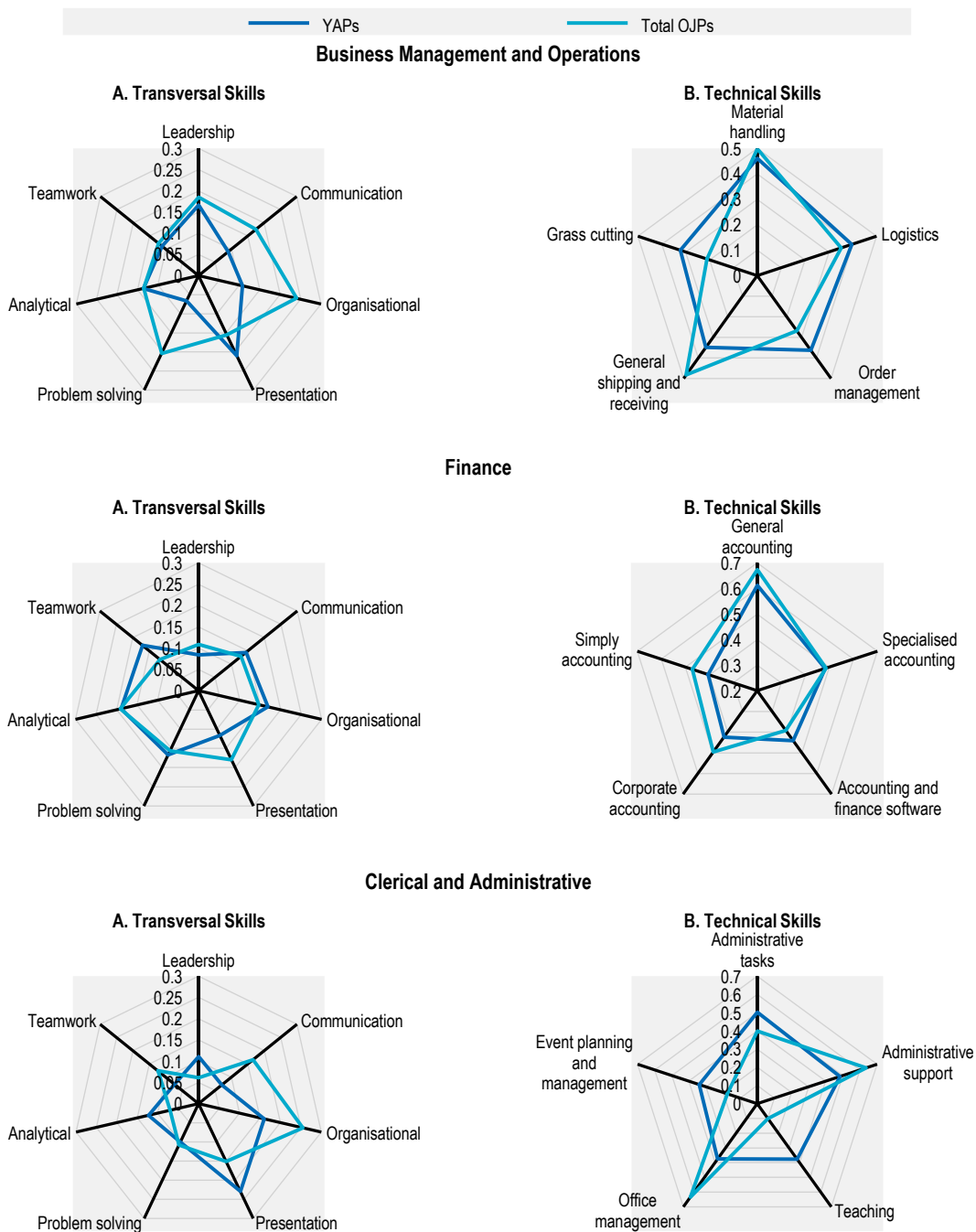
The engineering area accounts for 9% of the YAPs in Alberta, with some of the main occupations including civil, mechanical and electrical engineers and technicians. Most of the YAPs advertised in this area in 2021 were for positions as graduate engineers (mainly in civil engineering) and co-operation education (co-op) programmes' students. The relevance of co-op programs in engineering YAPs is in line with local initiatives such as the University of Alberta's Engineering Co-op Programme, established in 1981 and one of the largest co-operative education programmes in Canada (University of Alberta, 2023^[25]).

Some of the most relevant skills for youth-accessible jobs in the engineering area are teamwork, analytical and organisational skills. This result significantly diverges from the main transversal skills required when including all the OJPs in engineering. In the case of more senior positions, leadership, problem-solving and presentation are found to be more relevant, which suggest the need for youth to develop a broader set of transversal skills when going up the occupational ladder. In YAPs, transversal skills are bundled with technical skills, such as engineering practices, drafting and engineering design and project commissioning (as shown in Figure 5.11, Panel B). Project commissioning, for instance, refers to a group of engineering techniques and procedures to inspect and test every operational component of a project (Price et al., 2021^[26]).

Figure 5.11. Transversal and technical skills in main career areas for youth employment – 2021

Relevance score for each skill in the main career areas for youth (closer to 1 = more relevant)





Note: Scores in the figure shows the relevance of each skill for the career area at hand. Skill relevance score are inferred by applying natural language processing (NLP) algorithms to the analysis of online job postings for Canada in 2021 (details provided in Annex C). Source: OECD calculations based on Lightcast data.

A smaller proportion (6%) of YAPs are in the area of business management and operations. Occupations in this area range from warehouse workers to buyers and logistics analysts. According to job titles extracted from job postings, some common entry-level positions in youth-accessible postings include order fillers/pickers, who ensure the accuracy of customer orders in a warehouse, and entry-level labourers who perform manual tasks.

Overall, across business management and operations YAPs, the transversal skills leadership and presentation show the highest scores, although transversal skills are relatively less relevant in these positions. However, when considering both YAPs and non-YAPs, communication, organisational, and problem-solving skills become more relevant for the occupations included in this area for older cohorts and workers with longer experience. These skills are, in fact, likely to be more related to occupations in the business management area, such as project managers or co-ordinators. Additionally, material handling, logistics, and order management are some of the main technical skills required for these positions.

The finance area represents an additional 6% of YAPs in Alberta. The main youth-plausible jobs in this field are entry-level accountants, branch managers (trainees), and articling students in financial institutions (Table 5.1). The distribution of relevance scores across transversal skills for financial occupations are similar to those from the engineering area. Analytical, problem-solving, and organisational skills are the most relevant transversal skills for these positions. This bundle of skills does not differ significantly when including all the other job postings in the area, with the exception of presentation skills becoming more relevant in the overall sample of OJPs. The key technical skills for youth-accessible financial positions are mainly related to accounting knowledge.

Finally, the area of clerical and administrative occupations includes positions such as administrative assistant, supervisors, and receptionists, among others. The specific job titles for YAPs in Alberta are mainly administrative assistants and data entry clerks. Communication and organisational skills stand out as the key transversal skills in this area, which are typically combined with specific skills regarding knowledge in administrative tasks and support.

Table 5.1. Main occupations per career area for YAPs in Alberta

Most frequent occupations for youth and job title examples per career area in 2021

Career Area	Type	Occupation 1	Occupation 2	Occupation 3
Sales	LOT Occupation	Retail Store Manager / Supervisor	Sales Representative	Retail Sales Associate
	Job title examples	Management Trainee	Entry Level Sales Representative	Retail Sales Representative
		Assistant Store Leader Manager	Entry Level Sales	Senior Sales Associate
		Sales And Operations Management Trainee	Sales Trainee	Retail Sales Associate
Education	LOT Occupation	College / University Administrator	College Professor / Instructor	Vocational Education Instructor
	Job title examples	Student Monitor	IT Summer Student	Veterinary Summer Student, DVM
		Summer Student	Summer Student – Pharmacy	Co-Op Work Experience Student
		Articling Student	Agribusiness Student	Allied Health Student Pharmacy
Engineering	LOT Occupation	Civil Engineer	Mechanical Engineer	Electrical Engineer
	Job title examples	Graduate Civil Engineer	Co-Op – Mechanical Engineering	Co-Op – Electrical Engineering
		Co-Op Student	Mechanical Engineering Student	Co-Op – Electrical Drafting
		Engineering Co-Op Student	Co-Op, Mechanical Engineering	Co-Op – Electrical
Business Management and Operations	LOT Occupation	Labourer / Warehouse Worker	Order Processor / Order Entry Clerk	Project Manager
	Job title examples	Summer Student Labourer	Order Filler Picker	Co-Op – Project Management Assistant

Career Area	Type	Occupation 1	Occupation 2	Occupation 3
		General Labourer	Entry Level Order Picker	Technical Project Management Student
		Summer Student – Warehouse	-	Co-Op – Junior Project Manager
Finance	LOT Occupation	Bookkeeper / Accounting Clerk	Banking Branch Manager	Accountant
	Job title examples	Summer CPA Articling Student, Assurance and Accounting	Branch Manager Trainee	Chartered Accountant Student
		Co-Op – CPA Articling Student, Assurance and Accounting	Assistant Branch Manager Trainee	Entry Level Accountant
		Accounting Student	Management Trainee/Branch Manager Trainee	Co-Op – Accountant, Assurance and Accounting
Clerical and Administrative	LOT Occupation	Office / Administrative Assistant	Receptionist	Administrative Supervisor
	Job title examples	Student Support Assistant	Entry Level Appointment Setter	Student – Shipping
		Housewares Student/Assistant	Entry Level Receptionist	Order Management Student
		Apparel Student/Assistant	Student Recruitment Welcome Centre Receptionist	Pharmacy Student

Note: LOT refers to Lightcast Occupation Taxonomy (see Box 2.1 in Chapter 2).

Source: OECD calculations based on Lightcast data.

Transition pathways from low to high demand occupations: The example of career transitions from administrative assistants to business/management analysts

In a rapidly changing labour market, it is key for individuals to adapt effectively to recent changes and ensure that they are able to move from declining occupations to others that are expected to thrive following labour-market demand changes. In addition to build transversal skills that contribute to smooth the transition process, reskilling and upskilling efforts are necessary to acquire the skills required to transition from declining to fast-growing occupations.

This section investigates an example of such career moves using the concept of “occupation clusters”. It does so by identifying a set of occupations that share similar skill requirements, which is likely to contribute to a smoother career transition due to the overlap in skill demands.

The similarity assessment between occupations uses the same approach used for the calculation of skill relevance scores (see Annex C). The analysis focuses on a specific pair of occupations, one for which labour market prospects are declining (the origin occupation: administrative assistants) and another that is, instead, thriving and increasing in demand (business/management analysts). The analysis below also presents other alternative occupations that are similar to the origin and destination occupations and that could also be viable career transitions. These occupations represent the declining and thriving clusters.

Specifically, the Canadian Occupation Projection System -COPS- (Government of Canada, 2021_[27]) expects the demand for administrative assistants to decrease on average 1.6% per year between 2022 and 2028. In Alberta, most recent job prospects for the next two years in this occupation shows a “limited” demand (Government of Canada, 2022_[28]), which is likely to respond to the possibility that routine activities typically performed in this occupation (i.e. scheduling appointments, drafting correspondence or providing information to callers) will be soon replaced by machines and algorithms. In contrast, the demand for business management analysts is expected to increase on average 1.3% per year, according to the COPS. Specific prospects from the Government of Canada for this occupation in Alberta are considered

“good”, based in an expected increasing demand to help businesses find and improve inefficiencies while transitioning to a post-pandemic world (Government of Alberta, 2022^[29]).

Figure 5.12 shows the clusters for both origin and destination occupations (central bubbles). Around each central bubble are their most similar occupations among the top 20 occupations with higher demand for YAPs including the expected average growth rate defined by the COPS. The dotted lines that connect the bubbles include the occupation similarity index calculated between each pair of occupations.

The declining cluster includes those occupations similar to administrative assistants, in term of skills required, that are also expected to have a relatively low demand. Bookkeeper / accounting clerks presents the higher similarity index with administrative assistants, where their demand is expected to increase only by 0.9% per year until 2028. Since bookkeepers perform routine accounting and financial tasks, such as recording transactions, organise records and data, they are also expected to be replaced by AI-powered accounting software that will reduce the enterprises’ need for these profiles.

At the other end of the spectrum in Figure 5.12, several occupations are expected to grow in the coming years and are yet relatively accessible for youth. Most of those occupations (right side of the chart) are in the area of business, human resources or software development. The closest occupation, in terms of skill requirements, to administrative assistants is that of business / management analysts which also shows both a higher demand outlook and a thriving cluster of similar occupations.¹⁵

A career transition from administrative assistants to business management analysts requires the acquisition of a variety of financial and management skills, many of which may require some significant upskilling or retraining. Table 5.2 ranks the most relevant skills for a management analyst by the difference between the relevance indices for a given skill between both occupations. This difference is used as a proxy of the training intensity needed to an administrative assistant to transit to it.

Figure 5.12. Occupation clusters: Administrative assistants and Business/management analysts



Note: The figure shows the occupation clusters for administrative assistants on the left and management analysts on the right. Among the top 20 occupations demanding youth-accessible positions, this figure identifies the most similar occupations to the one shown in the centre of each cluster by a dashed line above which the occupational similarity index is placed. Higher values of the similarity index indicate a higher degree of skill overlap between origin and destination. Canada’s official employment projections for the period 2022-28 indicated in brackets. The orange line connects the two occupation clusters, highlighting potential career pathways.

Source: OECD calculations based on Lightcast data and official employment projections for Canada (Government of Canada, 2021^[27]), Canadian Occupational Projection System (COPS), <https://occupations.esdc.gc.ca/sppc-cops/content.jsp?cid=occupationdatasearch&lang=en>.

Given the relatively low similarity index between origin and destination occupations, the transition from administrative assistants to Business/management analysts require a high intensity of retraining as some underlying skills requirements are typically far apart. Results from the analysis of skill similarities between these occupations show, for instance, the need for significant training in consulting, business intelligence and process and analysis. On the contrary, a relatively less effort would be necessary to upskill in competences associated to information management, IT management and ad hoc analysis, which refers to business intelligence tools designed to create specific (non-regular) reports (LinkedIn, 2020^[30]).

Table 5.2. Retraining pathways: Skills, competences and knowledge in technologies to move from administrative assistant to management analyst in Canada

Difference in skill relevance between origin and destination occupations, 10 most relevant skills at the destination

Skill	Skill distance from origin to destination
Business consulting	0.43
Business intelligence	0.37
Business process and analysis	0.33
Financial regulations	0.31
Knowledge management	0.30
Benefits analysis	0.28
Financial services industry knowledge	0.27
Enterprise information management	0.20
IT management	0.19
Ad hoc analysis and reporting	0.14

Note: The skill distance is the difference in the skill relevance scores derived from applying NLP algorithms to OJPs information (Annex C).
Source: OECD calculations based on Lightcast data.

Labour market transitions play a crucial role in an individual's career development and overall well-being, as well as in the functioning of the economy and the labour market as a whole. Smooth transitions can lead to increased job satisfaction, higher earnings, and better economic outcomes, while disruptions and difficulties during transitions can result in unemployment, reduced earnings, and reduced economic mobility. Analyses presented in this section show one of many examples of such possible transitions in Alberta, based on similarity measures of skills demands. Many more combinations between origin and destination occupations can be analysed, but those cannot be contained in a report. With this in mind, the OECD has developed a data visualisation tool that allows users to compare any given pair of occupations in the data and their skill demands. The data visualisation provides key information about both technical and transversal skills in the selected pair of origin-destination occupations and can be used to identify areas where training is typically needed to make a career switch. This tool can be accessed for free on the OECD publication page for this report.

Supporting youth to develop skills that are relevant in a changing world

The analysis above characterised the economic sectors that are currently likely to offer more opportunities to youth, as well as the career areas and skills more demanded in youth-accessible positions in Alberta. However, policies and strategies oriented to prepare the labour market of the future need to consider how these demands are aligned with the recent trends in the Alberta's labour market that have been discussed in previous chapters of this review and how they are expected to evolve with the mega-trends reshaping labour markets and societies.

One example is the retail sector. While this sector remains one of the largest employers in Alberta, the expansion of e-commerce and online shopping, exacerbated by the pandemic may have contributed to the recent declines in the demand for workers (see Table 2.1 in Chapter 2) and the relatively weak average growth in YAPs in the sales area (see Figure 5.9). Rapid technological developments and a more widespread adoption of e-commerce may reduce the demand in some of the key occupations for youth in early stages of their careers (such as sales representatives/associates or retail store supervisors).

Digitalisation and the expansion of e-commerce, however, can contribute to the rapid increase in the demand for workers in the transportation and warehousing sector. As shown in Chapter 3, occupations such as dispatchers, order entry clerks, schedulers and drivers experienced significant growth in the pre-pandemic period (see Table 3.1 in Chapter 3). Some of the key occupations for youth employment in the business, management and operations area (i.e. order entry clerks and warehouse workers) will hence likely continue to face an increase in their demand in Alberta's labour market. Technical skills associated with these occupations, such as logistics, general shipping and receiving or order management will likely become increasingly relevant in Alberta's labour market (see Figure 5.11).

The importance of the mining, quarrying and oil and gas extraction sector in Alberta's economy and the high growth in OJPs from this sector in recent years explains, to some extent, the high demand for workers in key areas for youth accessible postings, such as engineering and business, management and operations. Figure 2.4 (in Chapter 2) shows that these areas represented nearly 30% of the OJPs published by employers in this sector in the period 2017-20. In addition, Figure 5.6 shows the unprecedented acceleration in both YAPs and non-YAPs in the mining sector in the period following the pandemic. The good performance of this sector, given the context of high international commodity prices, is likely to continue benefiting engineering occupations that youth can access as graduate engineers or through co-operative education (co-op) programmes (Table 5.1).

However, as countries invest in the transition to a greener and more sustainable economy, employees in the oil and gas sector will also need to go through significant retraining and upskilling as these industries will evolve in the coming years and some jobs will be lost to other sectors. Efforts to support the development of technical skills, such as the EDGE UP programme in Calgary, that provide training in new digital skills to former oil-and-gas workers that help them to fulfil jobs in the digital technology sector (EDGE Up, 2022^[31]) will become increasingly necessary. They can be complemented with increasing emphasis on the development of transversal skills (i.e. cognitive, communication or organisational skills) in youth.

While the analysis of the most relevant skills across career areas is key to understanding skill demands in YAPs today, mega-trends such as digitalisation, automation and the adoption of AI are certainly going to reshape most of those demands in the future and up to date labour market information will be needed to adjust to such changes in the future. As pointed out in Chapter 4, advanced data analytics (i.e. AI, big data, machine learning, etc.) and programming (i.e. software development, scripting languages, etc.) skills are becoming increasingly relevant in Alberta's labour market, showing high levels of diffusion across different occupations (see Figures 4.17 and 4.18). In contrast, analyses of OJPs reveal that several skills are becoming obsolete due to these technological advancements and changes in the economic structure, which can lead to job displacement.

In this context, developing adequate Information and Communication Technologies (ICT) and cognitive skills to interact with AI and digital tools is becoming increasingly relevant in labour markets. Individuals, and among these youth, will need to learn how to apply these tools in different tasks, not exclusively related with programming or advanced analytics skills but also to abilities and competencies to use these tools effectively and efficiently while mitigating the risks of misuse (bias, cyber risks, fakes, etc.). Retraining and lifelong learning programmes can help individuals and youth to acquire the skills and knowledge needed for in-demand jobs in growing industries, allowing them to make a successful transition to a new job or career.

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Notes

¹ This chapter refers to youth or young people as the population aged 15 to 24 years.

² For more detail on youth unemployment by industry, see Statistics Canada (2022^[4]).

³ For a discussion about strengths and limitations of online job postings data see Chapter 1.

⁴ It is worth noticing that are some jobs that include one of these words but are not seeking to hire young professionals. This is mainly the case for jobs in the education sector including the word “Student” but looking for more experienced profiles, such as “Student Counsellor” or “Student Co-ordinator”. For that reason, the classification rule do not include OJPs with titles including the words “Advisor”, “Counsellor”, “Co-ordinator”, “Officer” or “Administrator”.

⁵ A caveat on this criterion is that nearly 60% of the data for Alberta about the maximum experience required is missing.

⁶ The WTI reference price fell from USD 105.79 per barrel (/b) in June 2014 to a minimum price of USD 30.32 /b in February 2016. After that, it started a positive trend that extended until September 2018 when it reached USD 70.75 /b (U.S. Energy Information Administration, 2023^[32]).

⁷ It is worth noticing that approximately 65% of the YAPs in Alberta do not include information on qualifications and degrees.

⁸ More stable positions are expected to last as long as possible, so they do not have a pre-defined termination date. Temporary positions have a pre-determined termination (projects or fixed-term contracts) (Statistics Canada, 2020^[33]).

⁹ Part-time positions are those job that requires employees to work less than 30 hours per week (OECD, 2023^[35]).

¹⁰ The impact of digitalisation on Alberta's labour market has been explored in Chapter 4.

¹¹ *"Lifelong learning starts in childhood and youth, continuing throughout adulthood and old age. It encompasses formal learning in settings such as schools and training centres, informal and non-formal learning derived from colleagues and workplace trainers, and unintentional learning stemming from spontaneous social interactions"* (OECD, 2021^[23]).

¹² Due to data scarcity at the 8th-digit level of occupation classification of YAPs in Alberta, this section uses the career area level to aggregate youth-accessible postings.

¹³ As explained in Chapter 1, service regions is a term used by Alberta Advanced Education, which refers to regions that have one or more post-secondary institutions.

¹⁴ These findings are in line with the descriptions available in the occupation explorer of the "Career, learning and employment information service for Albertans (ALIS)". For example, a retail salesperson is expected to "hav[e] clear rules and organised methods for their work" (ALIS Alberta, 2023^[34]), which is associated with organisational skills; while other sales representatives need communication, presentation and problem-solving skills.

¹⁵ The most similar occupation to management analysts that also shows a high demand for youth-accessible positions is software developer / engineer, whose demand growth is expected to be around 2.2% per year. Human resources specialists and researchers also show positive growth prospects for the next years.

Annex A. Occupations excluded from the teleworking analysis

Table A A.1. List of occupations excluded from the teleworking analysis

Lightcast occupational code	Occupation title
11-3071.02	Storage / Distribution Manager
11-9013.91	Fish Hatchery Manager / Technician
11-9021.00	Construction Manager
11-9051.00	Restaurant / Food Service Manager
13-1032.00	Auto Damage Appraiser
17-1012.00	Landscape Architect
17-1022.00	Surveyor
17-2051.01	Transportation Engineer
17-3023.00	Electrical and Electronics Technician
17-3029.09	Manufacturing / Production Technician
19-1013.00	Soil / Plant Scientist
19-1032.00	Forester
19-4091.91	Environmental Technician
21-1012.94	Vocational Rehabilitation Counselor
21-1019.91	Youth Counselor / Worker
21-1021.00	Family / School / General Social Worker
21-1091.00	Health Educator / Coach
25-2011.00	Preschool / Childcare Teacher
25-3021.94	Dance Teacher
27-2011.00	Actor
29-1011.00	Chiropractor
29-1021.00	Dentist / Orthodontist / Prosthodontist
29-1062.00	Physician
29-1122.00	Occupational Therapist
29-1123.00	Physical Therapist
29-1131.00	Veterinarian
29-1141.00	Registered Nurse
29-1171.00	Nurse Practitioner
29-2021.00	Dental Hygienist
29-2041.00	EMT / Paramedic
29-2061.00	Licensed Practical / Vocational Nurse
29-2071.96	Clinical Analyst / Clinical Documentation and Improvement Specialist
31-1011.00	Home Health Aide

Lightcast occupational code	Occupation title
31-1014.00	Nursing Assistant
31-9011.00	Massage Therapist
31-9091.00	Dental Assistant
31-9092.00	Medical Assistant
31-9095.00	Pharmacy Aide
33-2011.00	Firefighter
33-9092.00	Lifeguard
35-1011.00	Chef
35-1012.00	Restaurant / Food Service Supervisor
35-2011.00	Cook
35-2021.00	Kitchen Staff
35-3011.00	Bartender
35-3021.00	Food Service Team Member
35-3022.01	Barista
35-3031.00	Waiter / Waitress
35-9011.00	Busser / Banquet Worker / Cafeteria Attendant
35-9021.00	Dishwasher
35-9031.00	Host / Hostess
37-2011.00	Janitor / Cleaner
37-2012.00	Maid / Housekeeping Staff
37-3011.00	Landscaping / Groundskeeping Worker
39-1021.92	Pet Care Worker / Manager
39-6012.00	Concierge
39-7012.00	Travel / Tour Guide
39-9011.01	Nanny / Babysitter
39-9021.00	Caregiver / Personal Care Aide
39-9031.00	Personal Trainer / Fitness Instructor
41-2011.00	Cashier
41-9099.91	Sales Assistant
43-4081.00	Hotel Desk Clerk
43-4171.00	Receptionist
43-5011.00	Cargo Co-ordinator / Freight Forwarder
43-5021.00	Courier / Messenger
43-5031.00	Dispatcher
43-5071.00	Shipping / Receiving Clerk
43-5081.01	Stocking Clerk / Sales Floor Support
43-9051.00	Postal Service / Mail Room Worker
45-1011.05	Logging Worker / Supervisor
45-2092.00	Farm / Nursery / Greenhouse Worker
47-1011.00	Construction Foreman
47-2031.00	Carpenter

Lightcast occupational code	Occupation title
47-2041.00	Carpet Installer
47-2044.00	Tile / Granite Worker
47-2051.00	Concrete Finisher
47-2061.00	Construction Helper / Worker
47-2073.00	Operating Engineer / Heavy Equipment Operator
47-2081.00	Drywall Installer / Finisher
47-2111.00	Electrician
47-2121.00	Glazier
47-2141.00	Painter
47-2152.01	Pipe Fitter
47-2152.02	Plumber
47-2161.91	Plasterer / Stucco Mason
47-4011.00	Construction / Building Inspector
47-5012.00	Driller / Drill Operator
47-5013.00	Oil / Gas Field Service Technician
47-5042.00	Miner / Mining Worker
49-1011.00	Maintenance / Service Supervisor
49-2022.00	Satellite / Broadband Technician
49-2097.00	Television / Satellite Television Installer
49-2098.00	Alarm / Security System Technician
49-3021.00	Auto Body Technician
49-3023.00	Automotive Service Technician / Mechanic
49-3031.00	Diesel Mechanic
49-9021.00	HVAC Mechanic / Installer
49-9031.00	Home Appliance Repairer
49-9041.00	Industrial Mechanic
49-9052.00	Cable Technician / Installer
49-9071.91	Building and General Maintenance Technician
49-9071.92	Field Service Technician
49-9097.00	Railroad Service Worker
49-9099.00	Repair / Service Technician
51-1011.92	Production Plant Manager
51-3011.00	Baker
51-3021.00	Butcher / Meat Cutter
51-4031.00	Press / Press Brake Operator
51-4121.00	Welder / Solderer
51-6011.00	Laundry Worker
51-6031.00	Sewing Machine Operator
51-6051.00	Tailor / Seamstress
51-7011.00	Cabinetmaker
51-8031.00	Water Treatment Specialist / Waste Water Operator

Lightcast occupational code	Occupation title
51-9012.92	Manufacturing Machine Operator
51-9061.00	Quality Inspector / Technician
51-9082.00	Medical Assembler
51-9121.00	Coating / Industrial Painter
51-9199.00	Production Worker
53-1021.00	Warehouse / Distribution Supervisor
53-2011.00	Pilot
53-2021.00	Air Traffic Controller
53-3021.00	Bus Driver
53-3031.00	Sales Delivery Driver
53-3032.00	Tractor-Trailer Truck Driver
53-3033.00	Light Truck Delivery Driver
53-7051.00	Forklift / Pallet Jack Operator
53-7062.00	Labourer / Warehouse Worker
53-7073.00	Oilfield / Rig Worker

Annex B. Details on occupations

This Annex contains four main tables:

- Average monthly online job postings in Alberta by occupation and period of analysis
- Top 5 most relevant skills by occupation
- Typical Education qualification by occupation
- Typical CIP code by occupation

Table A B.1. Average monthly online job postings in Alberta by occupation and period of analysis

Lightcast occupational code	Occupation title	Average monthly online job postings January 2015-December 2016	Average monthly online job postings January 2017-February 2020	Average monthly online job postings March 2020-December 2020	Average monthly online job postings January 2021-September 2022	Highest/lowest growth quintile
11-1021.91	Operations Manager / Supervisor	56.6	57.4	45.8	99.3	
11-1021.92	General Manager	57.3	46.4	31.9	62.8	
11-2021.91	Marketing Manager	31.3	32.2	45.1	75.9	H
11-2021.92	Product Manager	8.6	11.0	13.7	29.9	H
11-2022.00	Business Development / Sales Manager	173.8	141.6	100.5	179.9	
11-2031.91	Communications / Public Relations Manager	12.8	13.5	11.7	28.9	
11-3011.92	Administrative Manager	17.6	14.8	13.9	40.5	
11-3031.00	Financial Manager	52.9	58.0	44.4	82.1	
11-3031.01	Treasurer / Controller	51.0	35.4	26.8	57.4	
11-3031.93	Banking Branch Manager	39.2	24.3	13.0	29.1	L
11-3121.92	Human Resources Manager	30.8	31.0	17.9	57.8	L
11-9021.00	Construction Manager	90.8	68.5	52.0	116.2	
11-9033.00	College / University Administrator	40.3	46.5	27.4	63.6	L
11-9041.00	Engineering Manager	29.3	29.6	14.7	37.4	L
11-9051.00	Restaurant / Food Service Manager	131.2	90.3	89.0	179.9	
11-9111.00	Healthcare Administrator	23.3	26.1	29.1	55.0	H
11-9141.91	Property / Real Estate / Community Manager	42.0	36.4	36.6	62.3	
11-9199.00	Program Manager	18.7	23.2	16.4	43.2	
13-1021.00	Buyer / Purchasing Agent	27.6	43.8	20.0	54.5	L
13-1051.00	Estimator	54.7	41.5	30.7	72.7	
13-1071.91	Recruiter	36.9	47.2	26.4	87.6	L
13-1071.92	Human Resources / Labour Relations Specialist	73.1	94.4	57.7	172.5	L

Lightcast occupational code	Occupation title	Average monthly online job postings January 2015-December 2016	Average monthly online job postings January 2017-February 2020	Average monthly online job postings March 2020-December 2020	Average monthly online job postings January 2021-September 2022	Highest/lowest growth quintile
13-1111.00	Business / Management Analyst	92.6	135.1	104.7	178.3	
13-1121.00	Event Planner	20.4	22.0	10.8	39.5	L
13-1151.00	Training and Development Specialist	19.0	27.4	18.6	39.7	
13-1161.00	Marketing Specialist	43.1	47.2	54.0	105.1	H
13-2011.02	Auditor	19.8	18.4	14.2	26.2	
13-2011.93	Accountant	96.3	97.5	57.1	115.2	L
13-2011.94	Account Manager / Representative	107.3	94.3	61.6	112.3	
13-2051.00	Financial Analyst	41.6	60.4	34.9	93.6	L
13-2052.00	Personal Financial Advisor	70.5	80.5	53.9	111.1	
13-2072.00	Loan Officer	20.5	20.7	18.9	28.6	
15-1121.00	Systems Analyst	67.2	87.9	64.5	103.6	
15-1122.00	Cyber / Information Security Engineer / Analyst	24.2	31.1	26.6	48.1	
15-1131.00	Software Developer / Engineer	135.3	201.8	198.5	294.1	
15-1131.91	Computer Programmer	24.9	22.0	17.3	25.8	
15-1133.00	Computer Systems Engineer / Architect	14.0	22.5	19.1	21.8	
15-1134.92	Web Developer	30.6	29.9	32.8	48.0	
15-1134.93	UI / UX Designer / Developer	7.3	10.8	13.0	18.4	H
15-1141.00	Database Administrator	20.7	23.8	18.6	33.5	
15-1142.00	Network / Systems Administrator	31.1	34.2	23.5	42.1	
15-1151.00	Computer Support Specialist	57.1	74.3	47.5	107.7	
15-1199.01	Software QA Engineer / Tester	25.2	39.8	31.5	47.3	
15-1199.02	Network Engineer / Architect	30.3	31.8	20.9	44.4	
15-1199.09	Project Manager	117.8	139.0	99.3	204.7	
15-1199.91	Data / Data Mining Analyst	12.3	25.2	16.3	39.1	
15-1199.93	Business Intelligence Analyst	14.5	24.7	12.9	30.6	L
15-1199.95	IT Project Manager	38.8	56.7	44.2	88.3	
17-2051.00	Civil Engineer	42.6	64.2	34.5	83.5	L
17-2071.00	Electrical Engineer	23.1	30.9	15.9	43.7	L
17-2141.00	Mechanical Engineer	38.9	55.3	25.5	67.2	L
17-3023.00	Electrical and Electronics Technician	24.6	27.3	14.5	42.8	L
17-3027.00	Industrial / Mechanical Engineering Technician	39.8	46.7	30.9	47.3	
21-1014.00	Mental Health / Behavioural Counselor	24.9	17.2	15.7	34.4	
21-1021.00	Family / School / General Social Worker	24.5	17.5	16.9	37.8	

Lightcast occupational code	Occupation title	Average monthly online job postings January 2015-December 2016	Average monthly online job postings January 2017-February 2020	Average monthly online job postings March 2020-December 2020	Average monthly online job postings January 2021-September 2022	Highest/lowest growth quintile
23-1011.00	Attorney	19.5	27.4	22.6	45.8	
23-2011.00	Paralegal / Legal Assistant	30.4	34.4	34.0	64.1	
25-1199.91	College Professor / Instructor	80.8	103.6	103.6	165.7	
25-2011.00	Preschool / Childcare Teacher	52.2	84.2	53.6	132.7	
25-2021.00	Elementary School Teacher	23.2	10.4	10.7	32.0	
25-4013.00	Researcher / Research Associate	27.0	28.1	23.1	44.4	
27-1024.00	Graphic Designer / Desktop Publisher	19.5	13.5	11.4	24.3	
27-1026.92	Merchandiser / Ad Set Associate	77.3	63.1	52.0	98.9	
27-3031.94	Public Relations / Communications Specialist	35.9	42.7	26.1	75.7	L
29-1051.00	Pharmacist / Pharmacy Director	43.6	32.1	18.6	45.9	L
29-1062.00	Physician	17.3	12.4	20.4	26.2	H
29-1141.00	Registered Nurse	97.2	60.3	65.0	104.5	
29-2012.00	Laboratory Technician	26.0	34.1	36.1	55.6	
29-2052.00	Pharmacy Technician	21.0	13.6	11.6	21.0	
29-2061.00	Licensed Practical / Vocational Nurse	64.0	35.2	71.7	74.1	H
29-9012.00	Safety Specialist / Co-ordinator	29.9	31.9	21.1	63.5	
31-1011.00	Home Health Aide	18.8	34.1	94.1	120.4	H
31-1015.00	Patient Transporter	2.9	1.5	1.5	1.8	
31-9095.00	Pharmacy Aide	48.0	30.9	37.9	48.9	H
33-1099.00	Loss Prevention / Asset Protection Specialist	33.1	20.8	19.5	26.8	
33-9032.00	Security Officer	51.0	60.0	90.1	104.8	H
35-1011.00	Chef	46.5	32.9	22.5	78.2	
35-1012.00	Restaurant / Food Service Supervisor	351.3	349.6	360.7	542.4	
35-2011.00	Cook	303.3	298.0	340.3	719.0	H
35-2021.00	Kitchen Staff	43.7	32.9	25.7	96.9	
35-3011.00	Bartender	15.7	17.8	16.2	66.5	
35-3021.00	Food Service Team Member	156.5	88.8	85.9	263.4	
35-3031.00	Waiter / Waitress	69.4	63.2	55.4	183.9	
35-9021.00	Dishwasher	16.5	17.9	12.5	59.4	
35-9031.00	Host / Hostess	17.3	20.3	15.8	49.9	
37-2011.00	Janitor / Cleaner	77.1	85.9	142.8	210.1	H
37-2012.00	Maid / Housekeeping Staff	68.1	80.4	105.7	225.0	H
37-3011.00	Landscaping / Groundskeeping Worker	30.3	35.6	58.0	107.1	H
39-5012.00	Barber / Hair Stylist / Cosmetologist	53.5	25.9	35.3	56.1	H

Lightcast occupational code	Occupation title	Average monthly online job postings January 2015-December 2016	Average monthly online job postings January 2017-February 2020	Average monthly online job postings March 2020-December 2020	Average monthly online job postings January 2021-September 2022	Highest/lowest growth quintile
39-9011.01	Nanny / Babysitter	171.0	244.2	93.2	189.8	L
39-9021.00	Caregiver / Personal Care Aide	195.5	130.8	86.9	93.8	
39-9031.00	Personal Trainer / Fitness Instructor	16.1	16.0	12.6	32.1	
39-9032.00	Recreation / Activities Worker	16.5	20.0	15.7	35.5	
41-1011.00	Retail Store Manager / Supervisor	473.8	396.2	381.7	604.7	
41-1012.00	Sales Supervisor	20.1	26.2	25.0	50.7	
41-2011.00	Cashier	201.8	109.0	82.9	168.8	
41-2022.00	Parts Specialist / Salesperson	13.9	18.1	17.8	45.6	
41-2031.00	Retail Sales Associate	511.9	440.3	351.0	716.7	
41-3021.00	Insurance Sales Agent	25.8	22.1	24.0	70.8	
41-3031.00	Financial Services Sales Agent	23.8	24.4	11.5	21.0	L
41-4011.00	Sales Representative	348.8	374.9	234.6	453.3	L
41-4011.92	Technical Sales Representative	38.3	28.7	14.9	30.6	L
41-9011.00	Product Demonstrator	26.0	27.3	12.7	35.7	L
41-9021.00	Real Estate Agent / Broker	21.9	28.7	27.3	45.6	
41-9099.91	Sales Assistant	13.5	18.0	13.6	27.8	
43-1011.91	Office Manager	41.1	35.9	28.1	70.8	
43-1011.92	Customer Service Manager	22.3	19.9	15.6	30.9	
43-3031.00	Bookkeeper / Accounting Clerk	132.9	159.4	138.8	328.8	
43-3051.00	Payroll Specialist	29.9	33.5	22.9	47.4	
43-4051.00	Customer Service Representative	233.3	260.4	199.8	450.3	
43-4081.00	Hotel Desk Clerk	51.1	51.5	39.2	124.6	
43-4171.00	Receptionist	77.2	68.4	53.0	146.5	
43-5031.00	Dispatcher	14.3	28.1	26.1	48.3	
43-5061.00	Scheduler / Operations Co-ordinator	37.1	61.9	39.1	97.0	
43-5071.00	Shipping / Receiving Clerk	53.6	57.9	55.9	124.2	
43-5081.00	Inventory Associate	26.5	35.9	48.2	72.2	H
43-5081.01	Stocking Clerk / Sales Floor Support	95.5	62.1	62.6	85.2	
43-5081.04	Order Processor / Order Entry Clerk	13.8	24.1	37.9	36.2	H
43-6011.91	Executive Assistant	42.8	34.2	21.0	46.3	L
43-6011.92	Account Executive	44.5	48.1	21.7	40.8	L
43-6013.00	Medical Secretary	29.6	26.6	29.5	65.9	H
43-6014.00	Office / Administrative Assistant	309.1	386.6	355.4	726.5	
43-9021.00	Data Entry Clerk	18.5	23.9	16.2	31.2	
43-9051.00	Postal Service / Mail Room Worker	21.5	20.5	19.4	26.2	

Lightcast occupational code	Occupation title	Average monthly online job postings January 2015-December 2016	Average monthly online job postings January 2017-February 2020	Average monthly online job postings March 2020-December 2020	Average monthly online job postings January 2021-September 2022	Highest/lowest growth quintile
45-2092.00	Farm / Nursery / Greenhouse Worker	33.9	33.2	20.7	46.8	L
47-1011.00	Construction Foreman	30.1	26.9	33.3	75.2	H
47-2031.00	Carpenter	49.4	42.2	83.1	165.0	H
47-2061.00	Construction Helper / Worker	57.8	85.3	135.7	286.1	H
47-2111.00	Electrician	46.6	20.2	18.0	35.6	
47-2141.00	Painter	22.4	23.0	41.1	62.8	H
49-1011.00	Maintenance / Service Supervisor	67.6	64.9	44.3	98.0	
49-3021.00	Auto Body Technician	16.0	17.2	22.7	37.3	H
49-3023.00	Automotive Service Technician / Mechanic	91.4	99.9	111.1	209.3	H
49-3031.00	Diesel Mechanic	20.8	21.7	16.6	49.8	
49-3042.00	Heavy Equipment Mechanic	54.0	56.9	33.0	101.7	L
49-9021.00	HVAC Mechanic / Installer	27.7	22.0	25.0	56.0	H
49-9041.00	Industrial Mechanic	11.7	9.1	5.1	18.1	L
49-9044.00	Millwright	32.0	21.5	12.8	30.9	L
49-9071.91	Building and General Maintenance Technician	49.1	57.0	56.5	146.5	
49-9099.00	Repair / Service Technician	67.0	67.2	52.1	118.1	
51-1011.91	Production Supervisor	23.9	21.9	22.6	35.0	
51-1011.92	Production Plant Manager	17.1	13.2	11.2	21.8	
51-3011.00	Baker	57.4	46.1	44.8	91.1	
51-3021.00	Butcher / Meat Cutter	38.7	27.8	29.5	50.0	
51-4041.00	Machinist	11.5	20.6	8.2	37.1	L
51-4121.00	Welder / Solderer	25.8	27.1	9.4	45.5	L
51-9012.92	Manufacturing Machine Operator	39.5	41.0	38.0	90.8	
51-9061.00	Quality Inspector / Technician	44.7	53.9	21.6	58.3	L
51-9199.00	Production Worker	67.8	100.6	93.9	227.5	
53-3021.00	Bus Driver	15.2	24.6	35.3	45.2	H
53-3031.00	Sales Delivery Driver	28.1	47.3	68.1	159.9	H
53-3032.00	Tractor-Trailer Truck Driver	125.9	214.9	256.8	510.7	H
53-3033.00	Light Truck Delivery Driver	46.0	79.4	80.7	201.1	
53-7051.00	Forklift / Pallet Jack Operator	23.3	23.2	31.8	57.5	H
53-7062.00	Labourer / Warehouse Worker	136.1	210.8	303.5	542.6	H
53-7064.00	Packager	3.3	3.7	7.4	16.1	H

Note: Only occupations with an above average number of OJPs in January 2015-February 2020 period are shown. The last column shows an H if an occupation was among the 20% of occupations with the highest rate of growth in between the post-pandemic period, compared to the pandemic. It shows an L if an occupation was among the 20% of analysed occupations with the smallest growth rate, and nothing otherwise.

Source: OECD calculations based on Lightcast data.

Table A B.2. Top 5 most relevant skills by occupation

Occupation code	Occupation title	Skill 1	Skill 2	Skill 3	Skill 4	Skill 5
11-1021.91	Operations Manager / Supervisor	Operations management	Financial management	Appliance repair and maintenance	Budget management	Inventory metrics
11-1021.92	General Manager	Business strategy	Pipeline planning	Customer demand planning	Leadership and management	Financial management
11-2021.91	Marketing Manager	General marketing	Media strategy and planning	Marketing strategy	Online marketing	Pardot
11-2021.92	Product Manager	Product management	Product development	Data science	Software development principles	Cloud solutions
11-2022.00	Business Development / Sales Manager	Sales management	Customer retention analysis	Business strategy	Vantive	Data services industry knowledge
11-2031.91	Communications / Public Relations Manager	Business communications	Public relations	Social media tools	Social media	Journalism
11-3011.92	Administrative Manager	Business management	Finance	Business strategy	Process mapping tools	Procurement principles
11-3031.00	Financial Manager	Finance	Corporate accounting	Financial reporting	Financial analysis	General accounting
11-3031.01	Treasurer / Controller	General accounting	Corporate accounting	Financial analysis	Cost accounting	Financial accounting
11-3031.93	Banking Branch Manager	Sales management	Data services industry knowledge	Inside sales	Financial advisement	Banking industry knowledge
11-3121.92	Human Resources Manager	Human resource management systems	Employee relations	Payroll	Recruitment	Human resources systems
11-9021.00	Construction Manager	Construction management	Roofing	Construction inspection	Civil and architectural engineering	Road and bridge construction
11-9033.00	College / University Administrator	Conservation science	Higher education	Social media	Instructional and curriculum design	Online communications
11-9041.00	Engineering Manager	Engineering management	Engineering practices	Project management	Industrial engineering	Mechanical engineering
11-9051.00	Restaurant / Food Service Manager	Food and beverage industry knowledge	Food and beverage service	Customer service status reports	Fine dining experience	Store management
11-9111.00	Healthcare Administrator	Medical support	Basic patient care	Healthcare procedure and regulation	Oncology	Gastroenterology
11-9141.91	Property / Real Estate / Community Manager	Property management	Real estate and rental	Real estate industry knowledge	Financial efficiency	Management industry knowledge
11-9199.00	Program Manager	Program management	Business strategy	Financial management	Project management	Presentation skills
13-1021.00	Buyer / Purchasing Agent	Wholesale buying	Procurement	Supply chain management	Supplier relationship management	Supply chain planning
13-1051.00	Estimator	Estimating	Construction management	Project management software	Performance bonds	Construction industry knowledge

Occupation code	Occupation title	Skill 1	Skill 2	Skill 3	Skill 4	Skill 5
13-1071.91	Recruiter	Recruitment	Human resource management systems	Human resources software	Human resources industry knowledge	Sourcing best practices
13-1071.92	Human Resources / Labour Relations Specialist	Human resource management systems	Pagerduty	SAP successfactors	Sourcing technologies	Payroll services industry knowledge
13-1111.00	Business Management / Analyst	Business consulting	Business intelligence	Financial regulations	Financial services industry knowledge	Business process and analysis
13-1121.00	Event Planner	Event planning and management	Urban planning	Entertainment industry knowledge	Fundraising	Media strategy and planning
13-1151.00	Training and Development Specialist	Instructional and curriculum design	Training programs	Web content	Learning management systems	Multimedia
13-1161.00	Marketing Specialist	General marketing	Online marketing	Online advertising	Seo copywriting	Marketing strategy
13-2011.02	Auditor	Auditing	Financial risk management	Financial reporting	Financial accounting	Corporate accounting
13-2011.93	Accountant	General accounting	Cash flow reporting	Financial reporting	Specialised accounting	Accounts payable and receivable
13-2011.94	Account Manager / Representative	Account management	Inside sales	Technical sales	Order tracking in SAP	Data services industry knowledge
13-2051.00	Financial Analyst	Financial analysis	General accounting	Financial reporting	Corporate accounting	Ad hoc analysis and reporting
13-2052.00	Personal Financial Advisor	Financial advisement	Investment management	Carbon accounting	Financial services industry knowledge	Process mapping tools
13-2072.00	Loan Officer	Mortgage lending	Banking industry knowledge	Underwriting	Commercial lending	General lending
15-1121.00	Systems Analyst	IT management	Extensible languages	System design and implementation	SQL databases and programming	Software development methodologies
15-1122.00	Cyber / Information Security Engineer / Analyst	Cybersecurity	Information security	Government clearance and security standards	Nist cybersecurity framework	Open web application security project owasp
15-1131.00	Software Developer / Engineer	Software development principles	No SQL databases	Java	Programming principles	Typescript
15-1131.91	Computer Programmer	Java	C and c++	Object relational mapping orm	Nginx	Integrated development environments ides
15-1133.00	Computer Systems Engineer / Architect	System design and implementation	Software development principles	Software development methodologies	Network protocols	Firmware
15-1134.92	Web Developer	Web development	Javascript and jquery	It automation	No SQL databases	Typescript
15-1134.93	UI / UX Designer / Developer	User research	User interface and user experience ui ux design	Design thinking	Typescript	Telerik mobile app development platform
15-1141.00	Database Administrator	Data warehousing	SQL databases and programming	Scripting	Data dictionary system	Unix platforms
15-1142.00	Network / Systems Administrator	Network protocols	Network configuration	General networking	Systems administration	Virtual machines vm
15-1151.00	Computer Support Specialist	Network configuration	Operating systems	Network protocols	Help desk support	Hands on desktop fixes

Occupation code	Occupation title	Skill 1	Skill 2	Skill 3	Skill 4	Skill 5
15-1199.01	Software QA Engineer / Tester	Software quality assurance	Test automation	Software development principles	Java	Programming principles
15-1199.02	Network Engineer / Architect	It management	General networking	Microsoft certified professional azure	It automation	Distributed computing
15-1199.09	Project Manager	Project management software	Project management	Financial management	Budget management	Contract management
15-1199.91	Data / Data Mining Analyst	SQL databases and programming	Microsoft power bi	Data visualisation	Extraction	Data mining
15-1199.93	Business Intelligence Analyst	Business intelligence	SQL databases and programming	Microsoft power BI	Data warehousing	SAP
15-1199.95	IT Project Manager	Software development methodologies	IT management	Software development principles	Software quality assurance	Waterfall development process
17-2051.00	Civil Engineer	Civil and architectural engineering	Engineering software	Drafting and engineering design	Structural steel design	Geotechnical engineering
17-2071.00	Electrical Engineer	Electrical and computer engineering	Electrical power	Electrical construction	Engineering software	Mechanical engineering
17-2141.00	Mechanical Engineer	Mechanical engineering	Industrial engineering	Engineering practices	Solidworks	Electrical and computer engineering
17-3023.00	Electrical and Electronics Technician	Electrical construction	Schematic diagrams	Electronics industry knowledge	Electrical and computer engineering	Electrical power
17-3027.00	Industrial Mechanical Engineering Technician /	Basic electrical systems	Schematic diagrams	Electrical construction	Equipment repair and maintenance	Preventive maintenance
21-1014.00	Mental Health / Behavioural Counselor	Mental health therapies	Social work	Mental and behavioural health specialties	Advanced patient care	Cognitive behavioural therapy
21-1021.00	Family / School / General Social Worker	Social work	Social services industry knowledge	Mental health therapies	Child development	Advanced patient care
23-1011.00	Attorney	Litigation	Legal research	Legal databases	Litigation support software	Mergers and acquisitions
23-2011.00	Paralegal / Legal Assistant	Litigation	Dictation	Will preparation	Legal document proofreading	Legal and law enforcement industry knowledge
25-1199.91	College Professor / Instructor	Instructional and curriculum design	Education administration	Teaching	Learning management systems	Economic development
25-2011.00	Preschool / Childcare Teacher	Childhood education and development	Childcare	Child development	Child CPR	Changing diapers
25-2021.00	Elementary School Teacher	Teaching	Childcare	Emergency and intensive care	First aid	Speech language pathology
25-4013.00	Researcher / Research Associate	Research methodology	Research	Drug design	Data analysis	Molecular cloning
27-1024.00	Graphic Designer / Desktop Publisher	Graphic and visual design	Art and illustration	Graphic and visual design software	Web design	Creative design
27-1026.92	Merchandiser / Ad Set Associate	Merchandising	Retail industry knowledge	Store management	Personal care industry knowledge	Retail store operations

Occupation code	Occupation title	Skill 1	Skill 2	Skill 3	Skill 4	Skill 5
27-3031.94	Public Relations / Communications Specialist	Public relations	Business communications	General marketing	Journalism	Social media tools
29-1051.00	Pharmacist / Pharmacy Director	Pharmacy	Prescription compounding	Intake co-ordination	Prescription filing	Basic patient care
29-1062.00	Physician	Obstetrics and gynecology obgyn	Neurology	Surgery	Pediatrics	General medicine
29-1141.00	Registered Nurse	Pediatrics	Medical support	Basic patient care	Advanced patient care	Central lines
29-2012.00	Laboratory Technician	Laboratory research	Blood collection	Specimen processing	Chemical analysis	Cerebrospinal fluid analysis
29-2052.00	Pharmacy Technician	Prescription compounding	Pharmacy	Benzodiazepines	Blister packaging	Pharmaceuticals labeling
29-2061.00	Licensed Practical / Vocational Nurse	Pediatrics	Advanced patient care	Medical support	Geriatrics	Patient education and support
29-9012.00	Safety Specialist / Co-ordinator	Occupational hygiene	Hazard identification	Occupational health and safety	Hazardous waste management	Emergency response planning
31-1011.00	Home Health Aide	Basic living activities support	Healthy meal preparation	Geriatrics	Mental health diseases and disorders	Medical support
31-1015.00	Patient Transporter	Medical support	Influenza immunisation	Patient physical measurements	Prevention of unauthorised entry	Tuberculosis skin test
31-9095.00	Pharmacy Aide	Pharmacy	Drug storage	Pharmaceuticals labeling	Prescription compounding	Blister packaging
33-1099.00	Loss Prevention / Asset Protection Specialist	Loss prevention	Physical security	Law enforcement and criminal justice	Government clearance and security standards	Internet security
33-9032.00	Security Officer	Physical security	Internet security	Transportation security	Prevention of unauthorised entry	Communications industry security
35-1011.00	Chef	Allergies	Food and beverage service	Fine dining experience	Food allergy	Hospitality and leisure industry knowledge
35-1012.00	Restaurant / Food Service Supervisor	Food and beverage service	Manometers	Staff relations	Generator installation	Insulating materials
35-2011.00	Cook	Food and beverage service	Allergies	Thai	Food and beverage industry knowledge	Fine dining experience
35-2021.00	Kitchen Staff	Food and beverage service	Food and beverage industry knowledge	Work area maintenance	Allergies	Thai
35-3011.00	Bartender	Food and beverage service	Fine dining experience	Food and beverage industry knowledge	Cash register operation	Hospitality and leisure industry knowledge
35-3021.00	Food Service Team Member	Food and beverage service	Food and beverage industry knowledge	Work area maintenance	Process mapping tools	Retail store operations
35-3031.00	Waiter / Waitress	Bill preparation	Food and beverage industry knowledge	Fine dining experience	Allergic reaction	Hospitality and leisure industry knowledge
35-9021.00	Dishwasher	Food and beverage service	Food and beverage industry knowledge	Work area maintenance	Power hoists	Thai

Occupation code	Occupation title	Skill 1	Skill 2	Skill 3	Skill 4	Skill 5
35-9031.00	Host / Hostess	Bill preparation	Fine dining experience	Hospitality and leisure industry knowledge	Wideorbit automation	Macromedia lingo
37-2011.00	Janitor / Cleaner	Furniture moving	Housekeeping	Infection control protocol	Cleaning	Pressure washers
37-2012.00	Maid / Housekeeping Staff	Housekeeping	Furniture moving	Process mapping tools	Food and beverage service	Cleaning
37-3011.00	Landscaping / Groundskeeping Worker	Landscaping and yard care	Oral irrigation	Skid steer loader	Grass cutting	Rototillers
39-5012.00	Barber / Hair Stylist / Cosmetologist	Personal care	Cosmetics industry knowledge	Skin conditions	Joint conditions	Retail store operations
39-9011.01	Nanny / Babysitter	Childcare	Child development	Childhood education and development	Changing diapers	Down syndrome
39-9021.00	Caregiver / Personal Care Aide	Basic living activities support	Geriatrics	Housekeeping	Mental health diseases and disorders	Healthy meal preparation
39-9031.00	Personal Trainer / Fitness Instructor	Exercise training	Emergency and intensive care	Coaching and athletic training	Calendar software	Osteoarthritis
39-9032.00	Recreation / Activities Worker	Child development	Childhood education and development	Program management	Archery	Music
41-1011.00	Retail Store Manager / Supervisor	Store management	Merchandising	Retail industry knowledge	Retail store operations	Retail sales
41-1012.00	Sales Supervisor	General sales	Account management	Sales management	Company product and service knowledge	Prospecting and qualification
41-2011.00	Cashier	Cash register operation	Merchandising	Retail industry knowledge	Payment processing and collection	Customer service status reports
41-2022.00	Parts Specialist / Salesperson	Ingres openroad	Inventory management	Sales analysis	Receiving functions	Automotive repair industry knowledge
41-2031.00	Retail Sales Associate	Retail sales	General sales practices	Retail industry knowledge	Retail store operations	General sales
41-3021.00	Insurance Sales Agent	Insurance sales	Underwriting	Property and casualty insurance sales	Small business service	Mortgage lending
41-3031.00	Financial Services Sales Agent	Banking services	Financial advisement	Segregated funds	Financial lending industry knowledge	Financial services industry knowledge
41-4011.00	Sales Representative	General sales	Specialised sales	Inside sales	Marketing software	B2b advertising
41-4011.92	Technical Sales Representative	Technical sales	Technical demonstrations	Inside sales	Prospecting and qualification	Solution sales engineering
41-9011.00	Product Demonstrator	Brand management	Brand loyalty	Audio board	Equipment implementation	Macromedia lingo
41-9021.00	Real Estate Agent / Broker	Real estate and rental	Property management	Real estate industry knowledge	Due diligence	Vanity installation
41-9099.91	Sales Assistant	Inside sales	General sales	Company product and service knowledge	General sales practices	Order management
43-1011.91	Office Manager	Office management	General accounting	Ad hoc analysis and reporting	Business management	Performance management

Occupation code	Occupation title	Skill 1	Skill 2	Skill 3	Skill 4	Skill 5
43-1011.92	Customer Service Manager	Clarizen	Account management	Data services industry knowledge	Business to business b2b sales	General sales
43-3031.00	Bookkeeper / Accounting Clerk	Accounts payable and receivable	General accounting	Simply accounting	Accounting and finance software	Office management
43-3051.00	Payroll Specialist	Payroll	Deductions	Human resource management systems	Ultipro	Canadian payroll
43-4051.00	Customer Service Representative	Inside sales	Customer service status reports	Credit debit card processing	Monitoring road conditions	Service failure reporting
43-4081.00	Hotel Desk Clerk	Hospitality and leisure industry knowledge	Telephone skills	Office management	Cash register operation	Active alpha generation
43-4171.00	Receptionist	Administrative support	Office management	Telephone skills	Payment processing and collection	Alternative distribution channels
43-5031.00	Dispatcher	Monitoring road conditions	Radio frequency equipment	Order tracking in SAP	Ground transportation industry knowledge	Emergency services
43-5061.00	Scheduler / Operations Co-ordinator	Logistics	Supply chain management	Project management software	Transportation operations management	Supply chain planning
43-5071.00	Shipping / Receiving Clerk	General shipping and receiving	Stock counting	Warehouse management	Purchase order reconciliation	Material handling
43-5081.00	Inventory Associate	General shipping and receiving	Material handling	Inventory management	Warehouse management	Centura
43-5081.01	Stocking Clerk / Sales Floor Support	Merchandising	Store management	Shrinkage management	Inventory management	Customer service status reports
43-5081.04	Order Processor / Order Entry Clerk	Order management	General shipping and receiving	Material handling	E commerce	Stock counting
43-6011.91	Executive Assistant	Myob	Organizing office supplies	Filing pleadings	Legal document editing	Fixed asset register
43-6011.92	Account Executive	Account management	Business to business b2b sales	Solution sales engineering	General sales	Marketing software
43-6013.00	Medical Secretary	Medical records	Basic patient care	Office management	Patient reception	Treatment room preparation
43-6014.00	Office / Administrative Assistant	Administrative support	Office management	Myob	Typing	Organizing office supplies
43-9021.00	Data Entry Clerk	Typing	Health records	General administrative and clerical tasks	Office machines	Organizing office supplies
43-9051.00	Postal Service / Mail Room Worker	Postal services industry knowledge	Accounting and finance software	Fault codes	Outside sales	Benzodiazepines
45-2092.00	Farm / Nursery / Greenhouse Worker	Disease detection	Agronomy and farming	Tillage	Manure spreaders	Planting drills
47-1011.00	Construction Foreman	Construction management	Road and bridge construction	Skid steer loader	Road construction	Pneumatic hammers
47-2031.00	Carpenter	Carpentry	Window and door installation	Construction carpentry	Deck building	Shingle replacement
47-2061.00	Construction Helper / Worker	Construction labour	Road and bridge construction	Construction management	Roofing	Road construction

Occupation code	Occupation title	Skill 1	Skill 2	Skill 3	Skill 4	Skill 5
47-2111.00	Electrician	Industrial electrical experience	Basic electrical systems	Electrical construction	Electrical power	Conduits
47-2141.00	Painter	Construction painting	Brush painting	Painting	Painting art	Automotive painting
49-1011.00	Maintenance / Service Supervisor	Facility management and maintenance	Estimating	Lean manufacturing	Repair	Preventive maintenance
49-3021.00	Auto Body Technician	Automotive painting	Body panel repair	Frame straightening	Machine tending	Vehicle repair and maintenance
49-3023.00	Automotive Service Technician / Mechanic	Automotive repair industry knowledge	Vehicle repair and maintenance	Frame straightening	Mining services	Automotive industry knowledge
49-3031.00	Diesel Mechanic	Vehicle repair and maintenance	Frame straightening	Automotive repair industry knowledge	Ground transportation industry knowledge	Headlight replacement
49-3042.00	Heavy Equipment Mechanic	Heavy equipment	Lubrication systems	Repair	Equipment repair and maintenance	Automotive repair industry knowledge
49-9021.00	HVAC Mechanic / Installer	Hvac	Electrical construction	Ventilation	Plumbing	Insulation
49-9041.00	Industrial Mechanic	Industrial engineering industry knowledge	Repair	Industrial electrical experience	Machinery	Material handling
49-9044.00	Millwright	Welding	Industrial electrical experience	Machine tools	Gear alignment	Preventive maintenance
49-9071.91	Building and General Maintenance Technician	Plumbing	Facility management and maintenance	Landscaping and yard care	Drywall	Equipment repair and maintenance
49-9099.00	Repair / Service Technician	Equipment repair and maintenance	Repair	Printer repair	Plumbing	Basic electrical systems
51-1011.91	Production Supervisor	Lean manufacturing	Manufacturing processes	Trucking operations	Pollution control systems	Inspecting freight cars
51-1011.92	Production Plant Manager	Manufacturing processes	Manufacturing and production industry knowledge	Operations management	Lean manufacturing	Radial drills
51-3011.00	Baker	Allergies	Food and beverage service	Viscera	Work area maintenance	Thai
51-3021.00	Butcher / Meat Cutter	Viscera	Retail store operations	Food and beverage service	Work area maintenance	Shrinkage management
51-4041.00	Machinist	Machine tools	Computer aided manufacturing	Sawing machines	Radial drills	Powermill
51-4121.00	Welder / Solderer	Welding blueprints	Flame cutting equipment	Industrial welding	Welding	Brazing and soldering
51-9012.92	Manufacturing Machine Operator	Machine tools	Sawing machines	Hand tools	Oil drilling	Metal fabrication
51-9061.00	Quality Inspector / Technician	Quality assurance and control	Manufacturing standards	Packaging procedures	Plastics material industry knowledge	Sensory analysis
51-9199.00	Production Worker	Hand tools	Machine tools	Machine tending	Machine setting	Jigsaws
53-3021.00	Bus Driver	Transportation operations	Accident procedures	Streetcars	Bus safety	Vehicle repair and maintenance
53-3031.00	Sales Delivery Driver	Product delivery	Transportation industry knowledge	Transportation operations	Material handling	Household appliances industry knowledge

Occupation code	Occupation title	Skill 1	Skill 2	Skill 3	Skill 4	Skill 5
53-3032.00	Tractor-Trailer Truck Driver	Transportation operations	Load security	Product delivery	Weigh station	Heavy hauling
53-3033.00	Light Truck Delivery Driver	Transportation operations	Product delivery	Heavy hauling	Heavy equipment	Load security
53-7051.00	Forklift / Pallet Jack Operator	Material handling	General shipping and receiving	Hand tools	Machinery	Warehouse management
53-7062.00	Labourer / Warehouse Worker	Material handling	Purchase order reconciliation	Machinery	Rf scan gun	Warehouse management
53-7064.00	Packager	Material handling	General shipping and receiving	Purchase order reconciliation	Stock counting	Metal fabrication

Note: Skills in the table's columns are ordered by their relevance for the occupation at hand. Skill relevance score are inferred by applying natural language processing (NLP) algorithms to the analysis of online job postings for Canada. The ranking is based on the cosine similarity between each skill keyword vector representation and the vector representation of the occupation.

Source: OECD calculations based on Lightcast data.

Table A B.3. Typical education requirement by occupation

Canada, 2015-2022

Occupation code	Occupation title	1 st most likely requirement	2 nd most likely requirement	3 rd most likely requirement	Percentage N/A
43-6011.92	Account Executive	Bachelor's	Higher Secondary Certificate	Bachelor of Science	64.4%
13-2011.94	Account Manager / Representative	Bachelor's	Higher Secondary Certificate	Bachelor of Science	59.1%
13-2011.93	Accountant	Bachelor's	Chartered Accountant	Bachelor's in Accounting	65.8%
11-3011.92	Administrative Manager	Bachelor's	Associate's	Higher Secondary Certificate	64.5%
23-1011.00	Attorney	Juris Doctor	Doctorate	Master of Business Administration	79.8%
13-2011.02	Auditor	Bachelor's	Chartered Accountant	Bachelor's in Computer Science	58.8%
49-3021.00	Auto Body Technician	Higher Secondary Certificate	High School Equivalency	Secondary	88.9%
49-3023.00	Automotive Service Technician / Mechanic	Higher Secondary Certificate	Associate's	High School Equivalency	81.4%
51-3011.00	Baker	Higher Secondary Certificate	Associate's	High School Equivalency	87.4%
11-3031.93	Banking Branch Manager	Bachelor's	Higher Secondary Certificate	Bachelor of Arts	58.5%
39-5012.00	Barber / Hair Stylist / Cosmetologist	Higher Secondary Certificate	Associate's	High School Equivalency	91.8%
35-3011.00	Bartender	Higher Secondary Certificate	High School Equivalency	General Equivalency Degree	90.2%
43-3031.00	Bookkeeper / Accounting Clerk	Bachelor's	Higher Secondary Certificate	Associate's	69.8%
49-9071.91	Building and General Maintenance Technician	Higher Secondary Certificate	High School Equivalency	Associate's	75.2%
53-3021.00	Bus Driver	Higher Secondary Certificate	Secondary	Juris Doctor	95.1%
13-1111.00	Business / Management Analyst	Bachelor's	Bachelor of Arts	Bachelor's in Computer Science	52.2%

Occupation code	Occupation title	1 st most likely requirement	2 nd most likely requirement	3 rd most likely requirement	Percentage N/A
11-2022.00	Business Development / Sales Manager	Bachelor's	Higher Secondary Certificate	Associate's	52.1%
15-1199.93	Business Intelligence Analyst	Bachelor's	Bachelor's in Computer Science	Bachelor of Arts	45.4%
51-3021.00	Butcher / Meat Cutter	Higher Secondary Certificate	High School Equivalency	Secondary	90.7%
13-1021.00	Buyer / Purchasing Agent	Bachelor's	Higher Secondary Certificate	Associate's	63.8%
39-9021.00	Caregiver / Personal Care Aide	Higher Secondary Certificate	Associate's	High School Equivalency	73.5%
47-2031.00	Carpenter	Higher Secondary Certificate	High School Equivalency	General Equivalency Degree	86.6%
41-2011.00	Cashier	Higher Secondary Certificate	High School Equivalency	General Equivalency Degree	88.3%
35-1011.00	Chef	Higher Secondary Certificate	Associate's	Bachelor's	82.6%
17-2051.00	Civil Engineer	Bachelor's	Bachelor of Science	Master's	44.2%
11-9033.00	College / University Administrator	Bachelor's	Master's	Graduate Degree	56.2%
25-1199.91	College Professor / Instructor	Doctor of Philosophy	Bachelor's	Master's	40.2%
11-2031.91	Communications / Public Relations Manager	Bachelor's	Higher Secondary Certificate	Associate's	49.2%
15-1131.91	Computer Programmer	Bachelor's	Bachelor's in Computer Science	Higher Secondary Certificate	64.2%
15-1151.00	Computer Support Specialist	Bachelor's	Bachelor's in Computer Science	Higher Secondary Certificate	66.7%
15-1133.00	Computer Systems Engineer / Architect	Bachelor's	Bachelor's in Computer Science	Bachelor of Science	46.3%
47-1011.00	Construction Foreman	Higher Secondary Certificate	Bachelor's	Associate's	76.2%
47-2061.00	Construction Helper / Worker	Higher Secondary Certificate	High School Equivalency	General Equivalency Degree	87.6%
11-9021.00	Construction Manager	Bachelor's	Higher Secondary Certificate	Associate's	66.6%
35-2011.00	Cook	Higher Secondary Certificate	High School Equivalency	Associate's	83.0%
43-1011.92	Customer Service Manager	Bachelor's	Higher Secondary Certificate	Associate's	66.6%
43-4051.00	Customer Service Representative	Higher Secondary Certificate	Bachelor's	High School Equivalency	70.5%
15-1122.00	Cyber / Information Security Engineer / Analyst	Bachelor's	Bachelor's in Computer Science	Higher Secondary Certificate	48.0%
15-1199.91	Data / Data Mining Analyst	Bachelor's	Bachelor's in Computer Science	Master's	46.4%
43-9021.00	Data Entry Clerk	Higher Secondary Certificate	Bachelor's	Associate's	76.5%
15-1141.00	Database Administrator	Bachelor's	Bachelor's in Computer Science	Higher Secondary Certificate	59.9%
49-3031.00	Diesel Mechanic	Higher Secondary Certificate	Associate's	High School Equivalency	83.4%
35-9021.00	Dishwasher	Higher Secondary Certificate	High School Equivalency	General Equivalency Degree	92.4%
43-5031.00	Dispatcher	Higher Secondary Certificate	Bachelor's	Master's	72.5%
17-3023.00	Electrical and Electronics Technician	Higher Secondary Certificate	Bachelor's	Associate's	75.6%

Occupation code	Occupation title	1 st most likely requirement	2 nd most likely requirement	3 rd most likely requirement	Percentage N/A
17-2071.00	Electrical Engineer	Bachelor's	Bachelor of Science	Master's	48.9%
47-2111.00	Electrician	Higher Secondary Certificate	Associate's	High School Equivalency	82.4%
25-2021.00	Elementary School Teacher	Bachelor's	Bachelor's in Education	Master's	76.4%
11-9041.00	Engineering Manager	Bachelor's	Bachelor of Science	Bachelor's in Computer Science	50.0%
13-1051.00	Estimator	Bachelor's	Higher Secondary Certificate	Associate's	70.7%
13-1121.00	Event Planner	Bachelor's	Higher Secondary Certificate	Associate's	65.5%
43-6011.91	Executive Assistant	Bachelor's	Higher Secondary Certificate	Associate's	74.0%
21-1021.00	Family / School / General Social Worker	Bachelor's	Master's	Master of Social Work	50.5%
45-2092.00	Farm / Nursery / Greenhouse Worker	Higher Secondary Certificate	Associate's	High School Equivalency	93.0%
13-2051.00	Financial Analyst	Bachelor's	Master of Business Administration	Bachelor's in Business	46.1%
11-3031.00	Financial Manager	Bachelor's	Master of Business Administration	Higher Secondary Certificate	56.3%
41-3031.00	Financial Services Sales Agent	Higher Secondary Certificate	Bachelor's	Associate's	76.5%
35-3021.00	Food Service Team Member	Higher Secondary Certificate	High School Equivalency	General Equivalency Degree	86.1%
53-7051.00	Forklift / Pallet Jack Operator	Higher Secondary Certificate	High School Equivalency	Bachelor of Arts	81.7%
11-1021.92	General Manager	Bachelor's	Higher Secondary Certificate	Master's	52.3%
27-1024.00	Graphic Designer / Desktop Publisher	Bachelor's	Associate's	Higher Secondary Certificate	69.5%
11-9111.00	Healthcare Administrator	Bachelor's	Master's	Bachelor of Science	44.6%
49-3042.00	Heavy Equipment Mechanic	Higher Secondary Certificate	Associate's	General Equivalency Degree	82.2%
31-1011.00	Home Health Aide	Higher Secondary Certificate	High School Equivalency	General Equivalency Degree	85.7%
35-9031.00	Host / Hostess	Higher Secondary Certificate	High School Equivalency	Juris Doctor	89.8%
43-4081.00	Hotel Desk Clerk	Higher Secondary Certificate	Associate's	Bachelor's	74.0%
13-1071.92	Human Resources / Labour Relations Specialist	Bachelor's	Higher Secondary Certificate	Associate's	53.4%
11-3121.92	Human Resources Manager	Bachelor's	Associate's	Higher Secondary Certificate	48.1%
49-9021.00	HVAC Mechanic / Installer	Higher Secondary Certificate	Associate's	High School Equivalency	78.4%
17-3027.00	Industrial / Mechanical Engineering Technician	Higher Secondary Certificate	Bachelor's	Associate's	74.9%
49-9041.00	Industrial Mechanic	Higher Secondary Certificate	Associate's	Master of Science	88.4%
41-3021.00	Insurance Sales Agent	Higher Secondary Certificate	Bachelor's	Associate's	72.8%
43-5081.00	Inventory Associate	Higher Secondary Certificate	High School Equivalency	Bachelor's	72.4%
15-1199.95	IT Project Manager	Bachelor's	Bachelor's in Computer Science	Master's	48.2%

Occupation code	Occupation title	1 st most likely requirement	2 nd most likely requirement	3 rd most likely requirement	Percentage N/A
37-2011.00	Janitor / Cleaner	Higher Secondary Certificate	High School Equivalency	General Equivalency Degree	85.2%
35-2021.00	Kitchen Staff	Higher Secondary Certificate	High School Equivalency	General Equivalency Degree	89.8%
29-2012.00	Laboratory Technician	Higher Secondary Certificate	Bachelor's	Bachelor of Science	63.5%
53-7062.00	Labourer / Warehouse Worker	Higher Secondary Certificate	High School Equivalency	Associate's	75.6%
37-3011.00	Landscaping / Groundskeeping Worker	Higher Secondary Certificate	High School Equivalency	Associate's	86.6%
29-2061.00	Licensed Practical / Vocational Nurse	Associate's	Higher Secondary Certificate	High School Equivalency	91.1%
53-3033.00	Light Truck Delivery Driver	Higher Secondary Certificate	High School Equivalency	General Equivalency Degree	83.3%
13-2072.00	Loan Officer	Bachelor's	Higher Secondary Certificate	Associate's	78.1%
33-1099.00	Loss Prevention / Asset Protection Specialist	Higher Secondary Certificate	Bachelor's	Associate's	63.5%
51-4041.00	Machinist	Higher Secondary Certificate	Associate's	High School Equivalency	81.0%
37-2012.00	Maid / Housekeeping Staff	Higher Secondary Certificate	High School Equivalency	Master's	89.5%
49-1011.00	Maintenance / Service Supervisor	Bachelor's	Higher Secondary Certificate	Associate's	69.7%
51-9012.92	Manufacturing Machine Operator	Higher Secondary Certificate	High School Equivalency	Bachelor's	75.7%
11-2021.91	Marketing Manager	Bachelor's	Associate's	Higher Secondary Certificate	46.9%
13-1161.00	Marketing Specialist	Bachelor's	Associate's	Bachelor of Science	61.4%
17-2141.00	Mechanical Engineer	Bachelor's	Bachelor of Science	Master's	50.1%
43-6013.00	Medical Secretary	Higher Secondary Certificate	Associate's	Bachelor's	73.4%
21-1014.00	Mental Health / Behavioural Counselor	Bachelor's	Master's	Higher Secondary Certificate	40.9%
27-1026.92	Merchandiser / Ad Set Associate	Higher Secondary Certificate	Bachelor's	High School Equivalency	69.6%
49-9044.00	Millwright	Higher Secondary Certificate	Associate's	General Equivalency Degree	82.8%
39-9011.01	Nanny / Babysitter	Higher Secondary Certificate	Associate's	Bachelor of Arts	90.4%
15-1142.00	Network / Systems Administrator	Bachelor's	Bachelor's in Computer Science	Associate's	63.4%
15-1199.02	Network Engineer / Architect	Bachelor's	Bachelor's in Computer Science	Bachelor of Science	52.6%
43-6014.00	Office / Administrative Assistant	Higher Secondary Certificate	Bachelor's	Associate's	72.6%
43-1011.91	Office Manager	Bachelor's	Higher Secondary Certificate	Associate's	59.5%
11-1021.91	Operations Manager / Supervisor	Bachelor's	Higher Secondary Certificate	Associate's	54.8%
43-5081.04	Order Processor / Order Entry Clerk	Higher Secondary Certificate	Bachelor's	High School Equivalency	80.7%
53-7064.00	Packager	Higher Secondary Certificate	High School Equivalency	Associate's	79.3%
47-2141.00	Painter	Higher Secondary Certificate	High School Equivalency	General Equivalency Degree	87.2%

Occupation code	Occupation title	1 st most likely requirement	2 nd most likely requirement	3 rd most likely requirement	Percentage N/A
23-2011.00	Paralegal / Legal Assistant	Bachelor's	Higher Secondary Certificate	Associate's	85.5%
41-2022.00	Parts Specialist / Salesperson	Higher Secondary Certificate	Associate's	Bachelor's	83.1%
31-1015.00	Patient Transporter	Higher Secondary Certificate	Secondary	Secondary	98.5%
43-3051.00	Payroll Specialist	Bachelor's	Higher Secondary Certificate	Associate's	77.8%
13-2052.00	Personal Financial Advisor	Bachelor's	Higher Secondary Certificate	Associate's	76.5%
39-9031.00	Personal Trainer / Fitness Instructor	Bachelor's	Higher Secondary Certificate	Associate's	57.8%
29-1051.00	Pharmacist / Pharmacy Director	Doctor Of Pharmacy	Master's	Doctorate	97.2%
31-9095.00	Pharmacy Aide	Higher Secondary Certificate	High School Equivalency	Secondary	86.3%
29-2052.00	Pharmacy Technician	Higher Secondary Certificate	Associate's	High School Equivalency	92.3%
29-1062.00	Physician	Doctorate	Doctor of Medicine	Doctor of Philosophy	85.9%
43-9051.00	Postal Service / Mail Room Worker	Higher Secondary Certificate	Bachelor's	Master of Business Administration	57.4%
25-2011.00	Preschool / Childcare Teacher	Associate's	Bachelor's	Higher Secondary Certificate	76.0%
41-9011.00	Product Demonstrator	Higher Secondary Certificate	Bachelor's	Bachelor of Arts	75.6%
11-2021.92	Product Manager	Bachelor's	Bachelor's in Computer Science	Bachelor of Science	40.1%
51-1011.92	Production Plant Manager	Bachelor's	Higher Secondary Certificate	Associate's	58.0%
51-1011.91	Production Supervisor	Higher Secondary Certificate	Bachelor's	Associate's	66.5%
51-9199.00	Production Worker	Higher Secondary Certificate	High School Equivalency	Bachelor's	77.1%
11-9199.00	Program Manager	Bachelor's	Master's	Bachelor's in Computer Science	44.9%
15-1199.09	Project Manager	Bachelor's	Higher Secondary Certificate	Bachelor's in Computer Science	55.1%
11-9141.91	Property / Real Estate / Community Manager	Bachelor's	Higher Secondary Certificate	Associate's	70.9%
27-3031.94	Public Relations / Communications Specialist	Bachelor's	Associate's	Master's	59.1%
51-9061.00	Quality Inspector / Technician	Higher Secondary Certificate	Bachelor's	Associate's	50.2%
41-9021.00	Real Estate Agent / Broker	Bachelor's	Higher Secondary Certificate	Associate's	72.2%
43-4171.00	Receptionist	Higher Secondary Certificate	Associate's	Bachelor's	80.9%
39-9032.00	Recreation / Activities Worker	Higher Secondary Certificate	Bachelor's	Associate's	77.9%
13-1071.91	Recruiter	Bachelor's	Higher Secondary Certificate	Associate's	61.9%
29-1141.00	Registered Nurse	Associate's	Bachelor's	Bachelor of Science	48.0%
49-9099.00	Repair / Service Technician	Higher Secondary Certificate	Associate's	High School Equivalency	78.0%
25-4013.00	Researcher / Research Associate	Bachelor's	Master's	Doctor of Philosophy	40.9%

Occupation code	Occupation title	1 st most likely requirement	2 nd most likely requirement	3 rd most likely requirement	Percentage N/A
11-9051.00	Restaurant / Food Service Manager	Higher Secondary Certificate	Associate's	Bachelor's	71.1%
35-1012.00	Restaurant / Food Service Supervisor	Higher Secondary Certificate	Bachelor's	Associate's	73.7%
41-2031.00	Retail Sales Associate	Higher Secondary Certificate	Bachelor's	High School Equivalency	75.2%
41-1011.00	Retail Store Manager / Supervisor	Higher Secondary Certificate	Bachelor's	Associate's	69.3%
29-9012.00	Safety Specialist / Co-ordinator	Bachelor's	Higher Secondary Certificate	Associate's	65.0%
41-9099.91	Sales Assistant	Bachelor's	Higher Secondary Certificate	Associate's	73.4%
53-3031.00	Sales Delivery Driver	Higher Secondary Certificate	High School Equivalency	General Equivalency Degree	85.8%
41-4011.00	Sales Representative	Bachelor's	Higher Secondary Certificate	Associate's	69.6%
41-1012.00	Sales Supervisor	Bachelor's	Higher Secondary Certificate	High School Equivalency	67.5%
43-5061.00	Scheduler / Operations Co-ordinator	Bachelor's	Higher Secondary Certificate	Associate's	68.4%
33-9032.00	Security Officer	Higher Secondary Certificate	Bachelor's	Bachelor of Science in Technology	65.3%
43-5071.00	Shipping / Receiving Clerk	Higher Secondary Certificate	High School Equivalency	Bachelor's	73.5%
15-1131.00	Software Developer / Engineer	Bachelor's	Bachelor's in Computer Science	Bachelor of Science	51.4%
15-1199.01	Software QA Engineer / Tester	Bachelor's	Bachelor's in Computer Science	Bachelor of Science	56.3%
43-5081.01	Stocking Clerk / Sales Floor Support	Higher Secondary Certificate	Associate's	Bachelor's	88.8%
15-1121.00	Systems Analyst	Bachelor's	Bachelor's in Computer Science	Bachelor of Arts	53.2%
41-4011.92	Technical Sales Representative	Bachelor's	Higher Secondary Certificate	Associate's	59.3%
53-3032.00	Tractor-Trailer Truck Driver	Higher Secondary Certificate	High School Equivalency	Master's	85.6%
13-1151.00	Training and Development Specialist	Bachelor's	Higher Secondary Certificate	Master's	58.3%
11-3031.01	Treasurer / Controller	Bachelor's	Master of Business Administration	Bachelor of Science	65.0%
15-1134.93	UI / UX Designer / Developer	Bachelor's	Bachelor's in Computer Science	Bachelor of Science	60.1%
35-3031.00	Waiter / Waitress	Higher Secondary Certificate	High School Equivalency	General Equivalency Degree	86.4%
15-1134.92	Web Developer	Bachelor's in Computer Science	Bachelor's	Bachelor of Science	62.7%
51-4121.00	Welder / Solderer	Higher Secondary Certificate	Associate's	Bachelor's	84.9%

Source: OECD calculations based on Lightcast data.

Table A B.4. Typical CIP code by occupation

Canada, 2015-2022

Occupation code	Occupation title	CIP 1 st	CIP 2 nd	CIP 3 rd	Percentage N/A
11-1021.91	Operations Manager / Supervisor	52.0201	14.0101	52.0801	67.4%
11-1021.92	General Manager	52.0201	14.0101	52.0801	50.7%
11-2021.91	Marketing Manager	52.0201	52.1401	9.01	68.3%
11-2021.92	Product Manager	52.0201	11.0701	14.0101	62.9%
11-2022.00	Business Development / Sales Manager	52.0201	52.1401	14.0101	64.7%
11-2031.91	Communications / Public Relations Manager	9.01	52.1401	9.09	77.5%
11-3011.92	Administrative Manager	52.0201	44.0401	44.04	47.9%
11-3031.00	Financial Manager	52.0201	52.0301	52.0801	39.7%
11-3031.01	Treasurer / Controller	52.0301	52.0201	52.0801	63.6%
11-3031.93	Banking Branch Manager	52.0201	52.0801	52.1401	37.7%
11-3121.92	Human Resources Manager	52.1005	52.0201	52.1001	60.1%
11-9021.00	Construction Manager	14.0101	52.2001	52.0201	70.8%
11-9033.00	College / University Administrator	52.0201	52.1401	11.0701	72.6%
11-9041.00	Engineering Manager	14.0101	14.1901	14.1001	46.0%
11-9051.00	Restaurant / Food Service Manager	52.0201	52.0901	52.0905	57.8%
11-9111.00	Healthcare Administrator	51.3808	52.0201	51	57.1%
11-9141.91	Property / Real Estate / Community Manager	52.0201	52.0301	14.0101	51.6%
11-9199.00	Program Manager	52.0201	14.0101	11.0701	86.0%
13-1021.00	Buyer / Purchasing Agent	52.0201	52.0203	14.0101	53.2%
13-1051.00	Estimator	14.0101	52.2001	52.0201	74.0%
13-1071.91	Recruiter	52.1005	52.0201	52.1001	86.5%
13-1071.92	Human Resources / Labour Relations Specialist	52.1005	52.0201	52.1001	63.8%
13-1111.00	Business / Management Analyst	52.0201	11.0701	52.0801	47.2%
13-1121.00	Event Planner	52.0201	52.1401	9.01	43.9%
13-1151.00	Training and Development Specialist	52.0201	52.1005	13.0501	52.9%
13-1161.00	Marketing Specialist	52.1401	52.0201	9.01	65.9%
13-2011.02	Auditor	52.0301	52.0201	52.0801	61.6%
13-2011.93	Accountant	52.0301	52.0201	52.0801	92.5%
13-2011.94	Account Manager / Representative	52.0201	52.1401	14.0101	73.6%
13-2051.00	Financial Analyst	52.0201	52.0301	52.0801	72.3%
13-2052.00	Personal Financial Advisor	52.0201	52.0801	52.0301	72.2%
13-2072.00	Loan Officer	52.0201	52.0801	52.0301	79.1%
15-1121.00	Systems Analyst	11.0701	52.0201	14.0101	69.9%
15-1122.00	Cyber / Information Security Engineer / Analyst	11.0701	52.0201	14.0101	65.6%
15-1131.00	Software Developer / Engineer	11.0701	14.0101	14.09	41.5%
15-1131.91	Computer Programmer	11.0701	14.0101	14.09	92.6%
15-1133.00	Computer Systems Engineer / Architect	11.0701	14.0101	14.1001	94.1%
15-1134.92	Web Developer	11.0701	14.0101	14.09	70.9%
15-1134.93	UI / UX Designer / Developer	11.0701	52.0201	50.0409	54.9%
15-1141.00	Database Administrator	11.0701	14.0101	52.0201	62.8%
15-1142.00	Network / Systems Administrator	11.0701	11.0103	14.0101	66.8%
15-1151.00	Computer Support Specialist	11.0701	11.0103	14.0101	60.7%
15-1199.01	Software QA Engineer / Tester	11.0701	14.0101	14.09	55.2%
15-1199.02	Network Engineer / Architect	11.0701	14.0101	14.1001	50.7%
15-1199.09	Project Manager	52.0201	14.0101	11.0701	37.3%
15-1199.91	Data / Data Mining Analyst	11.0701	52.0201	27.0501	58.3%
15-1199.93	Business Intelligence Analyst	52.0201	11.0701	27.0501	58.8%
15-1199.95	IT Project Manager	11.0701	52.0201	14.0101	63.1%
17-2051.00	Civil Engineer	14.0801	14.0101	14.39	80.4%

Occupation code	Occupation title	CIP 1 st	CIP 2 nd	CIP 3 rd	Percentage N/A
17-2071.00	Electrical Engineer	14.0101	14.1001	14.1901	73.5%
17-2141.00	Mechanical Engineer	14.1901	14.0101	14.1001	65.2%
17-3023.00	Electrical and Electronics Technician	14.1001	14.0101	15	50.1%
17-3027.00	Industrial / Mechanical Engineering Technician	14.1901	14.0101	14.1001	50.4%
21-1014.00	Mental Health / Behavioural Counselor	44.07	42.0101	44.0701	71.3%
21-1021.00	Family / School / General Social Worker	44.0701	44.07	42.0101	40.7%
23-1011.00	Attorney	22.0101	52.0201	52.0801	62.3%
23-2011.00	Paralegal / Legal Assistant	22.0302	52.0201	22.0101	48.9%
25-1199.91	College Professor / Instructor	52.0201	11.0701	14.0101	69.8%
25-2011.00	Preschool / Childcare Teacher	13.121	19.0706	44.07	56.3%
25-2021.00	Elementary School Teacher	13.1001	14.0101	52.0201	86.3%
25-4013.00	Researcher / Research Associate	52.0201	11.0701	14.0101	88.6%
27-1024.00	Graphic Designer / Desktop Publisher	50.0409	9.01	52.1401	59.6%
27-1026.92	Merchandiser / Ad Set Associate	52.0201	52.1401	52.0801	50.0%
27-3031.94	Public Relations / Communications Specialist	9.01	52.1401	9.09	72.7%
29-1051.00	Pharmacist / Pharmacy Director	51.2001	52.0201	51.0805	71.0%
29-1062.00	Physician	51.12	51.2401	51.0401	56.7%
29-1141.00	Registered Nurse	51.3808	51.22	51.2201	61.7%
29-2012.00	Laboratory Technician	51.0802	40.0501	26.0502	45.2%
29-2052.00	Pharmacy Technician	51.0805	51.2001	52.0201	52.0%
29-2061.00	Licensed Practical / Vocational Nurse	51.3808	26.1001	30.1101	71.8%
29-9012.00	Safety Specialist / Co-ordinator	15.0701	51.2206	14.0101	81.3%
31-1011.00	Home Health Aide	51	51.3808	31.0505	66.4%
31-1015.00	Patient Transporter	9.09	14.0801	51.3808	70.8%
31-9095.00	Pharmacy Aide	51.0805	51.2001	11.0701	51.3%
33-1099.00	Loss Prevention / Asset Protection Specialist	43.0107	52.0201	11.0701	45.0%
33-9032.00	Security Officer	52.0201	11.0701	43.0107	49.5%
35-1011.00	Chef	12.0503	52.0901	52.0905	36.1%
35-1012.00	Restaurant / Food Service Supervisor	52.0201	52.0901	14.0101	67.9%
35-2011.00	Cook	12.0503	14.0801	52.0905	93.1%
35-2021.00	Kitchen Staff	12.0503	14.0801	52.0905	52.1%
35-3011.00	Bartender	52.09	52.1401	52.0901	28.6%
35-3021.00	Food Service Team Member	52.0201	14.0801	52.0901	70.5%
35-3031.00	Waiter / Waitress	11.0701	52.0201	52.0901	56.9%
35-9021.00	Dishwasher	52.0901	12.0503	14.0801	66.9%
35-9031.00	Host / Hostess	9.04	9.0401	52.1401	58.2%
37-2011.00	Janitor / Cleaner	14.0101	52.0201	14.0801	59.0%
37-2012.00	Maid / Housekeeping Staff	52.0201	52.0901	52.0905	71.8%
37-3011.00	Landscaping / Groundskeeping Worker	1.0601	1.1201	1.1102	83.1%
39-5012.00	Barber / Hair Stylist / Cosmetologist	12.0401	50.0407	52.0201	42.9%
39-9011.01	Nanny / Babysitter	13.121	44.07	19.0706	48.7%
39-9021.00	Caregiver / Personal Care Aide	51.3808	51	44.07	36.2%
39-9031.00	Personal Trainer / Fitness Instructor	31.0505	26.0908	51.12	28.2%
39-9032.00	Recreation / Activities Worker	30.1101	31.0505	51.2309	87.1%
41-1011.00	Retail Store Manager / Supervisor	52.0201	52.1401	14.0101	82.0%
41-1012.00	Sales Supervisor	52.0201	52.1401	14.0101	60.5%
41-2011.00	Cashier	52.0201	52.0301	14.0101	55.6%
41-2022.00	Parts Specialist / Salesperson	52.0201	15.0803	52.0203	79.7%
41-2031.00	Retail Sales Associate	52.0201	52.1401	52.0801	85.0%
41-3021.00	Insurance Sales Agent	52.0201	14.1901	52.0801	91.7%
41-3031.00	Financial Services Sales Agent	52.0201	52.0801	52.0301	15.6%
41-4011.00	Sales Representative	52.0201	52.1401	14.0101	35.0%

Occupation code	Occupation title	CIP 1 st	CIP 2 nd	CIP 3 rd	Percentage N/A
41-4011.92	Technical Sales Representative	14.0101	52.0201	14.1901	35.8%
41-9011.00	Product Demonstrator	52.0201	52.1401	11.0701	75.3%
41-9021.00	Real Estate Agent / Broker	52.0201	45.0601	52.0801	31.4%
41-9099.91	Sales Assistant	52.0201	52.1401	52.0801	17.8%
43-1011.91	Office Manager	52.0201	52.0301	11.0701	49.9%
43-1011.92	Customer Service Manager	52.0201	52.1401	11.0701	47.6%
43-3031.00	Bookkeeper / Accounting Clerk	52.0301	52.0201	52.0801	47.2%
43-3051.00	Payroll Specialist	52.0301	52.0201	52.0801	64.0%
43-4051.00	Customer Service Representative	52.0201	52.1401	11.0701	42.0%
43-4081.00	Hotel Desk Clerk	52.0901	52.0201	52.09	38.5%
43-4171.00	Receptionist	52.0201	52.0301	9.01	72.3%
43-5031.00	Dispatcher	9.01	9.09	9.04	62.0%
43-5061.00	Scheduler / Operations Co-ordinator	52.0201	14.0101	52.0203	58.6%
43-5071.00	Shipping / Receiving Clerk	52.0201	52.0203	52.1401	58.8%
43-5081.00	Inventory Associate	52.0201	52.0203	52.0301	32.3%
43-5081.01	Stocking Clerk / Sales Floor Support	52.0201	52.1401	13.121	61.8%
43-5081.04	Order Processor / Order Entry Clerk	52.0201	13.121	52.0301	63.8%
43-6011.91	Executive Assistant	52.0201	44.0401	44.04	73.7%
43-6011.92	Account Executive	52.0201	52.1401	14.0101	62.2%
43-6013.00	Medical Secretary	52.0201	51.3808	51	45.4%
43-6014.00	Office / Administrative Assistant	52.0201	52.0301	44.0401	54.6%
43-9021.00	Data Entry Clerk	52.0201	52.0301	11.0701	48.0%
43-9051.00	Postal Service / Mail Room Worker	52.0201	11.0701	52.1401	68.4%
45-2092.00	Farm / Nursery / Greenhouse Worker	1.0601	1	1.1101	42.5%
47-1011.00	Construction Foreman	14.0101	52.2001	14.1901	43.0%
47-2031.00	Carpenter	52.0201	14.0101	14.0801	53.5%
47-2061.00	Construction Helper / Worker	14.0101	14.0801	52.2001	55.1%
47-2111.00	Electrician	14.1001	14.0101	15.04	57.5%
47-2141.00	Painter	50.0404	14.0201	14.1901	84.7%
49-1011.00	Maintenance / Service Supervisor	14.0101	14.1901	52.0201	78.1%
49-3021.00	Auto Body Technician	14.1901	14.0101	51	36.2%
49-3023.00	Automotive Service Technician / Mechanic	14.1901	14.0101	52.0201	36.2%
49-3031.00	Diesel Mechanic	14.1901	14.0101	15.0614	48.3%
49-3042.00	Heavy Equipment Mechanic	14.1901	14.1001	14.0101	49.9%
49-9021.00	HVAC Mechanic / Installer	14.0101	14.1901	14.1001	27.5%
49-9041.00	Industrial Mechanic	14.1901	14.0101	14.1001	49.7%
49-9044.00	Millwright	14.1901	14.0101	14.1001	43.2%
49-9071.91	Building and General Maintenance Technician	14.0101	14.1901	14.1001	28.1%
49-9099.00	Repair / Service Technician	14.0101	11.0701	14.1001	18.8%
51-1011.91	Production Supervisor	14.0101	52.0201	14.1901	55.8%
51-1011.92	Production Plant Manager	14.0101	52.0201	14.1901	65.2%
51-3011.00	Baker	12.0503	14.0801	52.0901	62.1%
51-3021.00	Butcher / Meat Cutter	12.0503	52.0201	52.0301	76.0%
51-4041.00	Machinist	14.1901	14.0101	15	23.0%
51-4121.00	Welder / Solderer	15.0614	14.0101	14.1901	41.1%
51-9012.92	Manufacturing Machine Operator	14.0101	14.1901	11.0701	31.0%
51-9061.00	Quality Inspector / Technician	14.0101	11.0701	14.1901	37.8%
51-9199.00	Production Worker	14.0101	14.1901	52.0201	36.5%
53-3021.00	Bus Driver	52.0201	52.1401	52.1005	36.8%
53-3031.00	Sales Delivery Driver	11.0701	52.0201	14.0101	30.9%
53-3032.00	Tractor-Trailer Truck Driver	52.0201	14.0101	11.0701	46.5%
53-3033.00	Light Truck Delivery Driver	11.0701	52.0201	14.0101	26.0%

Occupation code	Occupation title	CIP 1 st	CIP 2 nd	CIP 3 rd	Percentage N/A
53-7051.00	Forklift / Pallet Jack Operator	14.1901	15.0614	14.0101	42.4%
53-7062.00	Labourer / Warehouse Worker	52.0201	52.0203	1.0601	43.0%
53-7064.00	Packager	11.0701	14.09	14.1901	45.3%

Source: OECD calculations based on Lightcast data.

Annex C. Using machine learning to analyse the information contained in online job postings

The information contained in online job postings is extremely rich and large. The database used in this paper spans several gigabytes of data and sums up to millions of keywords collected from job postings in different countries and over time. In addition to its size, the information contained in online job postings differs from most traditional labour market statistics (such as, for instance, labour force surveys) in that it contains information in the form of text rather than numbers and figures. Differently from standard quantitative data, text bears “semantic meaning” which can be multifaceted and ambiguous but it can also convey a far greater amount of information than just numbers and figures.

Recent advances in machine learning techniques led to the development of so-called language models which have the objective of understanding the complex relationships between words (their semantics) by deriving and interpreting the context those words appear in. Language models (and in particular Natural Language Processing- NLP- models) interpret text information by feeding it to machine learning algorithms that derive the logical rules to interpret the semantic context in which words appear. NLP and language models, used in the remainder of this paper, are therefore better suited for the analysis of text information than traditional statistics and, as such, they are used for the analysis of online job postings in the remainder of this report.

In particular, the approach taken in this report leverages “Word2Vec”, an NLP algorithm developed by researchers in Google. This algorithm functions by creating a mapping between the meaning (i.e. the semantics) of words contained in text and mathematical vectors, so-called “word vectors”. Put it differently, word vectors are the mathematical representation of the meaning of the words used in online job postings. Those vectors are plotted in a high-dimensional vector space (called “graph”) where words with similar meanings occupy close spatial positions in the vector space.

Since word vectors¹ occupy a specific place in the vector space, this makes it possible to calculate the distance (i.e. the cosine similarity) between those vectors and to rank the relationships between skills from the closest to the farthest from any given occupation. In other words, by estimating their semantic closeness, this approach allows to rank the similarities between every skill (word) vector relative to any given occupation vector.²

Skills that are more similar to a certain occupation are interpreted in this report as being more “relevant” to the occupation. Using this approach is, therefore, possible to assess whether the skill “Excel” is more relevant to the occupation “Economist” or to “Painter”, based on the semantic closeness of these words’ meanings extrapolated from millions of job postings.

In this report, the matrix of skills-to-occupations relevance scores (the Semantic Skill Bundle Matrix, SSBM) is used to identify the occupations for which digital skills are particularly relevant as well as to assess the relationship between digital skills and occupations and the speed of diffusion of the demand for digital technologies and skills across labour markets.

Notes

¹ One n -dimensional vector per skill.

² Occupation vectors are also calculated using a slight modification of Word2Vec called Doc2Vec.

Annex D. Leveraging big data to assess the diffusion of digital skill demands in labour markets

When using job postings to examine the diffusion of digital skills and technologies across labour markets, several previous studies have focused on counting the increase in the frequency with which the terms related to digital technologies have been mentioned across job postings.

Metrics based on the simple count of the frequency of digital skill mentions are, however, likely to miss whether such increase has been concentrated in a small number of sectors/occupations or if, instead, digital technologies and skill demands have actually spread across a wide variety of sectors and occupations, truly permeating labour markets. This latter question is arguably very important, as widespread diffusion of digital technologies across sectors and different job roles is what drive significant changes in the overall labour market that policy makers and firms need to adjust to.

In order to accurately capture the growth in the diffusion of skill demands in the digital economy across different sectors and occupations of the labour market, this chapter uses machine learning techniques applied to the analysis of online job postings to examine how much digital skills are interconnected with other skills across job vacancies and in employers' recruitment requirements.

A vector representation of skill keywords in a n-dimensional space is functional to assess the connections across skills and, as such, the degree by which skills are pervasive in the observed labour market published online. The connections between a group of keywords can be represented by a so-called skill graph. In such graph, the keywords extracted from online vacancies represent the vertices (also called nodes) which can be either connected when both vertices co-occur in a specific job vacancy or disconnected when both vertices never co-occur in the same vacancy.

A so-called adjacency matrix can be built to represent these skill co-occurrences.¹ Whenever a skill co-occurs with another skill in a certain job vacancy, the row corresponding to the skill "A", and the column corresponding to the skill "B" will get the value 1. Note that the adjacency matrix is symmetric, meaning that the co-occurrence between skills is undirected and therefore commutative.

One can hence use this adjacency matrix to calculate the eigenvector centrality (EVC) and the local clustering coefficient (LCC) for each skill. The power iteration algorithm is used to derive the relativity score for each vertex v in the network. Given a graph G , and adjacency matrix A , the relative centrality score of a certain skill can be defined as:

$$EVC_v = \frac{1}{\lambda} \sum_{t \in M(v)} EVC_t = \frac{1}{\lambda} \sum_{t \in G} a_{v,t} EVC_t \lambda$$

Since this is an undirected graph, the local clustering coefficient can also be defined as:

$$LCC_i = \frac{e_{jk}: v_j, v_k \in N_i, e_{jk} \in E}{k_i(k_i - 1)}$$

Both measures serve as an important indicator for contextual diversity and the importance of certain skills as compared to other skills in the network. In graph theory, the "eigenvector centrality" and the "local clustering coefficient" are two measures that are commonly used to assess the influence of a node in a

network or, in other words, to measure the degree and quality of connections of a keyword with the rest of words in the text under exam. Originally, these measures were developed by researchers in Google and used in the PageRank algorithm to quantify the importance of the connections among web pages based on the textual information contained in it. The same measures can, however, be used to capture the number of connections that a skill keyword has with other skills as well as the ‘quality’ of those connections, where higher quality connections are those with other skills that are also highly connected to the rest of the skills in the vector space.

One can finally create a unidimensional measure of skill diffusion by normalizing and rescaling the eigenvector centrality and the local clustering coefficient into a single measure using the following:

$$Diffusion_{it} = \frac{EVC_{it} + (1 - LCC_{it})}{2},$$

The change over time of the Diffusion index is used in the analysis above to measure the degree by which skills have become pervasive in the labour market. The Diffusion index is computed for each skill keyword analysed in the database of online job postings and compared to the average diffusion across all skills in each economy where faster diffusion of a skill means an increase (above average) of the connections of that particular skill with other skill demands across job postings, hence an increase in how much that skill is permeating the labour market in a variety of different work contexts and job roles.

Note

¹ The extracted skill graph forms an undirected acyclic graph, meaning that skills do not co-occur with themselves. As a result, the diagonal of the adjacency matrix is 0.

Labour and Skills Demand in Alberta

INSIGHTS USING BIG DATA INTELLIGENCE

This report examines Alberta's labour market trends, focusing on the impact of economic downturns, the COVID-19 crisis, and digital transformation. This study uses real-time labour market data, drawn from online job postings, to offer a granular perspective on demand dynamics across various sectors and occupations. The analysis in the report identifies emerging labour shortages in Alberta due to mega-trends such as digitalisation, AI adoption, automation, and population ageing and discusses key challenges such as youth unemployment and sector-specific labour shortages. The analysis in this report provides insights for policy makers, suggesting a need to support growing sectors, enhance digital skills development, address demand for health workers, and improve youth job access.

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