



A Digital Future for Alberta

**An Analysis of Digital
Occupations in Alberta's
High-Growth Sectors**

Research by



The Information and Communications
Technology Council

The Province of Alberta is working in partnership with the Government
of Canada to provide employment support programs and services.

Canada 

Alberta 

Preface

The Information and Communications Technology Council (ICTC) is a national centre of expertise for the digital economy. With over 25 years of experience delivering evidence-based research, innovative capacity building solutions, and practical policy advice, ICTC's goal is to support Canada's digital advantage in a global economy by fostering globally competitive Canadian industries empowered by a talented and diverse workforce.

The authors of this report made all reasonable efforts to ensure accuracy and fair reflection of the diverse perspectives gathered during the research process. The opinions and interpretations in this publication are those of the authors and do not necessarily reflect those of the Government of Canada or Government of Alberta.

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Executive Summary

Economic diversification is a long-held pillar of resilient economies around the world. Building and strengthening a variety of sectors can help shield nations from global economic shocks and support a sustainable future. From 2017 onward, Alberta's focus has been on economic diversification, with a strong note of technological enhancement and digitization. These investments will undoubtedly play an impactful role in the future economy of the province, and continue to propel industry demand for key digitally-skilled talent.

A number of top digital occupations stand out as in-demand across the Alberta economy. Leading this demand are roles like software developers, data scientists, full stack developers and cybersecurity analysts, among others. These are occupations that will drive business development and expansion, and ultimately, are central to the success of many sectors.

The need for these roles is substantial. The rapid pace of development in areas like artificial intelligence and data science, coupled with the increased adoption of technology across sectors indicates an accelerating demand for digital roles in Alberta – one that is forecasted to reach nearly 9,000 by 2023. With a job growth rate double that of the overall economy in the coming years, total employment in key digital roles is expected to surpass 77,000 by 2023.

While the demand for these roles will be notable across the economy, certain sectors will act as leading drivers of employment in the province. These are: healthcare, advanced manufacturing, cleantech, and interactive digital media. These sectors will not only generate opportunities for Albertans across a number of verticals, but they will be central employers of digital talent. With the advent of big data and emerging technologies like AR/VR creating ripples in healthcare for example, the sector's demand for digital talent will reach nearly 1,000 over the next few years. In the digital media sector, the demand will surpass 3,000 by 2023. Filling this need must be at the forefront of supporting future growth in Alberta.

Some developments have already taken place on the path to diversifying and strengthening Alberta's future economy; many of which have functioned to shine a light on the need for digitally-skilled workers to steer growth. Meeting industry demand however, will mean a concerted effort to build a strong and reliable supply pool of workers with critical skillsets – talent that will enable existing businesses and new entrepreneurs to continue to innovate and create solutions. Digitally-skilled youth, along with internationally-trained workers form two important components on this journey; as do other critical streams like women, career transitioners, Indigenous peoples, and persons with disabilities. Investments in economic diversification will continue to drive industry demand, accelerating the need for digitally-skilled talent. Our ability to meet these needs is rooted in an approach to talent and skill development that is inclusive, diverse, and future-oriented.

Introduction

Uncovering future economic growth and employment trajectories involves investigating past trends, recent developments, and potential impacts of investments and emerging realities.

In 2017, Alberta began a plan for diversification among many economic sectors in an attempt to ensure more sustainable, reliable and robust opportunities for growth. At the heart of these investments was a central focus on technology and its ability to propel both revenues and employment for the province. Anchored in primary evidence gathered from consultations with Albertan employers, and complemented by overall trend and data analysis, this study is an attempt to offer insight into the impact of technology and digital transformation on the Alberta labour force. With core digital occupations driving employment demand, this study forecasts critical employment trends for the top four high-growth sectors in the province until 2023.

Section I of this report offers a historical overview of the Alberta economy. With emphasis on the energy sector as the (historically) most significant influencer of growth in the province, this section follows Alberta's economic and employment trajectory from 2008 to the recent recession.

Section II provides a view of recent trends and future economic prospects for the province. Starting from Alberta's most recent journey into economic recovery, this section offers an introduction into the importance of technology for economic success and job growth.

Section III paints a picture of Alberta's future by showcasing employment growth forecasted across Alberta's top four high-growth sectors until 2023. For each sector, an analysis is provided of total employment, along with an understanding of the most in-demand digital and technical occupations. Employment forecasts for core digital roles and core technical roles are also included.

Section IV provides an overview of Alberta's largest municipalities, with the most substantial technology footprint. Employment forecasts in these key jurisdictions are showcased until 2023. The cities represented are: Calgary, Edmonton and Lethbridge.

Section V points to the top five in-demand digital roles in Alberta, followed by the critical skillsets needed by tomorrow's workforce.

Section VI highlights supply trends in Alberta. Looking at recent developments across various streams such as new grads, women, immigrants and others, this section analyses the supply available to fill critical digital roles in Alberta's future economy and growth sectors. This section also provides a snapshot of self-identified skill competencies among Alberta's workers employed in the most in-demand digital roles.



Section I

The Alberta Economy: A Recent History

The recent diversification efforts of the Alberta government have been substantial and impactful. Appreciating the footprint of these developments and their potential role in the future economy necessitates an awareness of the province's economic history. While each province comes equipped with its own strength industries – such as British Columbia's stronghold on the natural resources sector, or Ontario's claim in the manufacturing sector – Alberta's economy has been traditionally tied to the energy industry, and in particular, the oil and gas sector.

The Impact of Oil and Gas on the Alberta Economy

In 2007, the global financial crisis began to take shape – this is something that would shake the world economy by 2008. However, this economic downturn had a delayed impact in Canada and Alberta. In fact, in the early months of 2008, oil prices were surging in the province, with employment and production continuing to expand and grow¹. Yet, as the US fell into deep recession later that fall, the price of Albertan oil came propelling down with it. By October 2008, the price of a barrel of WCS² dropped to under \$77USD, with continuous devaluations reaching as low as \$39USD in January 2009³ before starting its slow ascent. The crisis lingered on for many other sectors, however, already by the winter of 2009 oil prices had nearly recovered, and by early 2010, were once again booming. From 2010 to 2014 as oil prices soared, with WCS reaching a peak of more than \$90 USD per barrel in July 2013⁴. The Alberta economy had once again entered an economic boom that would last until late 2015.

The downturn of 2015 had several causes that were unique from those previous. A slowing North American and global economy was one factor, and was complemented with developments like improved fuel efficiency, functioning to curb total energy demand. At the same time, global markets had “priced-in” substantial supply cuts due to geopolitical tensions in the Middle East⁵. This led to a price (over)correction when these cuts did not materialize. Unexpected (over)supply was also compounded by the American fracking revolution, which suddenly made vast new petroleum deposits available. Lastly, pipeline capacity to the west coast also grew increasingly scarce, causing more Albertan oil to flow onto the already oversupplied American market at a steep discount.

The effects of the 2015-16 recession were devastating to not just the sector, but the Albertan economy as a whole. Gross domestic product (GDP declined by 7.4% from 2014 to 2016 and during this period, the province lost nearly 20,000 jobs. This was the most substantial job loss seen since 1982⁶, causing the unemployment rate to rise to record highs – over 9% in the fall of 2016, the highest seen in the province in more than 20 years⁷.

¹Stephen Gordon, *Recession of 2008-09 in Canada* (The Canadian Encyclopedia, October 24, 2017). <https://www.thecanadianencyclopedia.ca/en/article/recession-of-200809-in-canada>

²Western Canadian Select.

³Oil Prices: Price per barrel of WCS oil in US dollars (Alberta Government Economic Dashboard, March 23, 2019). <https://economicdashboard.alberta.ca/OilPrice>

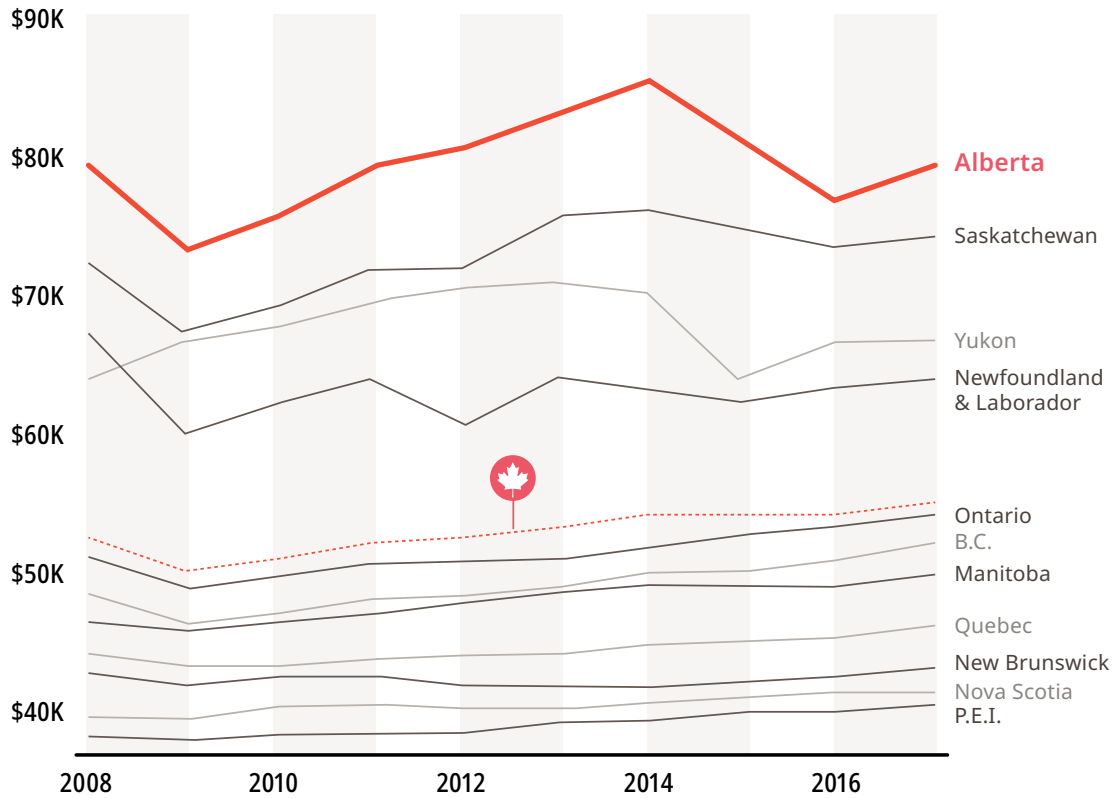
⁴Idem.

⁵Harrie Vredenburg, Tim Marchant, *Alberta and oil prices: How Middle East geopolitics and religion affect our future* (CBC News, March 27, 2016). <https://www.cbc.ca/news/canada/calgary/oil-global-opec-markets-1.3504298>

⁶David Parkinson, *Alberta endures most annual job losses since early 1980s recession* (The Globe and Mail, March 22, 2018). <https://www.theglobeandmail.com/report-on-business/economy/jobs/alberta-job-losses-last-year-worst-since-early-1980s-recession-statscan/article28393681/>

⁷Unemployment Rate (Alberta Government Economic Dashboard, June 7, 2019). <https://economicdashboard.alberta.ca/Unemployment>

Figure 1: Real GDP per Capita by Province, 2008-2017



Source: Statistics Canada, Chained (2012) CAD

Economic Recovery and Diversification: 2017 Onward

By January 2016, WCS had fully bottomed out, dropping to slightly over \$23 USD a barrel⁸ and Alberta entered a recession, until 2017 when economic recovery began to take shape. Oil prices had begun to see an uptick in 2017, however this time, the province began its recovery journey with a specific focus on diversification. Many sectors – including oil and gas – had begun seeking efficiencies and methods of improving productivity and output, with technology being one of the key focal points.

Although it has been provincial government policy to diversify the economy since the 1970s⁹, these prior attempts proved largely unsuccessful, until recently where even traditional sectors like oil and gas have been increasingly impacted by technology. Noting these changes, current-day diversification has not only been attempted, but prioritized, with a focus specifically on technologically-driven and green economic growth.

⁸Idem.

⁹Ken Norrie, Herb Emery, *Stay the course or seize an opportunity? Options for Alberta's post-secondary institutions in a period of uncertainty about the rebound from the oil economy* (The School of Public Policy Publications, Vol 10:20, September 2017).

<https://www.policyschool.ca/wp-content/uploads/2017/09/Post-Secondary-Institutions-Norrie-Emery.pdf>



Section II

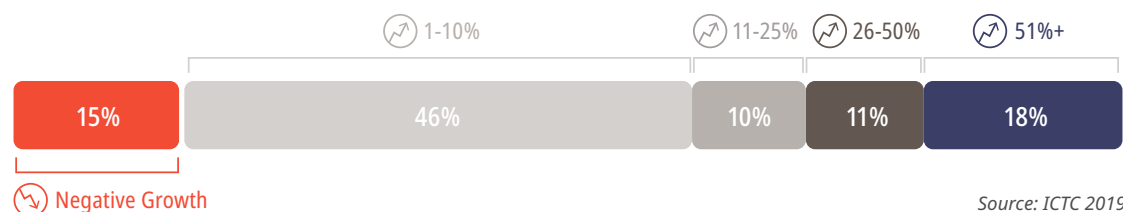
***The Alberta Economy:
A Future Perspective
and Focus on Technology***

While the Alberta economy saw substantial dips in 2015 and 2016, totaling nearly 4% and more than 3.5% in each respective year¹¹, in 2017, GDP began to rise again. That year, GDP grew by nearly 5% across all industries, and although impacted by setbacks in the fall of the year following, growth continued in 2018 at a rate of more than 2%¹². Moreover, even despite reports of expected slow growth in the economy in 2019 (0.7%¹³, diversification efforts are being undertaken in key areas like technology as effort to boost long-term economic performance and job growth across sectors, including energy.

In 2017, Alberta announced the Screen-based Production Grant (SPG). Offering production companies a grant to cover up to 30% of eligible expenditures¹⁴, is an attempt to promote economic diversification and growth via the creative industries. This was followed in 2018 by the Interactive Digital Media Tax Credit (IDMTC), offering a 25% refundable tax credit for costs related to interactive digital media activities in Alberta . In late 2018, the Federal government announced the provision of \$1.6 billion to help the province’s struggling oil and gas sector adapt via capital investments, primarily through the purchase and implementation of new technology¹⁵. And in early 2019, the Alberta government announced a \$100 million plan, focused on attracting investment from AI-based tech companies¹⁷, complementing the province’s already deep footprint in this space. Investing in technology is clearly something that is seen as not only beneficial to the technology sector, but rather, as a catalyst that can enable and support economic growth and opportunities for the province as a whole.

Consultations with employers in Alberta have showcased a level of optimism, driven in part by these recent trends. Requested to provide insights on forecasted economic growth over the next 12 months¹⁸, nearly no employers expected to see a decline. This is contrary to reflections on economic performance over the previous three years, where some employers – particularly those in the energy sector – noted seeing declines as sharp as 25%. An estimation of short-term economic performance over the next year found that the majority of employers (55%) expected to see modest to strong growth.

Figure 2: Employers' perception of revenue growth in Alberta, 2015-2018



These results were even more pronounced when analyzed across companies operating in the technology sector. Here, nearly 60% of businesses expected to see strong or very strong growth over the coming year.

¹⁰Shaping Alberta's Future: Report of the Premier's Council for Economic Strategy (Government of Alberta) <https://open.alberta.ca/dataset/97104aa2-b2e3-41d9-9b67-2ce04b1d2c48/resource/3a0bdd25-0b6a-45fc-9b50-4457dfecd158/download/shapingabfuturereport.pdf>
¹¹CANSIM table 379-0030 (Statistics Canada, May 2, 2018) <https://www150.statcan.gc.ca/n1/daily-quotidien/180502/cg-a004-eng.htm>
¹²Idem.
¹³largely as a result of production slow-down in oil and gas.
¹⁴New Alberta film grant program a 'first step forward' in turning industry around (CBC News, October 3, 2017) <https://www.cbc.ca/news/canada/calgary/alberta-film-screen-based-grant-program-announcement-1.4322579>
¹⁵Interactive Digital Media Tax Credit (IDMTC) (Government of Alberta, Corporate Tax and Incentives, 2019) <https://www.alberta.ca/interactive-digital-media-tax-credit.aspx>
¹⁶Dean Bennett, 'A stronger Alberta': Ottawa announces \$1.6 billion to bolster struggling energy sector (Financial Post, December 18, 2018) <https://business.financialpost.com/commodities/energy/ottawa-to-announce-help-for-struggling-oil-patch-but-no-money-for-rail-cars-yet>
¹⁷Alberta invests in innovation to fuel the future (Alberta Innovates, February 13, 2019) <https://albertainnovates.ca/alberta-invests-in-innovation-to-fuel-the-future/>
¹⁸Responses collected from Fall 2018 to March 2019

In-depth one-on-one consultations with employers in Alberta further supported this statement, where the majority expressed an expectation of substantial scale-up, accelerating demand for digitally-skilled workers such as software developers, data scientists, or UX/UI designers, for example.

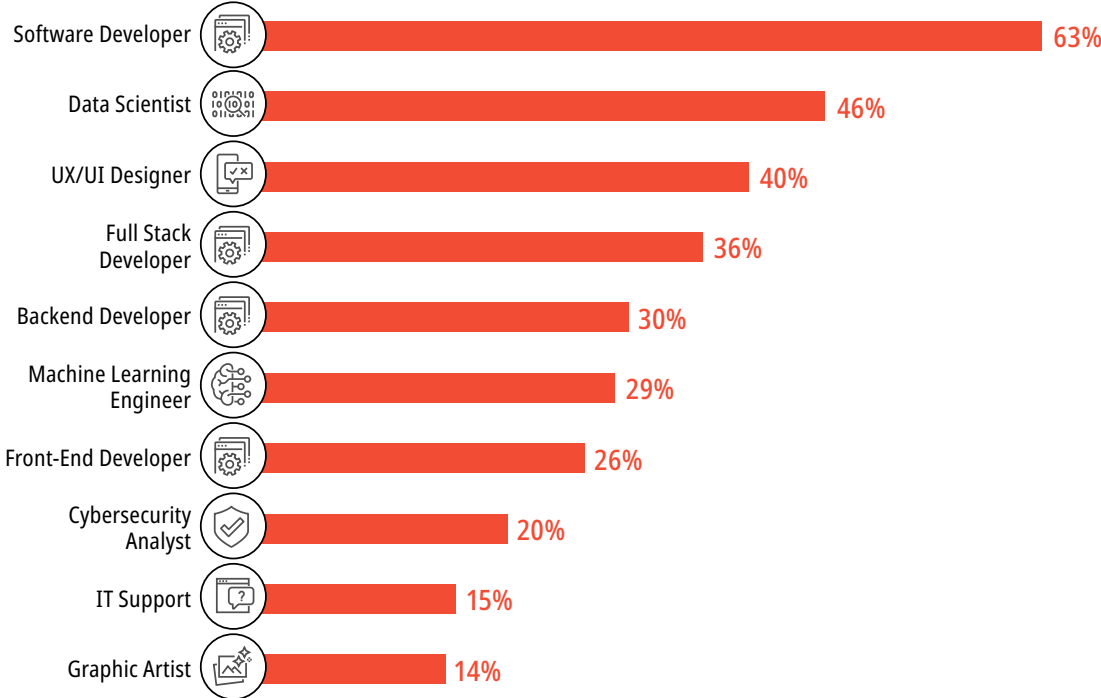
While the majority of small to medium-sized employers suggested an average hiring need between 3-5 of such roles, larger businesses (100+ employees) suggested a need of 10-15 or more. One commonality, however, was that all employers consulted with expected an increase in demand for these roles over the next year. One employer in the digital media sector stated an expectation to triple current staff numbers in the next 12 months, with nearly 70% of new roles being software developers or UX designers.

The Growing Demand for Digitally-skilled Talent in Alberta

The importance of digitally-skilled talent as a catalyst to drive economic growth for the province cannot be understated. Consultations with employers on the most substantial barriers to growth in Alberta pointed to this very reality. Increasingly, talent with skills in areas including data analysis, software development, design, and cyber threat detection were seen as crucial.

Consultations with Alberta employers found that occupations including software developers, data scientists, full stack developers, and cybersecurity analysts were among the top in-demand digital roles across the economy. Software developers appeared to be the most needed digital occupation, with more than 60% of employers ranking it as in-demand; however, potentially owing to Alberta’s leadership in the field of AI research, roles like data scientists and machine learning engineers were also of critical importance.

Figure 3: Top 10 most in-demand digital jobs in Alberta, 2019



Source: ICTC 2019

Difficulty sourcing this talent proved to be a considerable hurdle to growth. A lack of digitally-skilled talent was seen as the biggest obstacle to business growth by over 35% of employers in Alberta. This was followed by a lack of business development or sales-skilled workers. Combined, challenges in the attraction of these two talent streams was the most substantial barrier for more than 60% of Albertan employers.

Figure 4: Employers' perceptions of biggest barriers to business growth in Alberta, 2019



Source: ICTC 2019

Viewing this from the perspective of companies operating primarily in technology-related sectors paints an even clearer picture yet again. Here, nearly 43% of businesses articulated that a lack of digitally-skilled talent was by far, the most pressing barrier to growth. For these companies, the talent gap was found to be most pronounced at the mid¹⁹ and senior levels²⁰. A lack of these roles specifically was selected by over 85% of Alberta's technology-based employers to be a significant challenge.

Currently, key digital occupations like the above make up about 3% of all employment in Alberta. However, with the growing permeation of technology across a variety of sectors, coupled with strategic investments, the demand for digitally-skilled workers will only continue to accelerate.

The Labour Force and Increasing Impact of Technology Across the Alberta Economy

While there are some sectors of the economy that are expected to see lower than average growth in the coming years²¹, overall, employment driven by high-growth sectors will see substantial gain in Alberta. Between 2018 and 2023, ICTC forecasts a CAGR²² for employment of 1.7%. While this is slightly lower than the growth seen from 2001 to 2018 (CAGR of 2.2%), future employment trends are expected to be more stable, and less driven by large fluctuations in the energy sector, causing periods of rapid growth (2009-2014, followed by periods of rapid decline (2015-2016).

By 2023, Alberta is expected to see the addition of nearly 210,000 new jobs across the economy, bringing total potential employment in the province to more than 2.5 million.

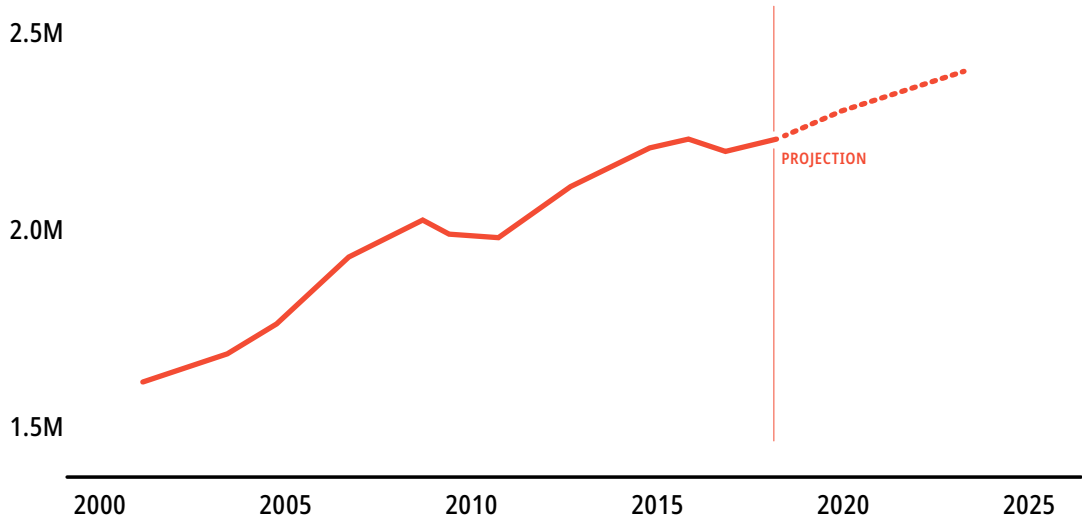
¹⁹Defined as workers with 3-5 years of experience.

²⁰Defined as workers with 6+ years of experience.

²¹See Appendix V for examples of the top 4 lowest-growth sectors of the economy.

²²Compound Annual Growth Rate

Figure 5: Alberta Employment History and Forecast, Total economy: all jobs in all sectors 2001-2023

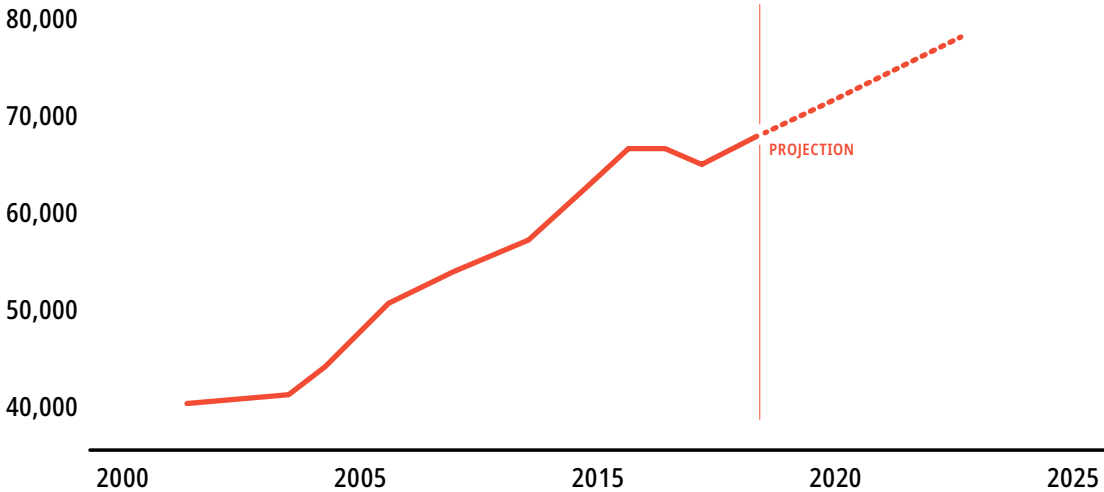


Source: ICTC 2019

The Impact of Digital Roles on Job Growth

The projected impact of technology across the provincial economy is substantial. Attributing for high-quality employment over a number of sectors, Alberta will see a demand for nearly 9,000 digitally-skilled workers in core digital occupations by 2023. If these roles are filled, the employment footprint of core digital jobs like software developers or data scientists will reach near nearly 77,500.

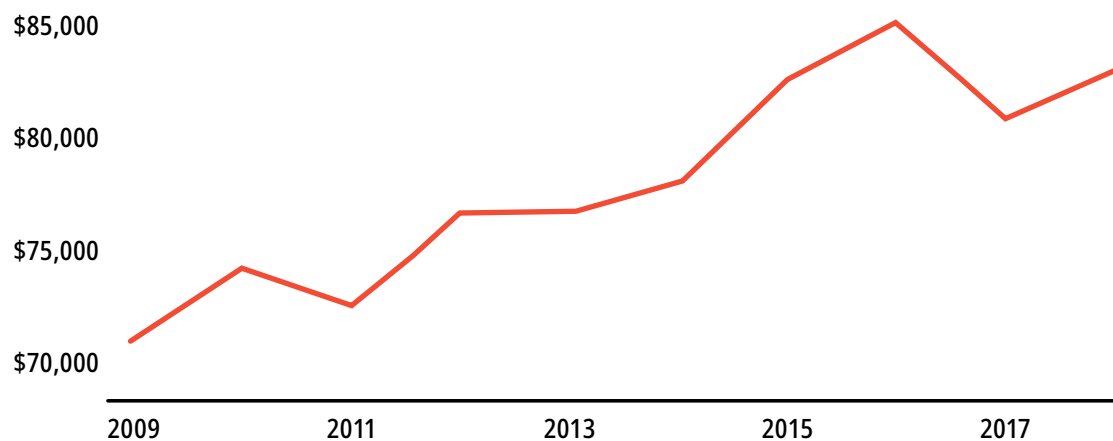
Figure 6: Alberta Employment History and Forecast, Core in-demand digital occupations, 2001-2023



Source: ICTC 2019

These are not only innovative roles contributing towards greater productivity and outputs, but they are also well-paying. An analysis of salaries for core digital occupations in Alberta finds the median annual wage²³ to be nearly \$83,000 in 2018 – a figure that is more than 55% higher than the average wage across the entire economy.

Figure 7: Alberta Wage Premium for Core in-demand digital jobs, 2009-2018



Source: ICTC 2019

A deeper analysis of average salaries for key digital roles at mid or senior levels further heightens the impact of the digital wage premium. In Calgary for example, consultations with employers found that nearly 40% were paying between \$81,000 to \$110,000 for a mid-level role in fields like software development or data science²⁴. 50% noted paying anywhere between \$96,000 to \$150,000 for a senior-level role²⁵ in such fields.

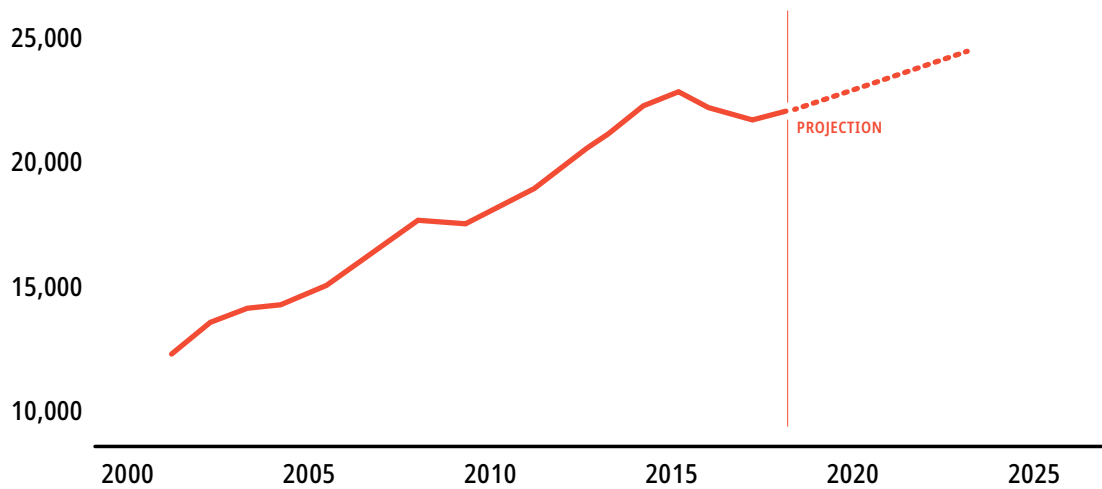
At the same time, key technical occupations such as chemical engineers, mechanical engineers, and biotechnicians, will also continue to play a significant part in the economy and contribute to the strength of the province's high-growth sectors. ICTC forecasts that the demand for these critical technical roles will reach nearly 2,500 by 2023, with potential employment totaling more than 24,500.

²³Average wages across occupations, irrespective of level of experience.

²⁴Alexandra Cutean, Robert Davidson, *Mapping Calgary's Digital Future: Tech Employment Opportunities for Displaced Workers* (ICTC, 2018) <https://www.calgaryeconomicdevelopment.com/dmsdocument/252>

²⁵Idem.

Figure 8: Alberta Employment History and Forecast: core in-demand technical occupations, 2001-2023



Source: ICTC 2019

Together, the demand for critical digital roles and core technical roles will reach more than 11,500 in Alberta by 2023, a figure representing nearly 5.5% of all employment demand over the coming years. As technology continues to become more integrated into traditional sectors such as oil and gas, agriculture, or transportation, the impact of these roles on employment demand will continue to scale.



Section III

Forecasting Alberta's Future: High-growth Sectors and the Digital and Technical Occupations that Drive Them

In this study, high-growth sectors are defined as those expected to grow at a CAGR greater than 1.7%, the forecasted growth rate of the general economy until 2023.

This section identifies four (4) sectors that will see significant growth over the coming five years, each with CAGRs of 2.2% or higher. These are: Healthcare, Advanced Manufacturing, Cleantech, and Interactive Digital Media. The following showcases overall employment growth, along with snapshot of employment demand across critical digital and technical occupations until 2023.

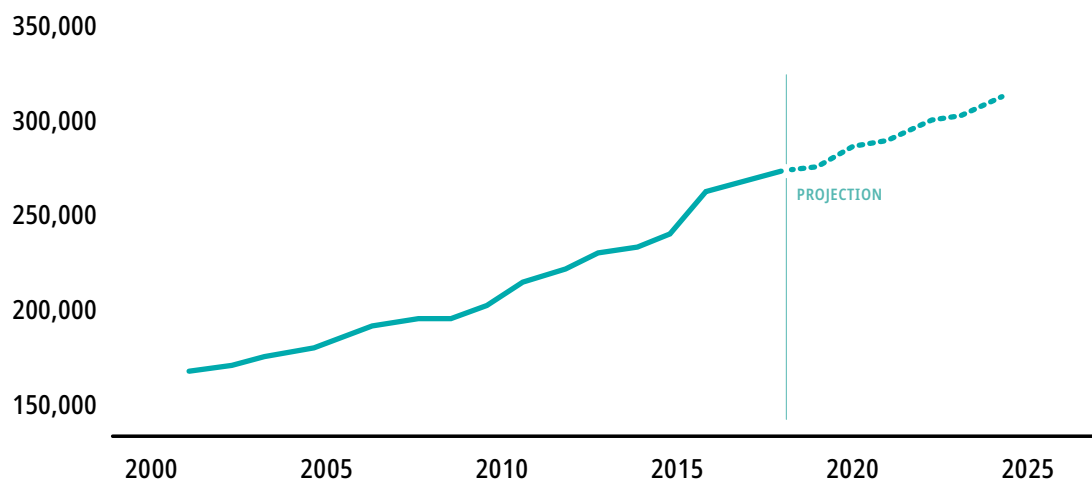
Healthcare

The healthcare sector is comprised of establishments primarily engaged in: providing health care by diagnosis and treatment, residential care for medical and social reasons; and social assistance services, such as counseling, welfare or child protection, among others. It is a prime contributor to the economy, responsible for approximately 12% of total employment in the province during 2018.

With low unemployment, rising wages, and the growing demand for services particularly as the population ages, the healthcare sector will see strong employment growth in the coming years. Technology trends such as robotic surgery, wearables, and data analytics will also continue to drive new treatments and innovations. More, as healthcare moves towards a 'personalized care' model, where treatment is uniquely specified based on predictive insights from the analysis of each individual's genome, many occupations in the sector may experience significant skill shifts along the way.

Total employment growth in the healthcare sector is forecasted at a CAGR of 2.6% from 2018 to 2023, nearly double the growth across the entire economy. By 2023, Alberta will see a demand for more than 37,000 new jobs in the healthcare sector, bringing total employment to nearly 315,000.

Figure 9: Alberta Healthcare Sector Employment History and Forecast (all jobs), 2001-2023



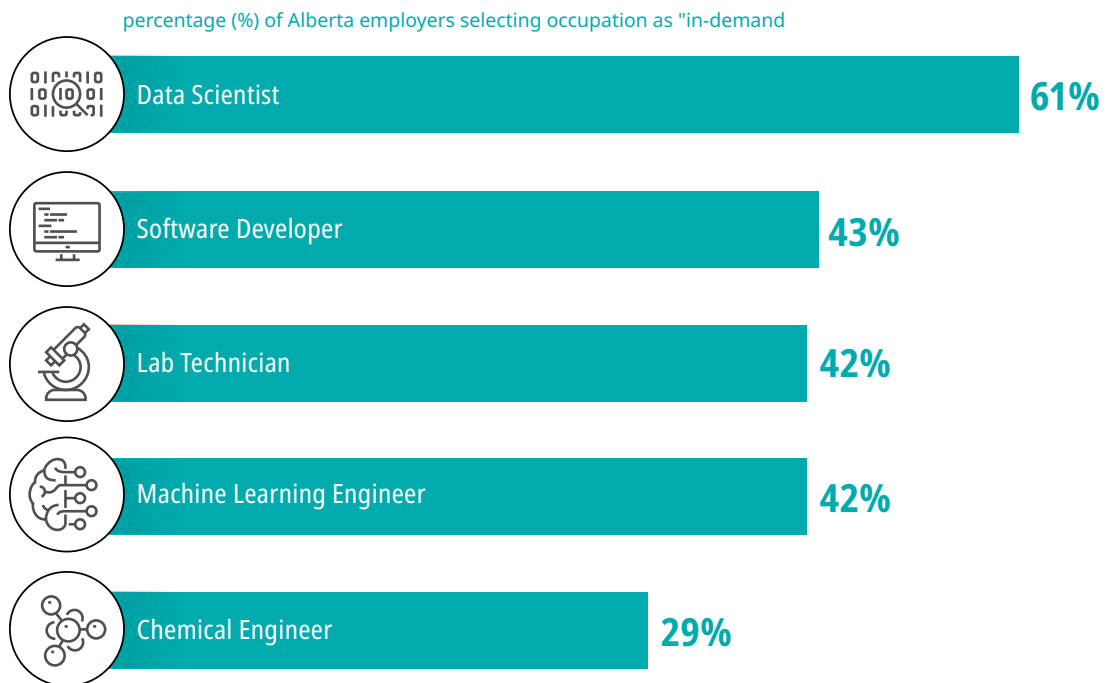
Source: ICTC 2019

Top Occupations in the Healthcare Sector: The Growing Demand for Digital Roles

In Alberta, healthcare is a very significant sector, supporting a number of critical professional and technical occupations. Roles in healthcare assistance, nursing, legal and social services, and technical occupations like lab technicians make up the largest share of employment. In 2018, this group of occupations accounted for nearly 60% of all jobs in the sector.

Additionally, with key changes ranging from electronic file management, to AR/VR assisted remote surgeries, and even advancements in the biotech sector leading to novel innovations in pharmaceutical development and even food generation, we will likely continue to see fast growth in digital occupations. Consultations with healthcare employers in Alberta found that digital roles like data scientists and machine learning engineers were seeing significant demand, alongside technical roles such as lab technicians.

Figure 10: In-demand digital and technical jobs in the Alberta healthcare sector, 2019

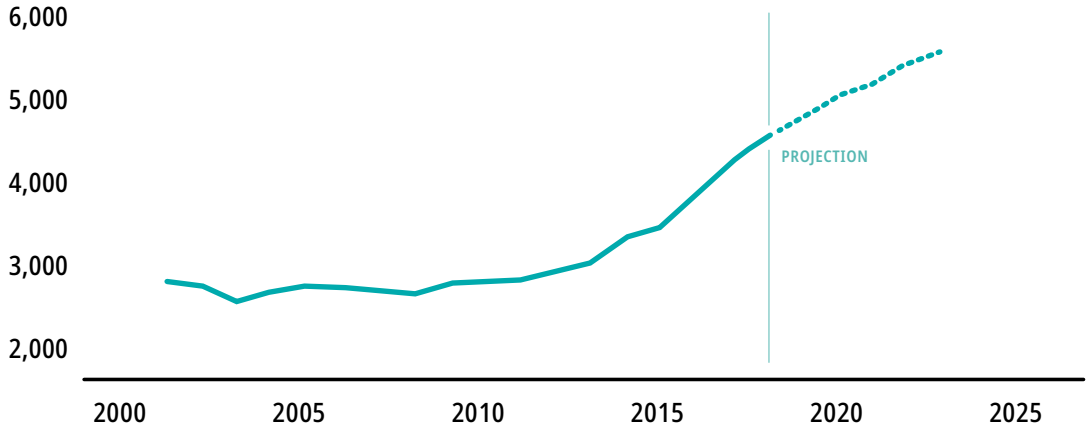


Source: ICTC 2019

Digital occupations within the healthcare sector are forecasted to grow substantially over the next number of years. Specifically, there will be a high demand for roles like data scientists, driven by the emergence of technological developments and the milestones among key subsectors like health tech and biotech. There is also an expectation for an increasing prominence of database administrators to manage large databases of electronic records, alongside software developers, and even network technicians, among others.

With big data and IoT leading advancements in patient care and treatment, it is no surprise that core digital occupations like data scientists are expected to scale by a CAGR of nearly 3% per year from 2018 to 2023. Digital occupations in the healthcare sector are forecasted to see a demand of more than 1,000 workers in Alberta by 2023. If filled, this will bring the total employment of core digital roles in the healthcare sector to more than 5,600.

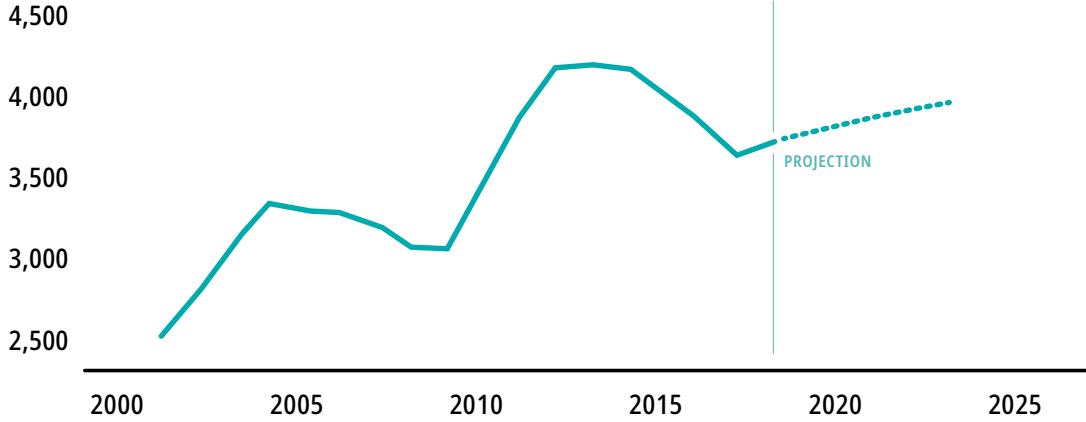
Figure 11: Alberta Healthcare Sector Employment History and Forecast - core in-demand digital roles, 2001-2023



Source: ICTC 2019

At the same time, advancements in the healthcare sector will continue to necessitate the presence of technical roles like lab technicians and technologists, biostatisticians, medical researchers and others. These roles have come up as highly relevant to the healthcare sector, and in particular the biotech industry. However, while needed, many employers have also stated that they are not necessarily in shortage – that is, qualified candidates tended to be sufficiently available in Alberta to fill these roles. Therefore, while important, healthy levels of supply are expected to dull demand somewhat, coming to approximately 300 by 2023. If filled, this will bring total employment of key technical occupations such as the above to nearly 4,000 in the healthcare sector.

Figure 12: Alberta Healthcare Sector Employment History and Forecast - core technical roles, 2001-2023



Source: ICTC 2019



Advanced Manufacturing

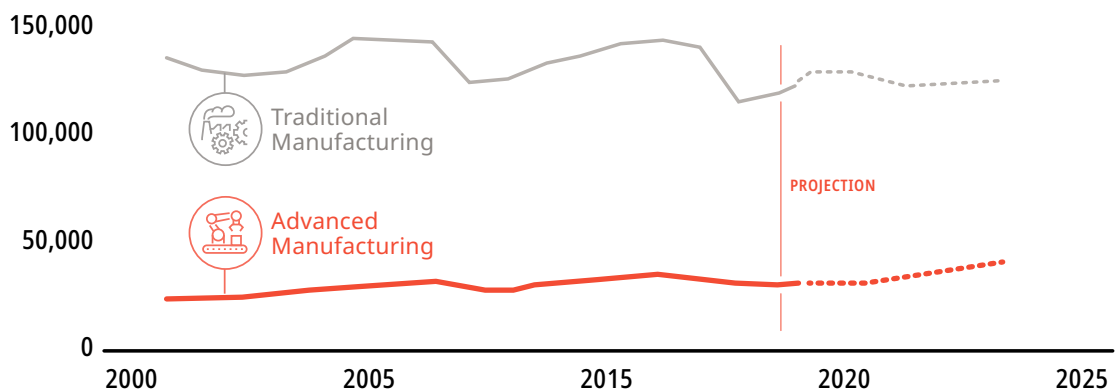
The Advanced Manufacturing sector uses next-generation manufacturing capabilities, incorporating technologies like advanced robotics, the Internet of Things, machine learning, and 3D printing to build familiar or novel products.

Traditional manufacturing has been a historically important sector in Alberta, employing nearly 130,000 workers across thousands of businesses. The primary activities are metal and equipment manufacturing (often for the oil & gas sector), petrochemicals, and food, beverage and tobacco manufacturing. Within the industrial manufacturing subsector, 29% of revenues come from oil & gas field machinery, 15% from structural metals, and 11% from pumps and compressors. Nearly 20% of workers in Alberta's manufacturing sector are employed in food manufacturing. The province specializes particularly in meat product manufacturing and grain and oilseed milling.

A growing subsector, Albertan researchers and businesses have a strong presence in advanced manufacturing and materials, particularly nanotechnology. Alberta specializes in micro-electro-mechanical systems (MEMS), micro-optical devices, nano-biotechnology, nano-engineered thin film structures, and nano-materials. Many of the products developed using advanced manufacturing techniques and technologies are relevant to a number of sectors, including energy, aerospace, and defense, among others.

In 2018, the manufacturing sector in Alberta accounted for 3.5% of all employment. However, future trajectories suggest that employment in traditional manufacturing will start to see decline. By 2023, Alberta is expected to see a contraction of nearly 3,000 jobs in the traditional manufacturing sector, while employment in advanced manufacturing is expected to climb.

Figure 13: Alberta Traditional vs Advanced Manufacturing Employment History and Forecast, 2001-2023



Source: ICTC 2019

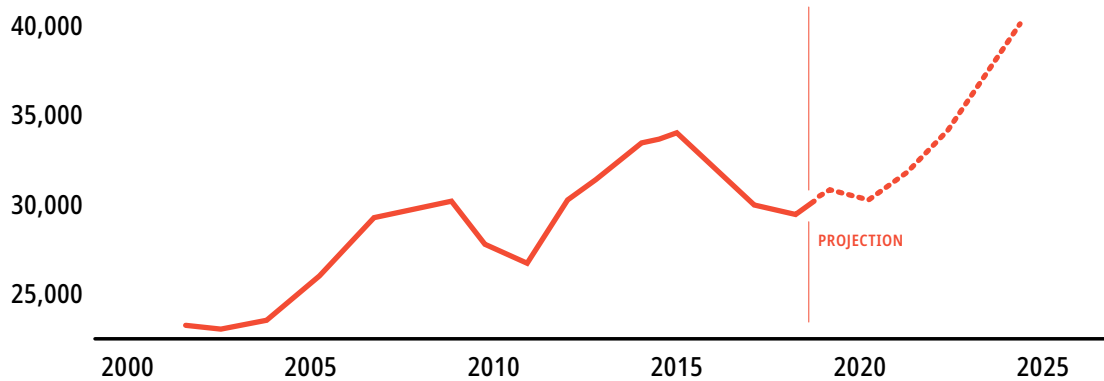
²⁶Industry profiles 2018: manufacturing industry (Government of Alberta, 2018) <https://work.alberta.ca/documents/industry-profile-manufacturing.pdf>

²⁷Industry profiles: manufacturing (Alberta alis, 2019) <https://alis.alberta.ca/occinfo/industry-profiles/manufacturing/>

²⁸Agriculture and Agri-food (Government of Alberta, 2019) <http://www.albertacanada.com/business/industries/agrifood-about-the-industry.aspx>

Given quickly-advancing technological developments leading to increased productivity across the economy, ICTC forecasts a CAGR of 5.5% from 2018 to 2023 for the advanced manufacturing sector in Alberta. This sector is expected to see a demand for nearly 9,500 workers in various occupations by 2023, bringing potential total employment to over 40,000.

Figure 14: Advanced Manufacturing Sector Employment History and Forecast (all jobs), 2001-2023

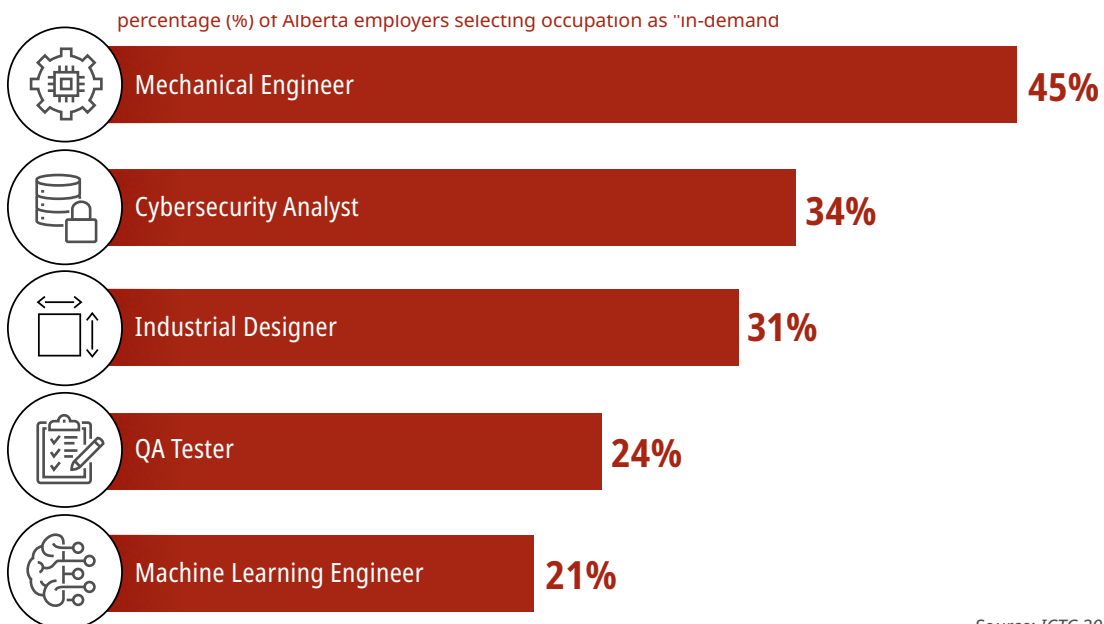


Source: ICTC 2019

Top Occupations in the Advanced Manufacturing Sector: The Growing Demand for Digital Roles

With advanced manufacturing being primarily a combination of engineering roles like mechanical engineers, and digital occupations like QA testers and machine learning engineers, there exists a strong demand for digital talent to drive growth and efficiencies in this sector. Technical roles like engineering managers for example, are forecast to grow very rapidly within the sector, at a CAGR of more than 8% from 2018 to 2023. Similarly, top digital roles like information systems analysts – where cybersecurity analysts fall under – are also seeing growing demand as plants and supply chains become automated and increasingly dependent on technology. Roles like cybersecurity analysts are forecasted to grow by a CAGR of 4% until 2023 in the sector.

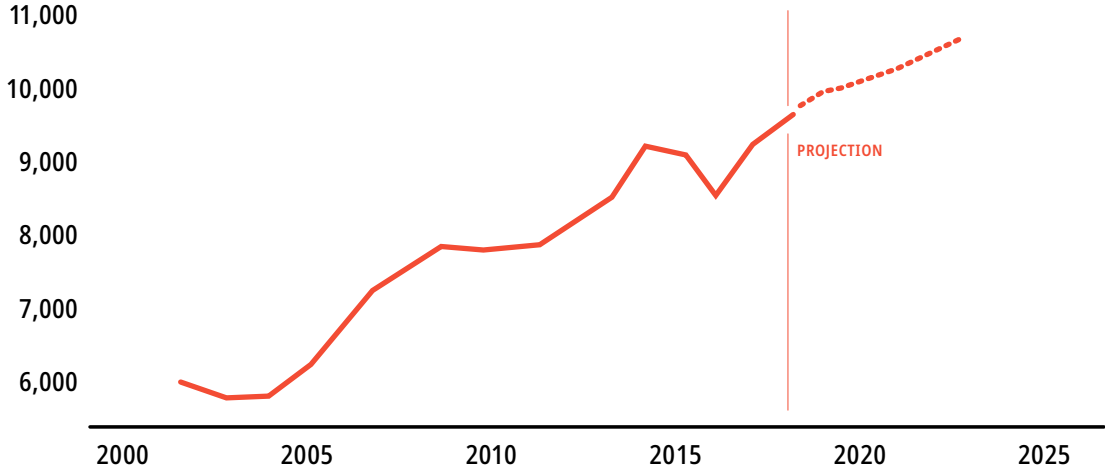
Figure 15: In-demand digital and technical jobs in the Alberta advanced manufacturing sector, 2019



Source: ICTC 2019

There is currently a strong need for core digital occupations like cybersecurity analysts and QA testers in this sector. With digital roles making up approximately one quarter of the advanced manufacturing sector, the demand for digital occupations is expected to reach more than 1,000 by 2023. If filled, this will bring total digital employment in Alberta's advanced manufacturing sector to nearly 10,700.

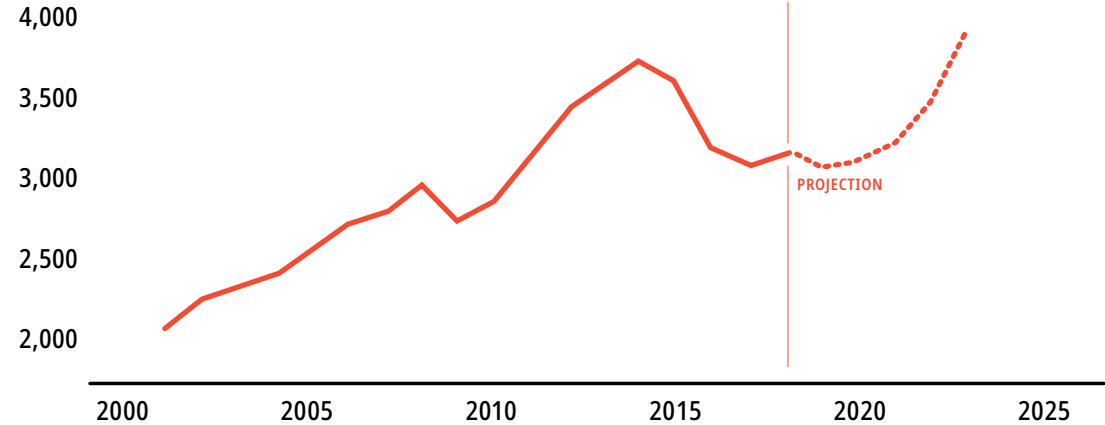
Figure 16: Alberta Advanced Manufacturing Sector Employment History and Forecast - core digital jobs, 2001-2023



Source: ICTC 2019

The advanced manufacturing sector is also expected to see a consistent need for core technical roles such as mechanical engineers, manufacturing engineers and industrial designers. These roles are necessary to achieve a number of tasks from designing concepts for manufactured products, to ensuring proper design of mechanical systems, to managing the manufacturing process. However, similar to technical roles in the healthcare sector, Alberta possesses a strong supply base among traditional engineering occupations. In addition to this, many former oil and gas engineers are also actively seeking opportunities in other parts of the economy. With ample supply, actual demand for these roles in the advanced manufacturing sector remains modest. From 2018 to 2023, the sector is expected to see a demand for more than 750 core technical roles, bringing total employment of such occupations to nearly 4,000 in Alberta.

Figure 17: Alberta Advanced Manufacturing Sector Employment History and Forecast - core technical jobs, 2001-2023



Source: ICTC 2019

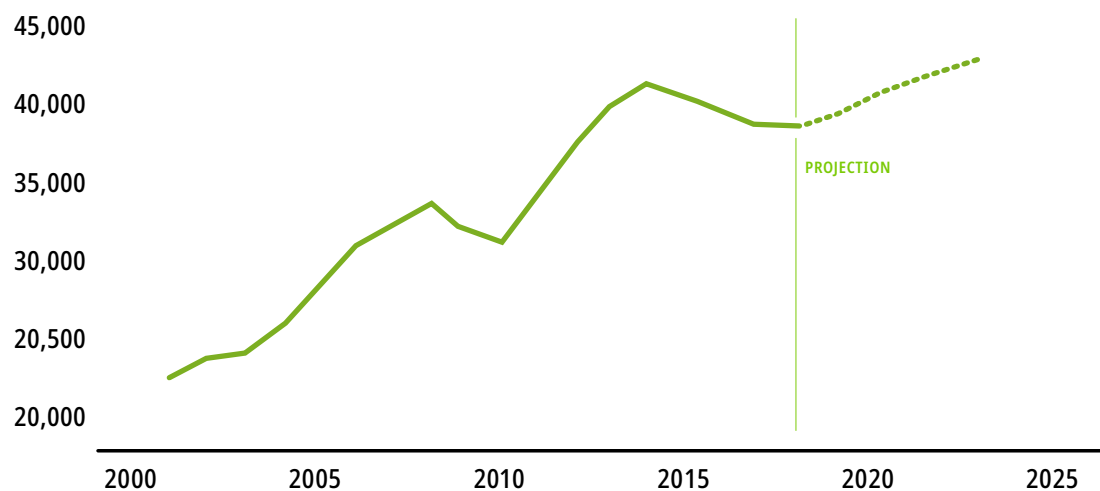


Cleantech

The Albertan cleantech sector is comprised of companies involved in advanced chemical processes, renewable power generation, IoT and sensors, energy storage, smart grid development, and others. Many companies in the cleantech space rely on government funding both provincially and federally, as well as external types of funding such as venture capital or angel investment. One of the reasons for a heavier reliance on government funding in the cleantech sector – vs. venture capital for example – is the comparatively longer-term payout period (or ROI) for cleantech products. In fact, in the US, not only had VC in the cleantech arena dropped by more than 30% between 2011 and 2016, but among the investments that were received in 2016, nearly 90% was attributed to late-stage investment – that is, companies that were already mature and near or at profitability²⁹. Consultations with cleantech employers in Alberta echoed this, where more than 40% identified their biggest obstacle to business growth being access to funding³⁰.

Despite some barriers related to attracting investment, the cleantech sector in Alberta has grown substantially since the early 2000s (3.2% annually from 2001-2018) and is expected to see further increase in the coming years. Overall, employment in the sector is expected to increase by a CAGR of 2.2% from 2018 to 2023. By 2023, the cleantech sector will see a demand for nearly 4,500 workers across a number of occupations, with total potential employment reaching nearly 43,000.

Figure 18: Alberta Cleantech Employment History and Forecast (all jobs), 2001-2023



Source: ICTC 2019

²⁹Devashree Saha, Mark Muro Cleantech venture capital: Continued declines and narrow geography limit prospects (Brookings, May 16, 2017) <https://www.brookings.edu/research/cleantech-venture-capital-continued-declines-and-narrow-geography-limit-prospects/>

³⁰58% of these respondents specifically stated that accessing VC was a hurdle.

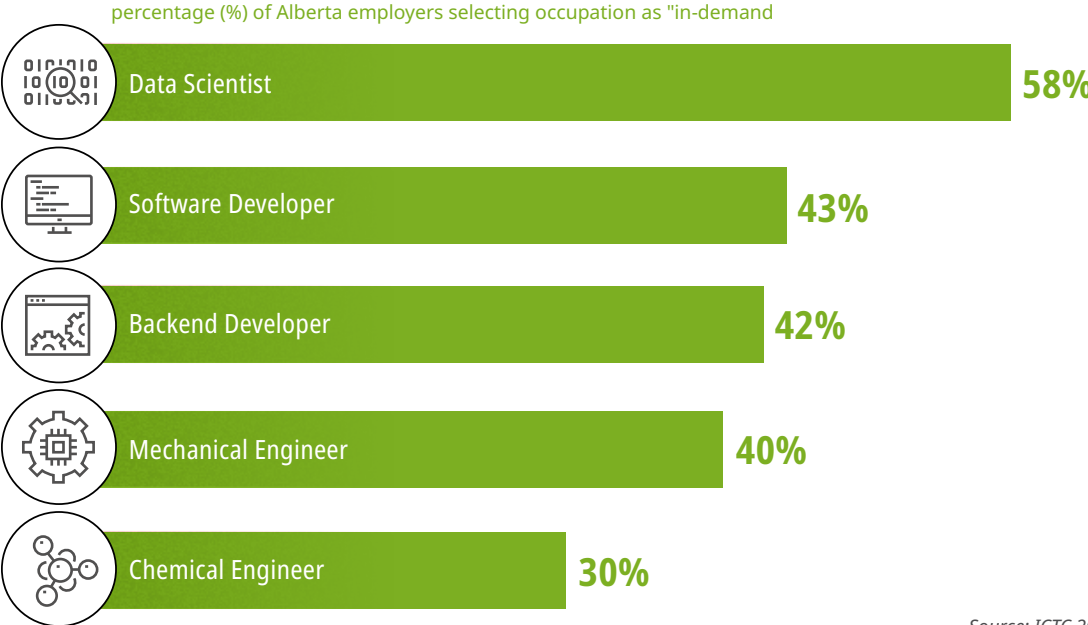
Cleantech, by its very name, is a sector that is and has always been rooted in technology. By focusing on technology as an enabler of green energy solutions, the sector is driven by a number of key digital and technical occupations. These include engineers – particularly mechanical and chemical – as well as roles like software developers and data scientists or data analysts.

Top Occupations in the Cleantech Sector: The Growing Demand for Digital Roles

A few notable digital roles are expected to grow substantially over the coming years. Data science is increasingly playing a central part in renewables and energy management. Smart grid and energy management systems analyze data gathered on usage, which can be repurposed to make decisions or create procedures to avoid unnecessary consumption. Consultations with cleantech employers in Alberta found that nearly 60% identified the data scientist as an in-demand role.

At the same time, the development of software that can support green energy activities, as well as resource and waste management, will continue to play a central role in the clean technology sector. For example, Alberta’s own *Ambyint* specializes in the development of software capable of predicting leaks from in-field oil & gas wellhead equipment using sensor data. In Alberta’s cleantech sector, software developers alone are expected to grow by a CAGR of 2.7% until 2023.

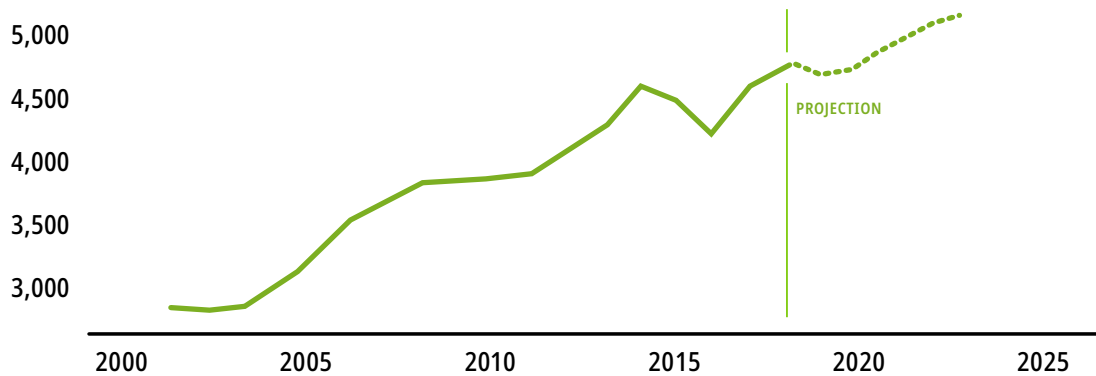
Figure 19: In-demand digital and technical jobs in the Alberta cleantech sector, 2019



Source: ICTC 2019

Core digital roles the cleantech sector will see a CAGR of 2% from 2018 to 2023. While the demand for digital solutions in the cleantech sector is clear, oftentimes faced with limited funding and capital-intensive activities, cleantech employers have looked to outsourcing of some roles in an effort to generate cost-savings. Consultations with Alberta cleantech employers found that nearly 15% had outsourced roles which did not necessarily require a physical presence – for example, like software developers or backend developers. Taking these factors into account, the cleantech sector in Alberta is expected to see a demand for nearly 500 digitally-skilled professionals until 2023. If filled, this will bring total employment of core digital roles to nearly 5,300.

Figure 20: Alberta Cleantech Sector Employment History and Forecast - core digital jobs, 2001-2023

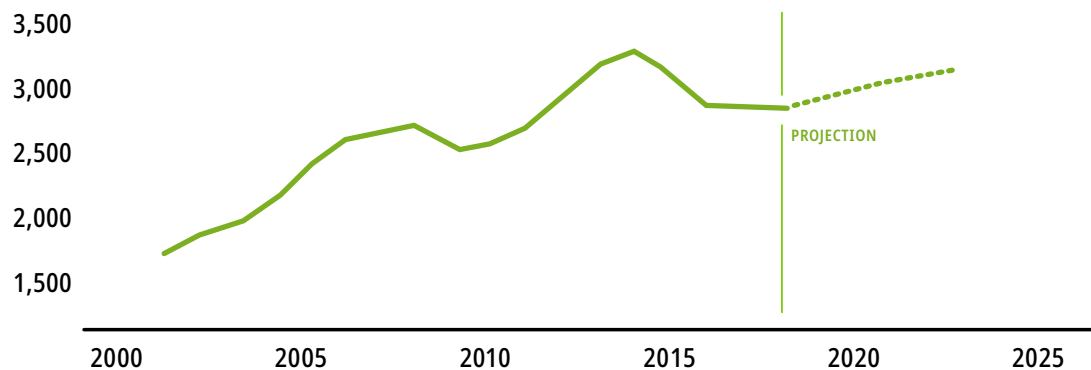


Source: ICTC 2019

The cleantech sector also relies on a number of technical occupations such as chemical engineers and mechanical engineers. Mechanical engineers are another example of an occupation that, while technical rather than digital in nature, is expected to see significant employment growth over the coming years. Consultations with Alberta cleantech employers identified that mechanical engineers were among the top most needed roles for the sector, and the most in-demand technical occupation.

However, similar to how much of the supply for top technical talent needed to drive the advanced manufacturing sector is readily available in Alberta, this story is even more pronounced in the cleantech sector. Cleantech, part of the overall energy industry, has strong ties with oil and gas. Many oil and gas businesses are top consumers of cleantech products. Shell, for example, is currently investing \$1-2 billion per year until 2020, and \$4 billion per year thereafter, in clean energy alternatives³¹. This linkage between the two sectors is also evident when it comes to jobs – oftentimes, the demand for engineering talent needed in cleantech is very similar to the talent needed in oil and gas. With many engineering occupations experiencing unemployment rates between 13% to 20% following the recent recession³², this highly-skilled talent can be easily repurposed from oil and gas into cleantech. As a result, the supply for these roles is also fairly available in the province, functioning to dull demand slightly. From 2018 to 2023 the demand for core technical roles is expected to total approximately 300, culminating in the potential employment of more than 3,000.

Figure 21: Alberta Cleantech Sector Employment History and Forecast - core technical jobs, 2001-2023



Source: ICTC 2019

³¹Will Dubitsky, Shell aims to lead Big Oil in pivot to clean energy (Canada's National Observer, April 22, 2019) <https://www.nationalobserver.com/2019/04/22/opinion/shell-aims-lead-big-oil-pivot-clean-energy>.

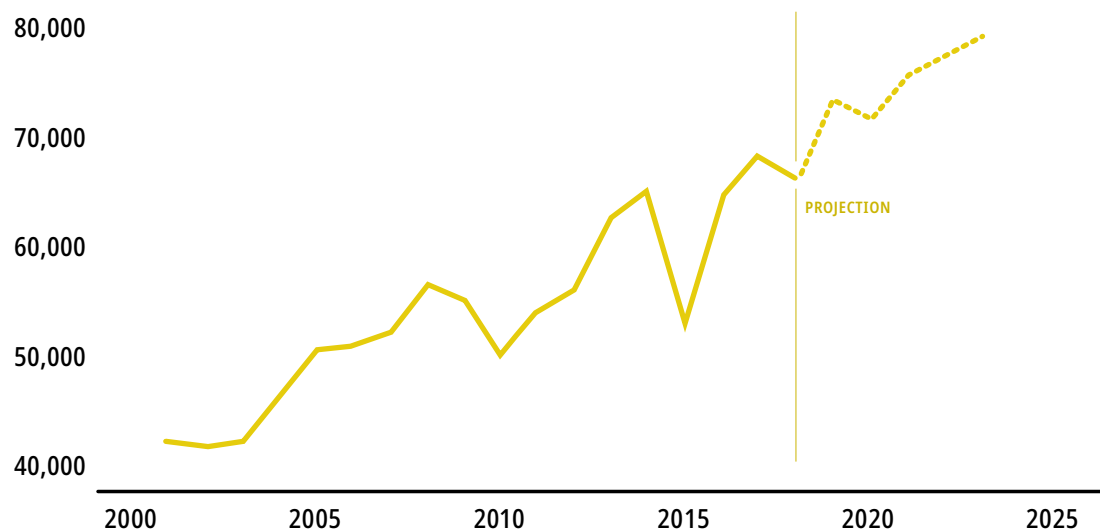
³²Alexandra Cutean, Robert Davidson, Mapping Calgary's Digital Future: Tech Employment Opportunities for Displaced Workers (ICTC, 2018). <https://www.calgaryeconomicdevelopment.com/dmsdocument/252>

Interactive Digital Media

Interactive Digital Media refers to the industry of digital platforms that tend to have some level of user engagement. Examples include film and television, graphic design, game design, user experience or user interface, music and post-production services.

The digital media sector is expected to see substantial growth over the coming years due to a number of factors such as advancements of businesses in this space, along with recent favorable policy developments like the Screen-Based Production Grant and the Interactive Digital Media Tax Credit. With over 50 firms specializing in video game design and development alone in Alberta³³, ICTC forecasts employment in the IDM sector to rise by a CAGR of 3.7% until 2023. It is expected that the sector will see a demand of more than 13,000 workers across a number of occupations, bringing total employment to nearly 80,000 in the sector by 2023. At this rate, the IDM sector alone will represent over 3% of total employment in the province.

Figure 22: Alberta Interactive Digital Media Employment History and Forecast (all jobs), 2001-2023



Source: ICTC 2019

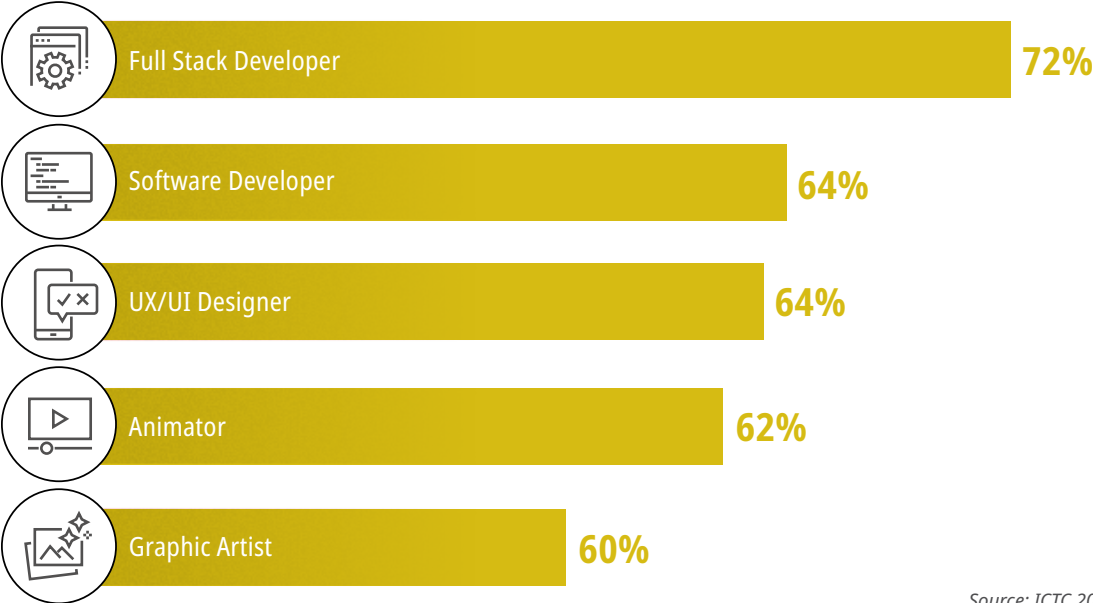
Top Occupations in the IDM Sector: The Growing Demand for Digital Roles

The digital media sector relies heavily on digital roles like software developers, full stack developers, and information systems professionals; as well as roles that are a blend of digital and design backgrounds like user experience and user interface professionals.

³³Interactive Digital Media (Government of Alberta, 2019) <https://investalberta.ca/industry-profiles/interactive-digital-media/>

Consultations with digital media employers in Alberta found that while a number of roles like software developers, UX/UI developers and even graphic artists were in demand for the sector, ultimately the most sought-after position was the full stack developer with more than 70% of IDM employers selecting this role as in-demand. The importance of the full stack developer is a trend that is reflected across Canada as well. A recent report by Randstad places this occupation, with a range of front and back end skills, among the top 10 most in-demand digital jobs in Canada³⁴.

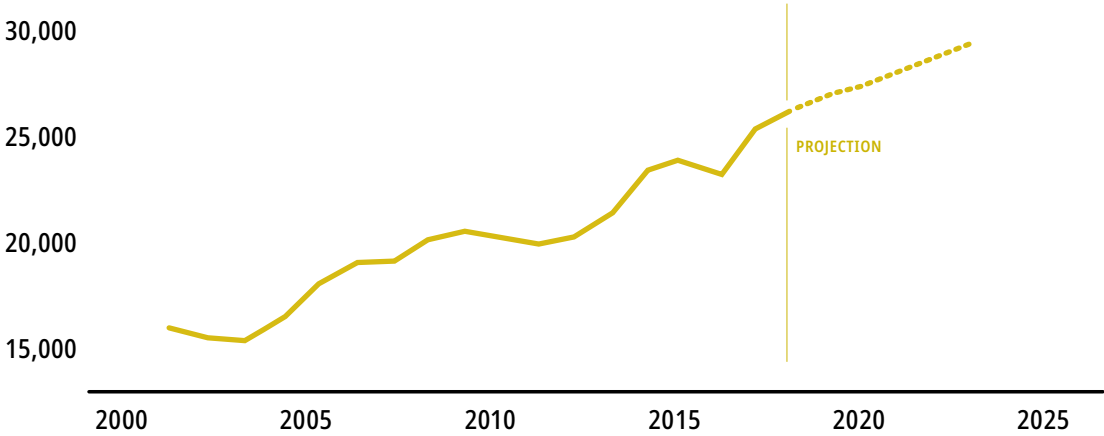
Figure 23: In-demand digital and technical jobs in the Alberta interactive digital media sector, 2019



Source: ICTC 2019

Core digital occupations like full stack developers, UX/UI designers and others make up nearly 40% of all employment in the sector. Over the next few years, this growth will only continue to accelerate, creating a demand for nearly 3,300 workers by 2023. If filled, this will bring total digital employment in Alberta’s digital media sector to nearly 30,000.

Figure 24: Alberta Interactive Digital Media Sector Employment History and Forecast - core digital jobs, 2001-2023

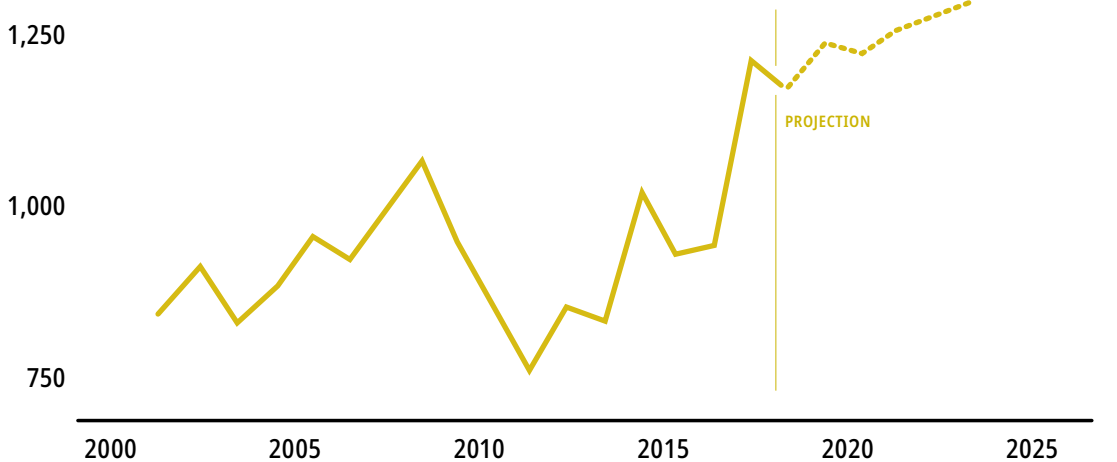


Source: ICTC 2019

³⁴Best technology and IT jobs in 2019 (Randstad, 2019) <https://www.randstad.ca/best-jobs/best-it-and-technology-jobs/#titles>

While the vast majority of employment demand in Alberta's digital media sector is owed to digitally-based roles like the above, there will also be a small demand for supporting technical roles such as broadcasting technicians or audio technicians. Between 2018 to 2023 such roles will see a need for more than 130 workers, bringing total employment to over 1,300.

Figure 25: Alberta Interactive Digital Media Sector Employment History and Forecast - core technical jobs, 2001-2023



Source: ICTC 2019

Spotlight on

Oil & Gas

Employment Growth Prospects for the Sector

Nestled in the energy industry, the oil and gas sector has been subject to significant changes and shifts for several decades. The economic impacts faced by the sector – significant periods of economic boom, followed by periods of economic bust – have had clear implications for employment.

While in this study, oil and gas has not been identified as a high-growth sector, it is worth noting due to its substantial impact on employment and economic strength for the province. Considering current-day factors including oil prices, pipeline development and export capacity along with recent GDP growth, near-term employment forecasts point to a decline followed by a relatively flat trend for the sector from 2019 to 2020. With total employment ranging from 146,000 to 148,000 between now and 2020 under low and high-growth estimations, a look towards diversification and growth led by technology-driven efficiencies can prove vital.

Figure 26: Alberta Mining, Quarrying, Oil & Gas Sector Employment (all jobs), 2019-2020 Forecast

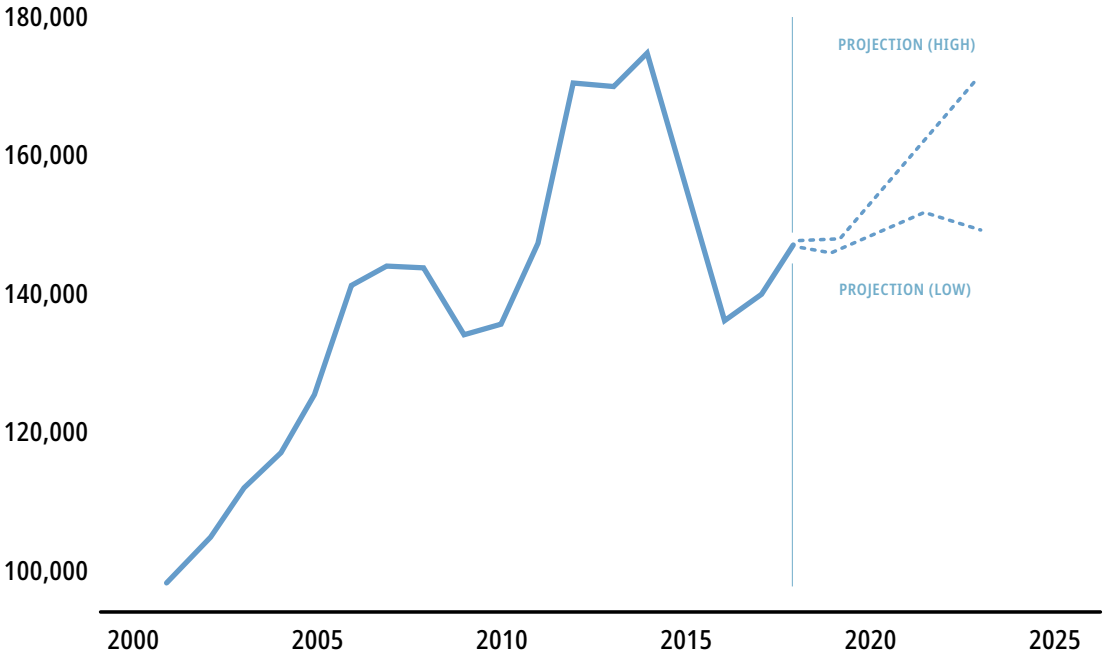


Source: ICTC 2019

Future long-term prospects for the sector can be significant, depending on investments made today in key technologies – some of which have already shown to substantially improve processes and drive productivity. For example, the use of IoT and predictive analytics in oil and gas has shown to yield significant benefits. Remote monitoring of pipelines via in-field sensors allows large amounts of data to be captured, which can then be analyzed to address well performance and maintenance needs. In so doing, this also provides opportunities for rapid response times, which can lead to the elimination of future errors. High-resolution 3D models of oil and gas wells, combined with the use of drones that capture live data is also a novel development for the sector. Such advanced imaging capabilities have already been used to detect and measure risks, and improve safety. These are but a few examples of how the implementation of technology in the oil and gas sector – beyond already-existing developments in automation – can help to boost economic performance and shape high-quality employment opportunities for Albertans.

With investments like these, the sector has the ability to change profoundly in terms of employment. Under a high-growth investment scenario, ICTC forecasts that employment in oil and gas will have the potential to scale at a CAGR of more than 3% from 2018 to 2023, creating a demand for more than 20,000 jobs in a number of occupations. Under this scenario, total employment in oil and gas would nearly reach its peak from 2015.

Figure 27: Alberta Mining, Quarrying, Oil & Gas Sector Employment, 2018-2023 Forecast – Low, Medium, High Growth



Source: ICTC 2019

An aerial photograph of a region in Alberta, Canada, overlaid with a semi-transparent red filter. The image shows a mix of urban development, including residential neighborhoods and commercial areas, and natural features like a winding river and agricultural fields. The text is overlaid on the left side of the image.

Section IV

Job Growth in Alberta: A Regional Analysis

A regional analysis of employment growth offers insight into the strength of specific jurisdictions in the province, while also showcasing potential hubs for investment and diversification. This section highlights critical and emerging economic pillars, labour force composition and overall employment prospects in three jurisdictions:

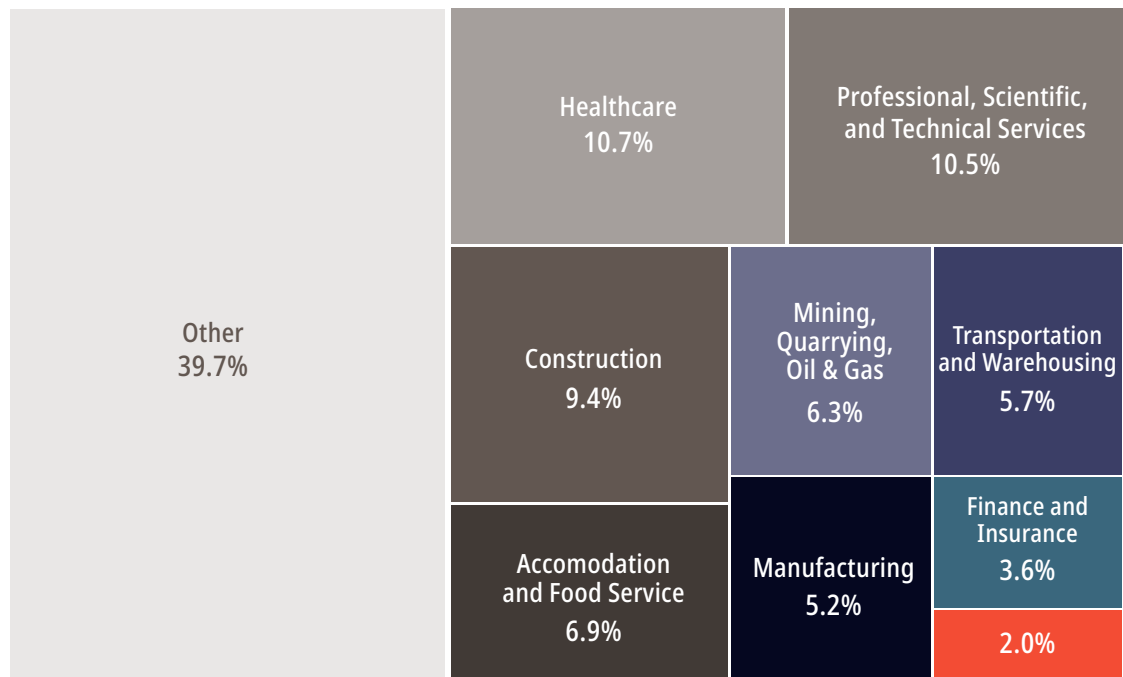
CALGARY | EDMONTON | LETHBRIDGE

Calgary

Calgary is the largest, most densely populated urban centre in Alberta. With the strongest level of economic activity, Calgary is expected to continue to show accelerated performance in comparison to other regions in the province over the coming years. Responsible for more than 30% of employment in Alberta³⁵, Calgary is home to a young and highly-educated workforce – it is the location of approximately 225,000 professionals with STEM backgrounds³⁶, making it Canada’s top headquarters for such workers³⁷.

Also home to nearly 30,000 head offices³⁸ and possessing one of the highest qualities of life in Canada³⁹, Calgary is an economic pillar for Alberta and Canada as a whole.

Figure 28: Calgary Labour Force Breakdown by Sector, 2016



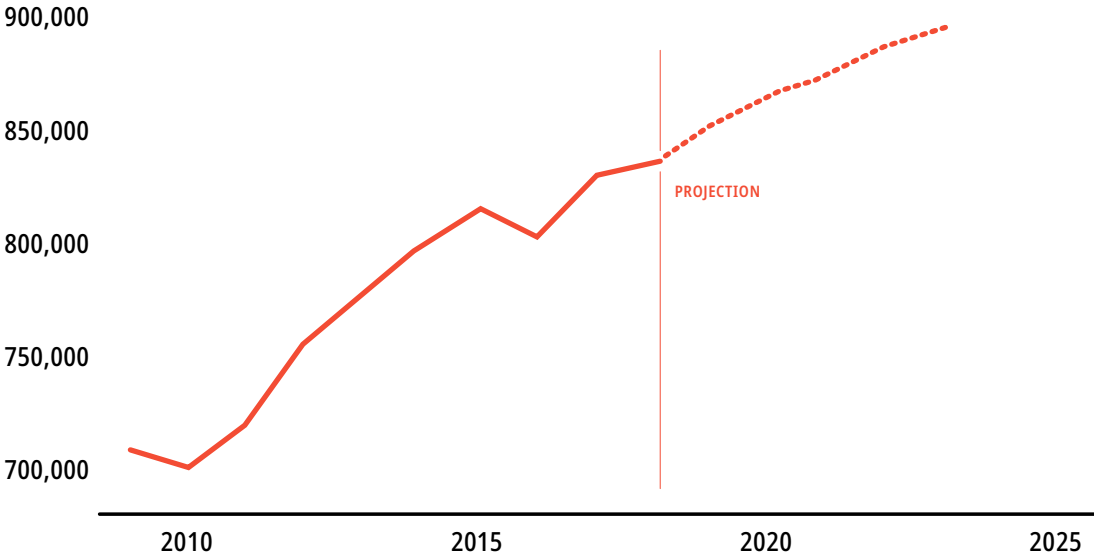
Source: NHS, 2016

³⁵Calgary (Government of Alberta Regional Dashboard, 2018) <https://regionaldashboard.alberta.ca/region/calgary/#/percentofalberta>
³⁶Labour Force Characteristics by Census Metropolitan Area, Three-month Moving Average, Seasonally Adjusted." Statistics Canada, Table: 14-10-0294-02. (Physical and Life Sciences Technologies; Mathematics, Computer and Information Sciences; Architecture, Engineering and Related Technologies CIP).
³⁷Among the highest concentration of STEM-educated professionals per capita.
³⁸Sarah Rieger, Is Calgary losing its status as a hub for office HQs? Depends on what number you look at (CBC News, January 31, 2019) <https://www.cbc.ca/news/canada/calgary/calgary-office-headquarters-1.4999738>
³⁹The Global Livability Index 2018 (The Economist Intelligence Unit, 2018) https://pages.eiu.com/rs/753-RIQ-438/images/The_Global_Livability_Index_2018.pdf

Emerging subsectors in the city are functioning to not only create new economic and employment opportunities, but to drive employment in changing traditional sectors as well. Examples include substantial growth seen in technology-based industries such as Ag-tech, autonomous systems and drone testing, and digital media. The growth of these subsectors is responsible for a surge in employment opportunities in areas like data science, GIS, QA testing and others in the city. In 2018, anywhere between 4.5-12% of Canada-wide job postings for top digital occupations like software developers or data scientists were found in Calgary⁴⁰. Calgary’s economic future is increasingly tied to technology.

As a result, Calgary is expected to see a demand for more than 58,000 workers across a number of occupations and industries by 2023. This will bring total potential employment to nearly 900,000.

Figure 29: Calgary Employment History and Forecast (all jobs), 2001-2023



Source: Statistics Canada

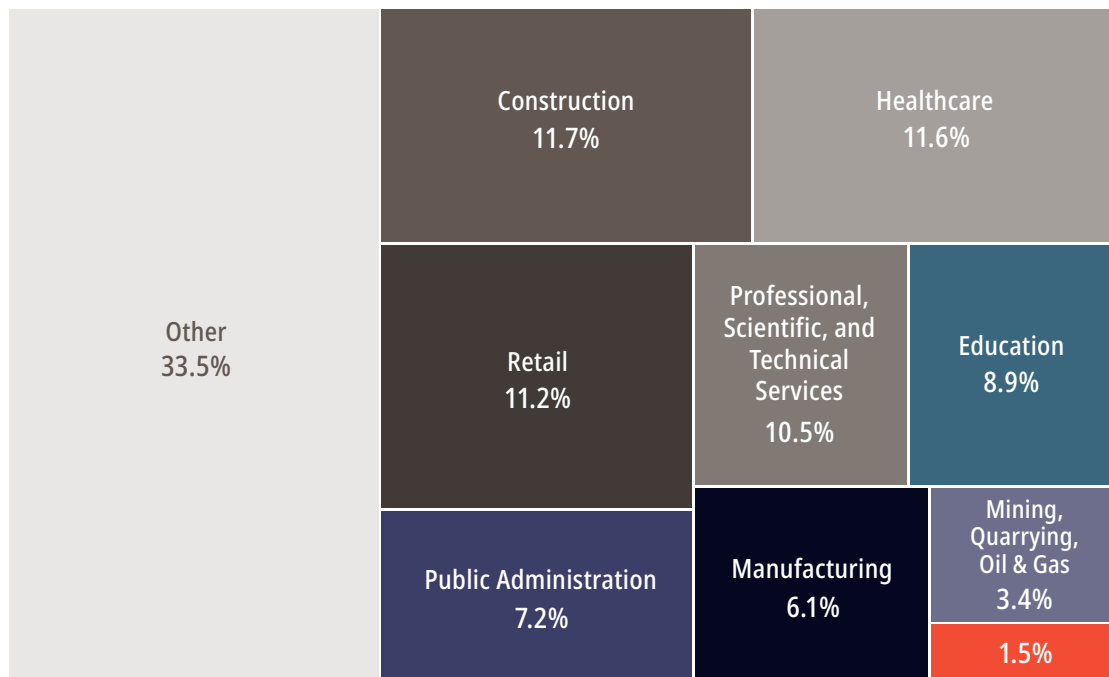
Source: Statistics Canada



Edmonton

As the second-largest city in Alberta, Edmonton is also expected to continue to see employment growth that surpasses that of other regions in the coming years. In the past, Edmonton has benefited from growth in areas like public administration, health-care, and education – sectors which tend to have a high proportion of post-secondary educated professionals, and higher than average wages.

Figure 30: Edmonton Labour Force Breakdown by Sector, 2016

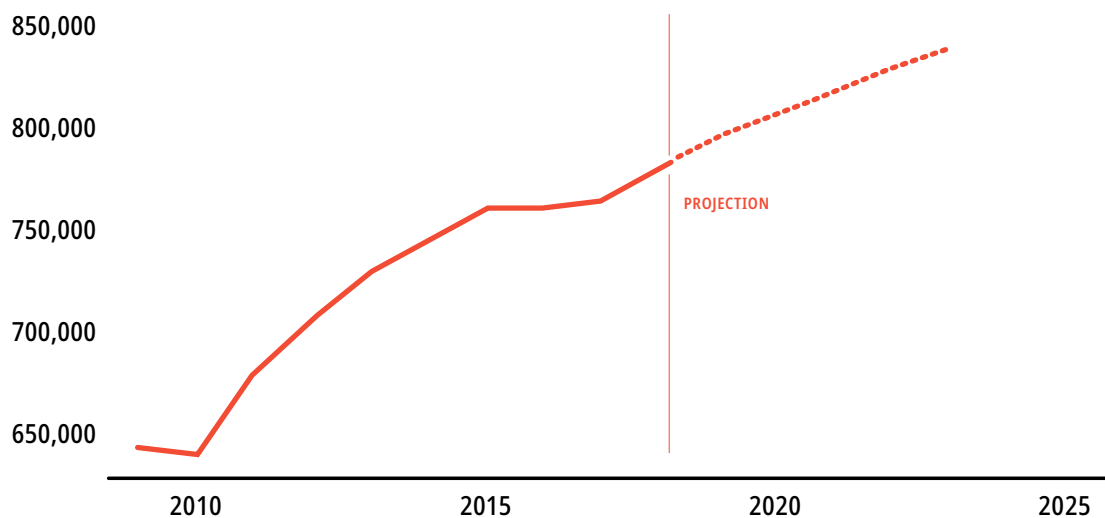


Source: NHS, 2016

Innovative healthcare (e-health) and green energy solutions are two of Edmonton’s top technology-driven focus areas. With the city being home to one of the largest AI research clusters in Canada and world-class institutes like the Alberta Machine Intelligence Institute (AMII)⁴¹, homegrown AI solutions are likely to spur growth across the economy. In 2018, more than one quarter of the city’s fastest growing companies (seeing growth of 95% to more than 1000% since 2012) were health or green energy focused⁴².

These factors, in addition to favorable demographic trends in Edmonton – with the city having a population growth rate twice the national average – make for strong employment prospects. By 2023, the city is expected to see a demand for more than 60,000 workers across all occupations, bringing total possible employment to approximately 840,000.

Figure 31: Edmonton Employment History and Forecast (all jobs), 2001-2023



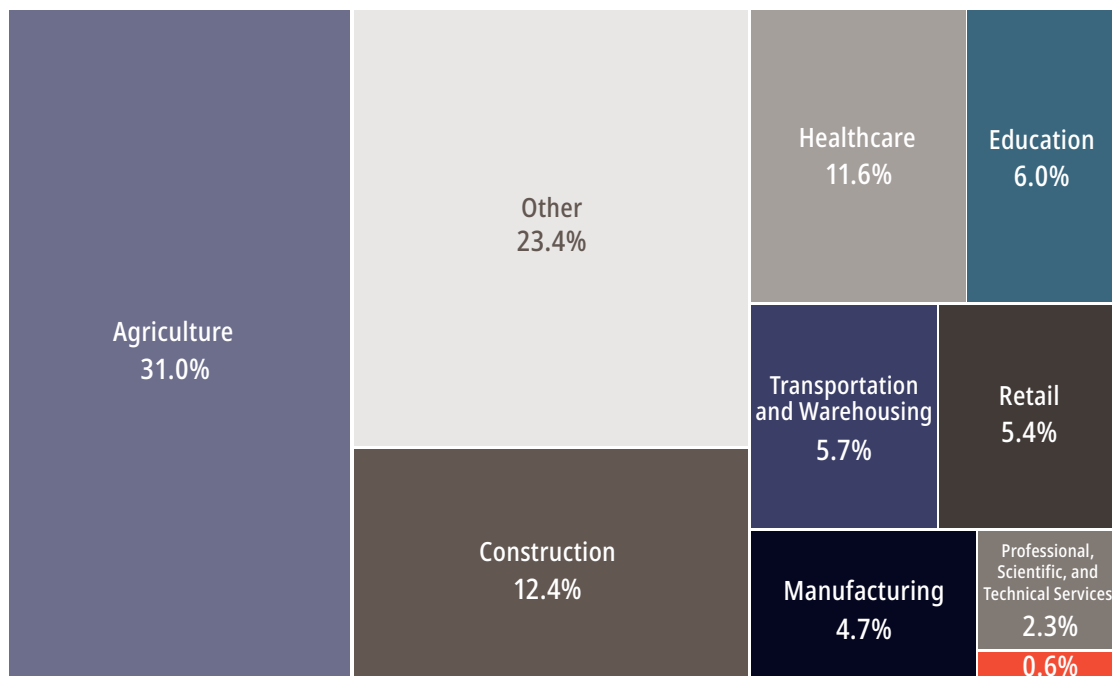
Source: ICTC 2019

⁴¹Industry: Artificial Intelligence (Edmonton Government, 2019) <https://www.investedmontonregion.com/invest/industries/artificial-intelligence/>.
⁴²Meet Edmonton's fastest-growing companies: 2018 Growth 500 (Canadian Business, September 13, 2018) <https://www.canadianbusiness.com/lists-and-rankings/growth-500/2018-edmonton-fastest-growing-companies/>.

Lethbridge

Smaller cities in Alberta such as Lethbridge, have experienced mixed employment outcomes in the past. A central reason for these fluctuations is that they tend to be more susceptible to changes in local industries, as well as events impacting the provincial economy as a whole. Among the top sectors in Lethbridge are agriculture, manufacturing and construction.

Figure 32: Lethbridge Labour Force Breakdown by Sector, 2016



Source: NHS, 2016

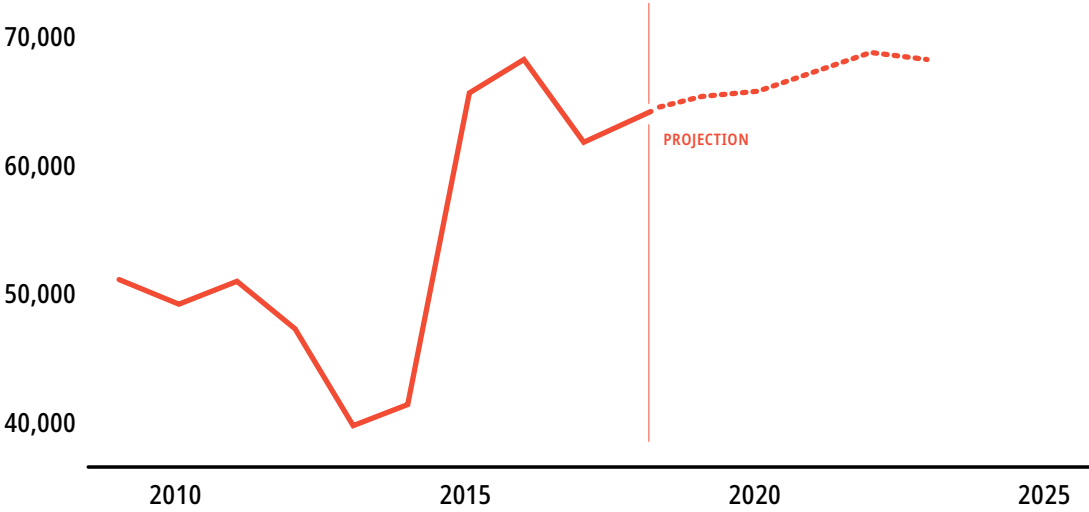
While traditional sectors currently play a dominant role in the Lethbridge economy, emerging sub-sectors such as Ag-tech have the ability to create a substantial impact in the city going forward. The Lethbridge Research Centre for example, is the largest within Agriculture and Agri-Food Canada's national networks, currently leading research and development in bio-industrial platforms⁴³.

⁴³Agriculture and Agri-food (Choose Lethbridge, 2019) <https://chooselethbridge.ca/index.php?seotitle=agriculture>

At the same time, emerging technologies like AR/VR are beginning to see growth in the city, and Lethbridge College recently announced that it will offer a certificate program in AR/VR. With developments like these, intended to build a solid base of digitally-skilled talent, Lethbridge may quickly become Alberta’s AR/VR hub.

Employment in Lethbridge is expected to increase across sectors over the coming years. By 2023, Lethbridge will see a demand for approximately 4,500 workers in a variety of occupations, bringing total employment to approximately 68,000.

Figure 33: Lethbridge Employment History and Forecast (all jobs) 2001-2023



Source: ICTC 2019

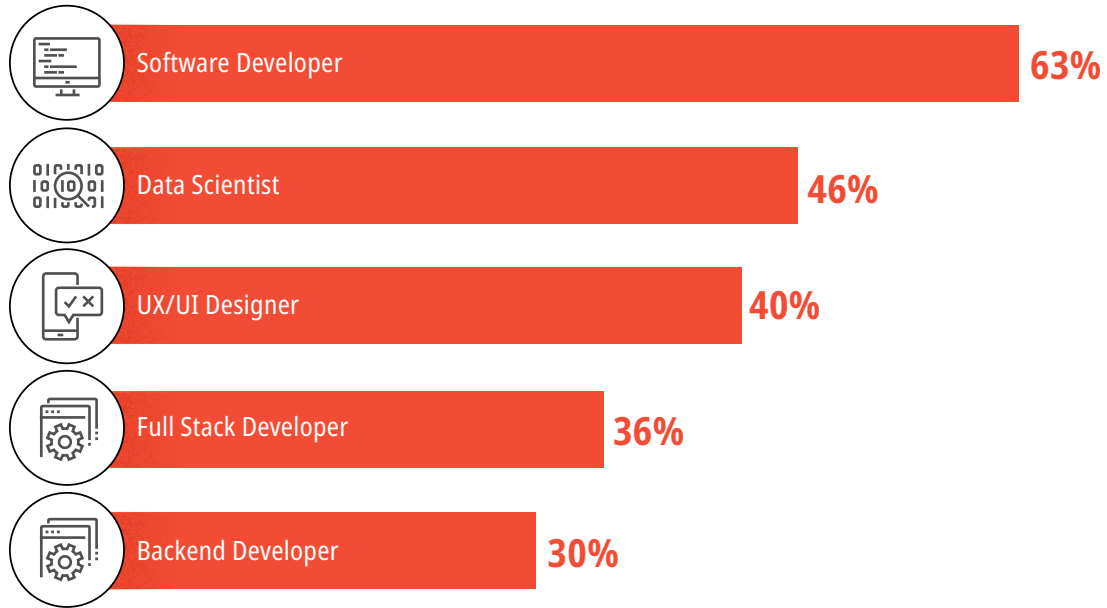
Section V

Top Digital Jobs & Skills in Alberta



Technology will increasingly play an important part of Alberta’s future, making a number of digital roles critical, particularly as key sectors like health, advanced manufacturing and IDM grow and develop. In this study, consultations with Alberta employers have highlighted five critical digital occupations as most in-demand across the economy: software developers, data scientists, UX/UI designers, full stack developers, and backend developers.

Figure 34: Top 5 most in-demand digital jobs in Alberta, 2019













Source: ICTC 2019

In addition to these five roles, a number of other both digitally-based and technically-based occupations were also identified as being central to the economic growth prospects of businesses in the province. These are: IT support specialists, cybersecurity analysts, mechanical engineers, lab technicians, and business analysts. The case of business analyst roles is particularly interesting given the high rate of cross-over with data analysts. Both roles require skills in statistical analysis and problem-solving, as well as working with various types of data to analyze findings and suggest solutions. However, while business analysts would typically complete such tasks in order to help inform better business practices internally, data analysts tend to focus more on the use and manipulation of data to highlight important findings, or improve the competitiveness of the business externally. In smaller organizations however, these positions can be synonymous with the title “business analyst” being broadly-used for a role rooted in data analysis⁴⁴.

The following represents vacancy trends across Alberta for these top 10 roles, extracted from the total number of job postings found for each during the period of January to April 2019.

Sanchita Lobo, What's the difference between data analysts and business analysts? (Analytics Training, November 30, 2018) <https://analyticstraining.com/whats-the-difference-between-data-analysts-and-business-analysts/>

Figure 35: Monthly job postings for in-demand digital and technical roles in Alberta, January to April 2019

	JAN 2019 JOB POSTINGS	FEB 2019 JOB POSTINGS	MAR 2019 JOB POSTINGS	APR 2019 JOB POSTINGS
 Software Developer	261	269	285	273
 Business Analyst	223	218	220	217
 IT Support	118	126	109	123
 Cybersecurity Analyst	101	120	121	114
 Mechanical Engineer	83	89	86	84
 Data Scientist	76	67	64	66
 UX/UI Designer	47	62	51	56
 Full Stack Developer	51	53	56	47
 Lab Technician	25	34	31	23
 Backend Developer	12	13	27	18

Source: ICTC 2019

In-demand Skills

Broad skills analysis

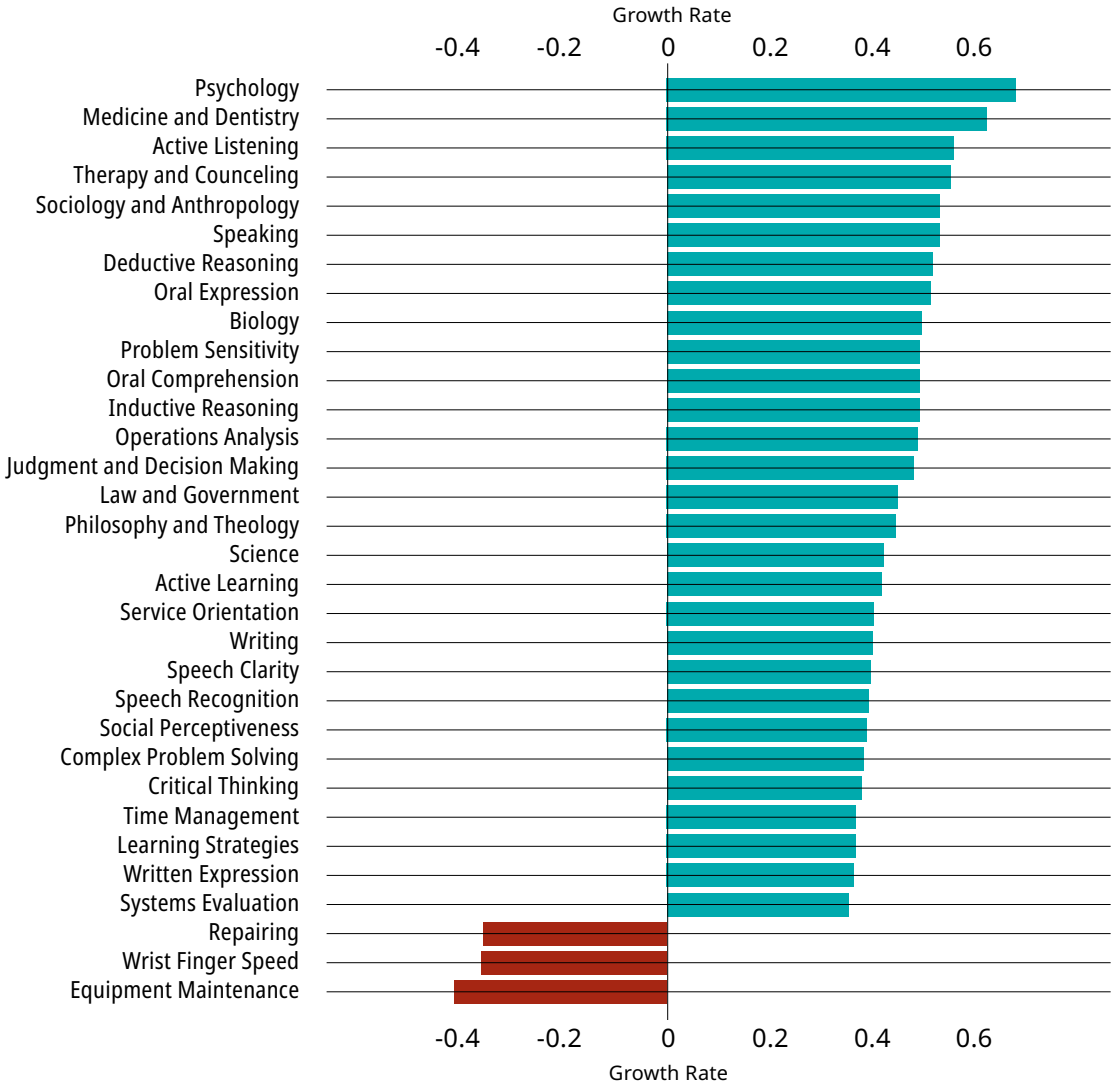
Developed with the support of the US Department of Labor, the *O*Net Research Centre* conducts surveys of employees to understand how important various skills, tasks, abilities, and technologies are for a variety of occupation codes⁴⁵. To extract relevant skill sets for Canadian occupational classifications associated with in-demand roles identified in this study, ICTC mapped the US occupational classification codes to Canadian ones and merged this data with the employment forecasts of high-growth roles. The findings of this exercise present interesting insights in relation to broad skillsets seeing demand.

While STEM and high-tech skills are critical for a variety of in-demand occupations, so-called “soft skills”, such as reasoning or judgment are the skills most associated with fast-growth roles Alberta from 2018 to 2023. This finding was echoed by employers throughout the study, who frequently noted that foundational skills like critical thinking, creativity and flexibility were the most important in the hiring process.

⁴⁵Standard Occupational Classification (SOC) codes.

Other skills like active listening, oral expression, and inductive reasoning are also strongly associated with high-growth occupations. According to this analysis, while 'learning to code' may be important, the capacity to communicate and present results in an effective way is equally or more important in the long-term.

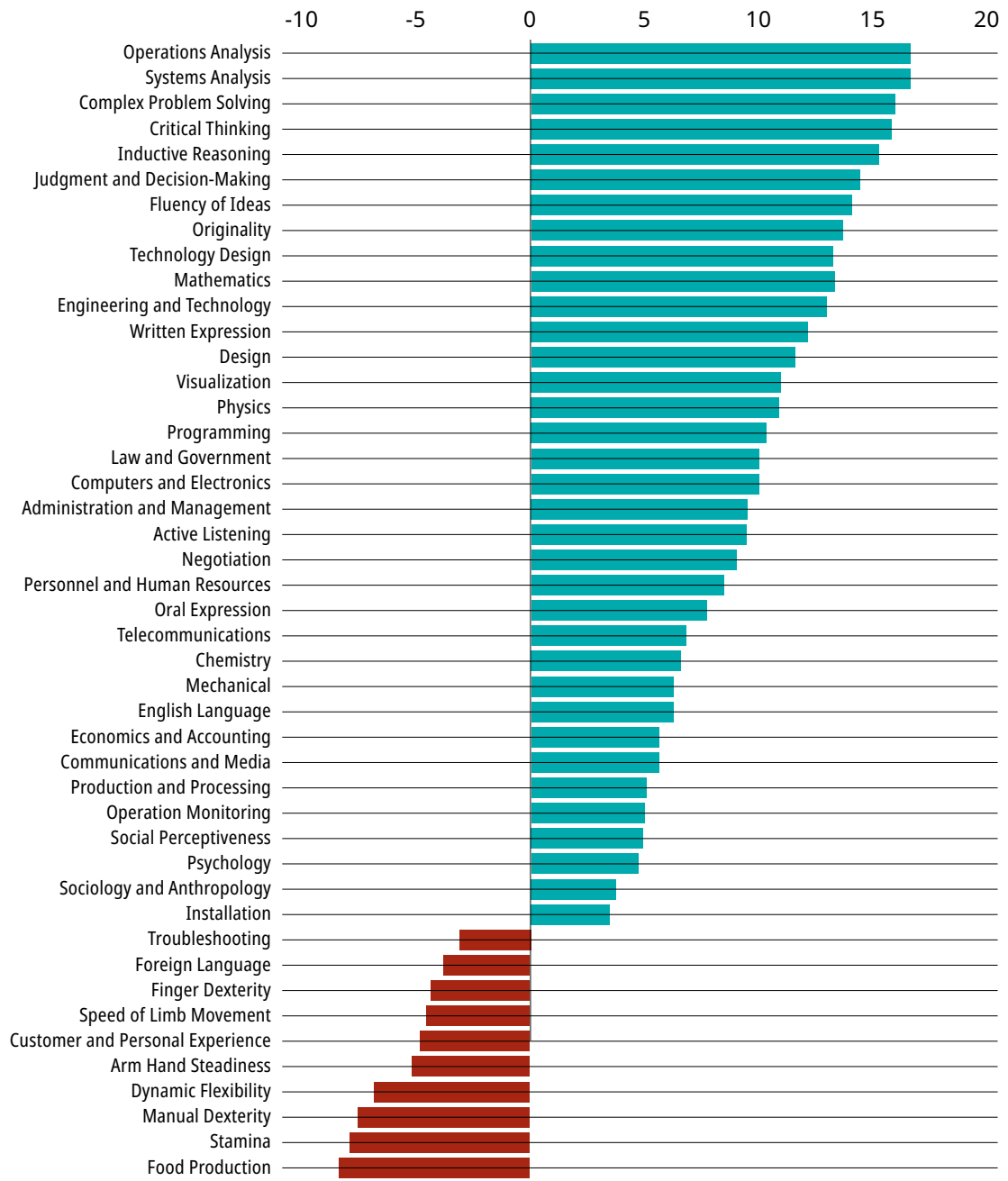
Figure 36: Skills Most Frequently Associated with Job Growth in Alberta, 2009-2018



Source: ICTC 2019

A further comparison of top skills with annual salaries is also interesting. Here, skills like operational and systems analysis, along with critical thinking are tied to higher annual salaries. Occupations requiring such technical skills (in addition to broad skills noted above) tend to be higher-paying. The fastest growing occupations that possess these skills tend to place an emphasis on soft skills like problem solving or critical thinking.

Figure 37: Skills Most Frequently Associated Salary Growth in Alberta, 2009-2018

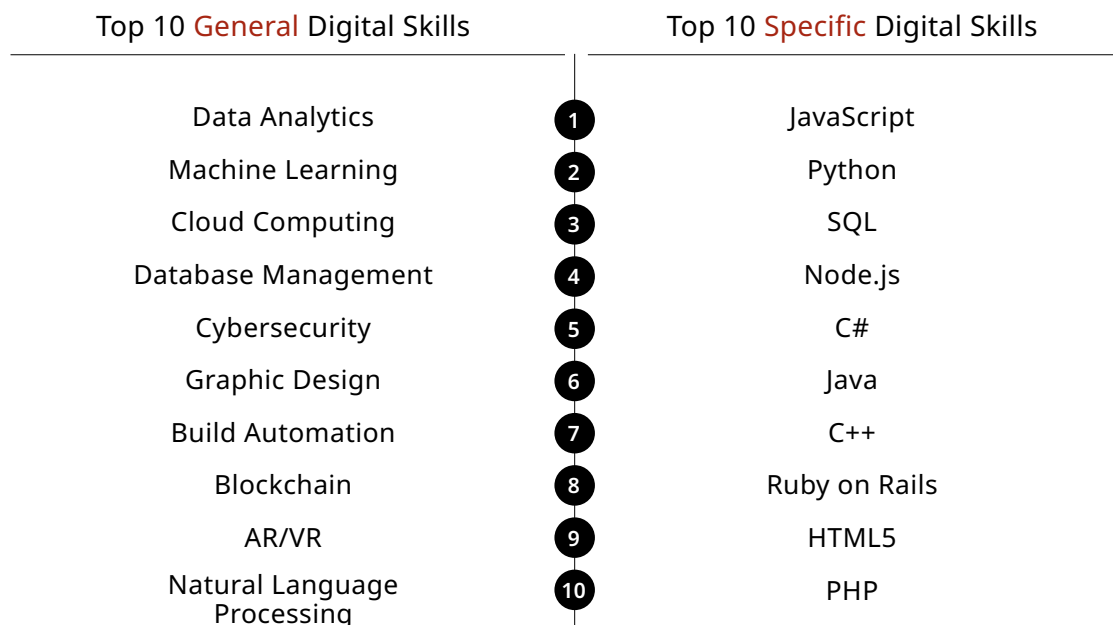


Source: ICTC 2019

A Deep Dive into Digital Skills

Consultations with Alberta employers highlighted a number of digital skillsets as critical for the most in-demand roles in the province. These varied between broad digital skills such as experience with machine learning, or knowledge of build automation; to specific skills such as JavaScript or Python proficiency, knowledge of the Node.js platform and others. While the 20 below were most highly referenced as in-demand, other skills like agile development, proficiency with CSS, experience with Angular.js frameworks, and familiarity with REACT libraries were also noted as important.

Figure 38: Alberta employers' perception of top in-demand digital skills, 2019



Source: ICTC 2019

Section VI

Supply Streams – The Link to Alberta’s Digital Future



Alberta is expected to face a significant demand for skilled workers across a number of verticals in the coming years. With technology being a key driver of economic growth in many sectors, increasingly, employers will require digitally-skilled talent to fill various positions and continue to spur productivity, business scale up, exports, and competition.

The demand for core digital roles like software developers, cybersecurity analysts, and data analysts will reach nearly 9,000 across the economy by 2023. Bolstering available supply with critical digital skills is essential to meet industry demand and support a sustainable economic future for Alberta.

The Alberta Talent Gap

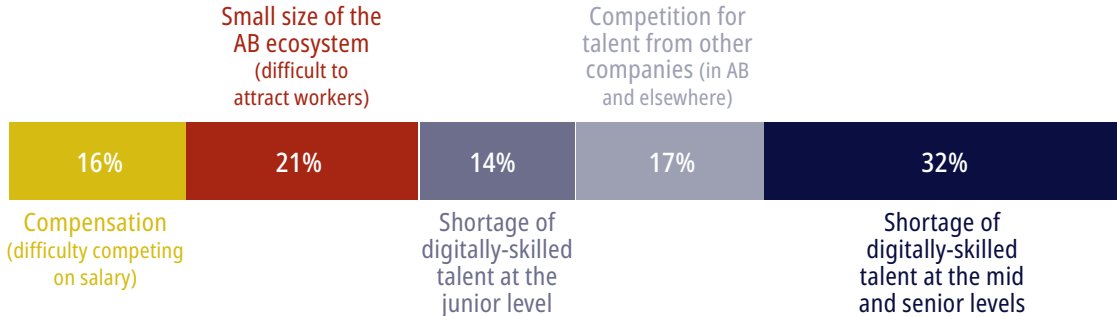
Consultations with employers identified a significant gap in the province when it comes to digitally-skilled talent. This gap was most pronounced at the mid and senior levels, where 80% of employers expressed difficulty sourcing qualified candidates.

Figure 39: Employers' perception of the talent gap in Alberta, 2019



Source: ICTC 2019

Figure 40: Employers' perception of the biggest challenges facing Alberta businesses, 2019



Source: ICTC 2019

Moreover, while junior-level talent was often sourced locally from Alberta post-secondary institutions, approximately 30% of employers noted having to hire mid and senior level talent from other provinces or other countries, due to the dearth of available local talent. The following is a sample of the self-identified skillsets⁴⁶ possessed by Alberta-based talent working in the province's most in-demand jobs. While a very preliminary analysis (based on self-identification, rather than skill verification), it potentially highlights a challenge in the ability of talent to appropriately articulate and effectively "sell" their capabilities to prospective employers.

⁴⁶Obtained from skills tagged by individuals working in these roles in Alberta.

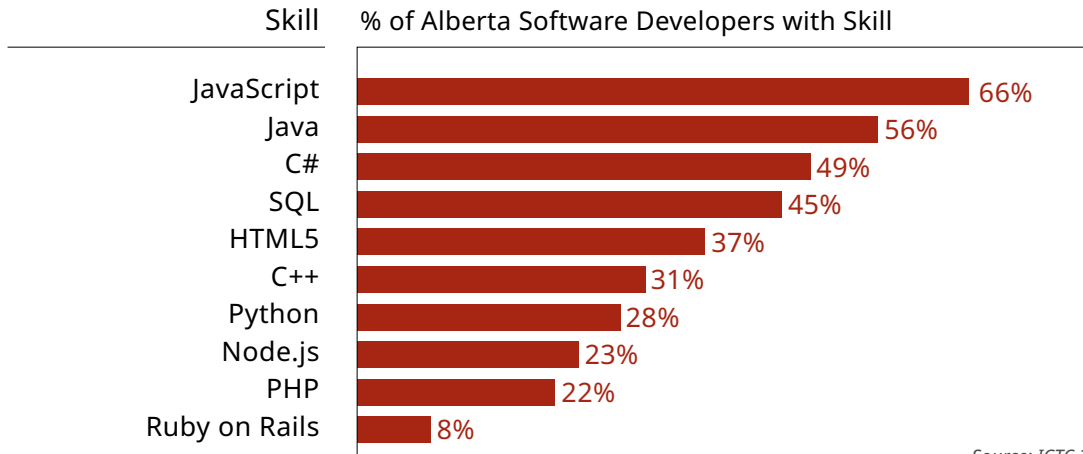
Figure 41: Skill availability among Alberta workers for in-demand jobs, 2019

Software developers



WHAT DO THEY DO?

Software developers identify core functionality needs and user requirements to design a variety of online programs and applications.



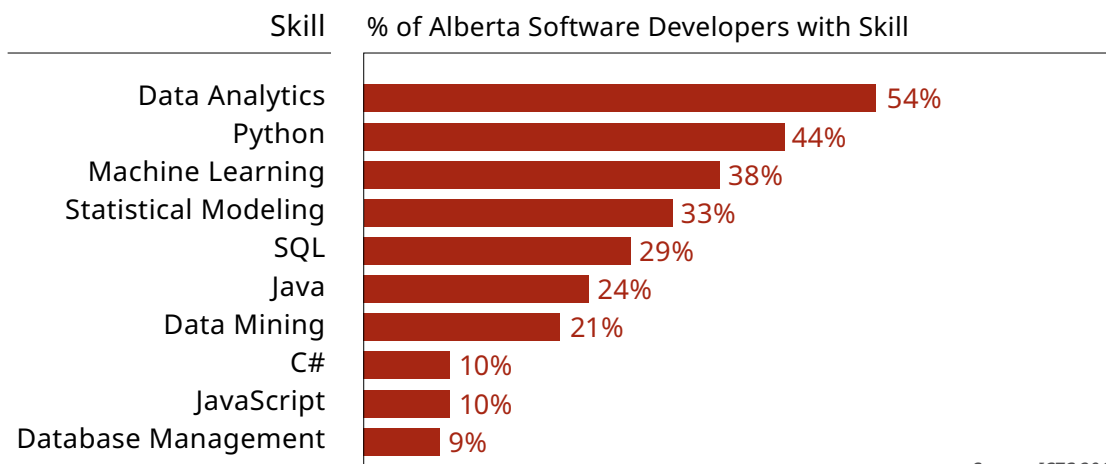
Source: ICTC 2019

Data Scientists



WHAT DO THEY DO?

Data scientists conduct analyses of data to extract insights, evaluate and identify strategic opportunities, and develop models and algorithms.



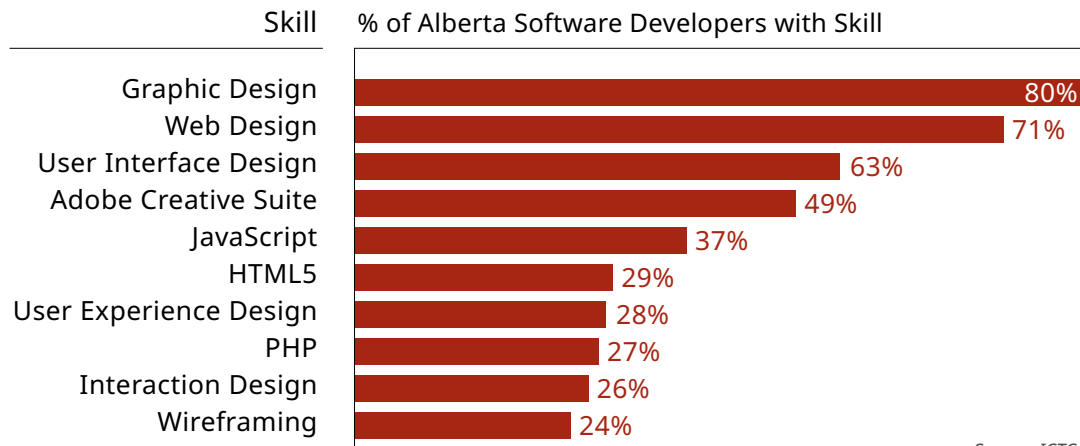
Source: ICTC 2019

UX/UI Designer



WHAT DO THEY DO?

UX/UI designers focus on the user experience and user interface of a product. This role can also be split into two separate roles, one focusing on the experience a user will have with a product; and the other on the interface (or look and feel) of it.



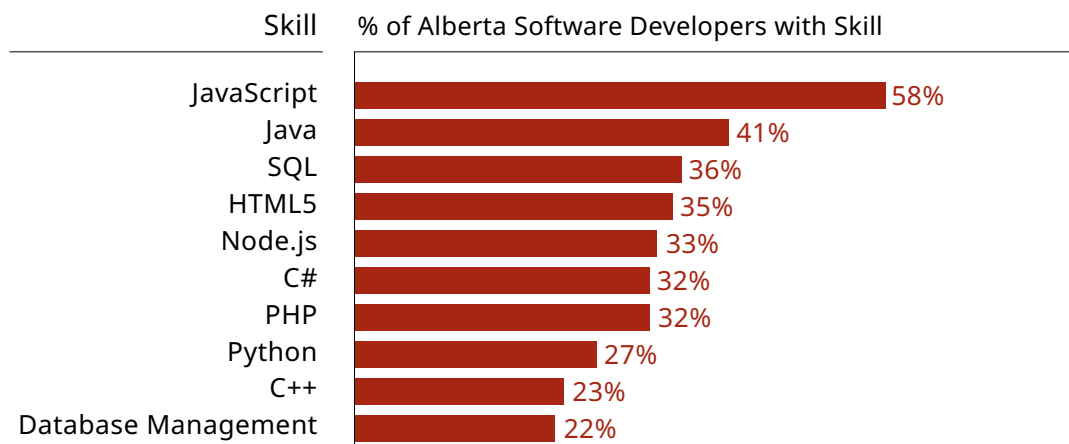
Source: ICTC 2019

Full Stack Developer



WHAT DO THEY DO?

Full stack developers possess proficiency with both the front end (consumer facing, visible); and back end (databases, infrastructure, etc.) parts of the development process.

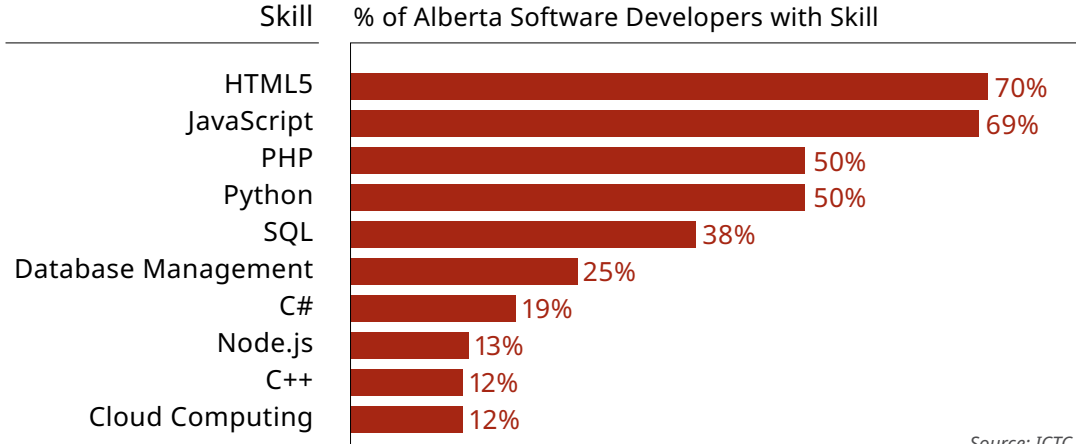


Source: ICTC 2019

Backend Developer



WHAT DO THEY DO? Backend developers build and manage IT infrastructure, databases, and other “under the hood” elements of a website that users do not interact with directly.



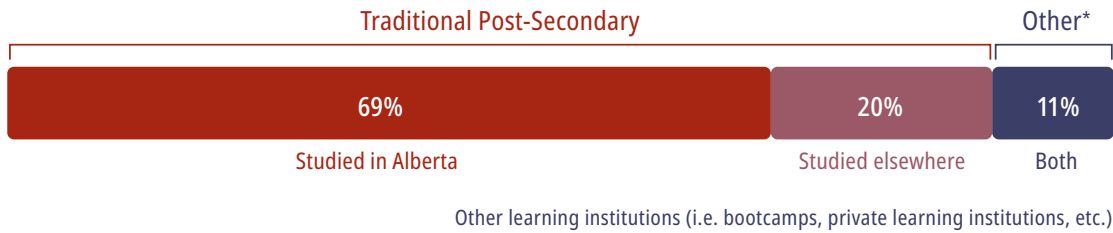
Source: ICTC 2019



Youth & New Grads

Youth and new grads are one of the most prominently sourced talent streams by Alberta employers. Over 70% of employers stated that they hired new grads the most often (over any other level), with clear preference given to traditional post-secondary institutions⁴⁷ within the province.

Figure 42: Sourcing of new grads in Alberta for in-demand roles, 2019



Source: ICTC 2019

Although a few employers showed a willingness to hire from non-traditional educational institutions (such as bootcamps), the majority still appear to regard the undergraduate university degree as the minimum required education. Nearly 45% of employers selected the university degree (at a Bachelor's level) as the minimum level of education for in-demand digital and technical roles in the province. This was followed by more than one quarter of employers who felt that a college diploma was sufficient. An important difference also exists between those who prefer the university degree or college diploma. Approximately 12% of employers who selected the college diploma as being sufficient also stated that a diploma in a non-STEM field was acceptable; whereas all of the employers who articulated a need for a university degree also specified that the degree must be in a STEM field.

Figure 43: Minimum education levels needed by Alberta employers for in-demand jobs, 2019



Source: ICTC 2019

⁴⁷Such as: Universities, Colleges, Polytechnics.

Of course, there are variances on the importance that employers place on formal education. In the cleantech sector for example, nearly 65% of employers regard a bachelor's degree in a STEM field as the minimum level of education required to fill an in-demand role. This is in part due to the strong reliance on engineering talent that the cleantech sector has – roles that require a degree in an engineering field. By contrast, 56% of employers in the digital media sector noted that a college diploma in a STEM field (in this case, including design) was the minimum level of education required for a high-demand job in the sector. Moreover, 15% of digital media employers stated that no formal education was required for their in-demand jobs. Instead, they emphasized the importance of portfolios and past experience.

Figure 44: Minimum education levels needed by Alberta's cleantech employers for in-demand jobs, 2019

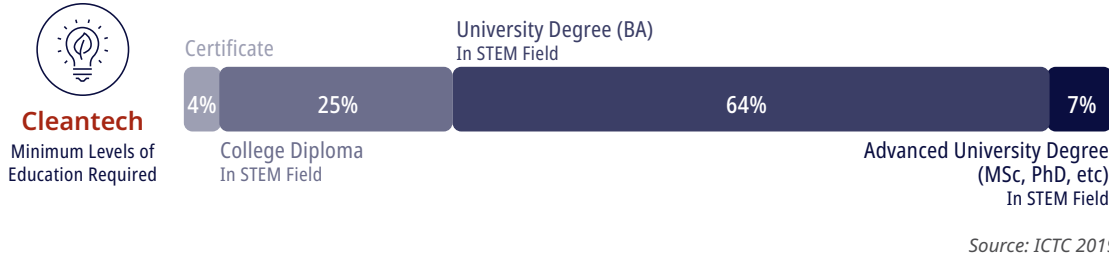


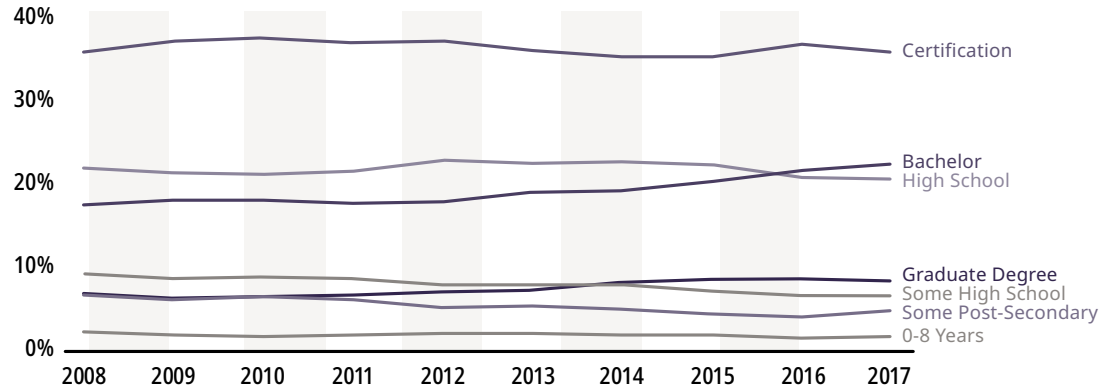
Figure 45: Minimum education levels needed by Alberta's interactive digital media employers for in-demand jobs, 2019



Educational Attainment in Alberta

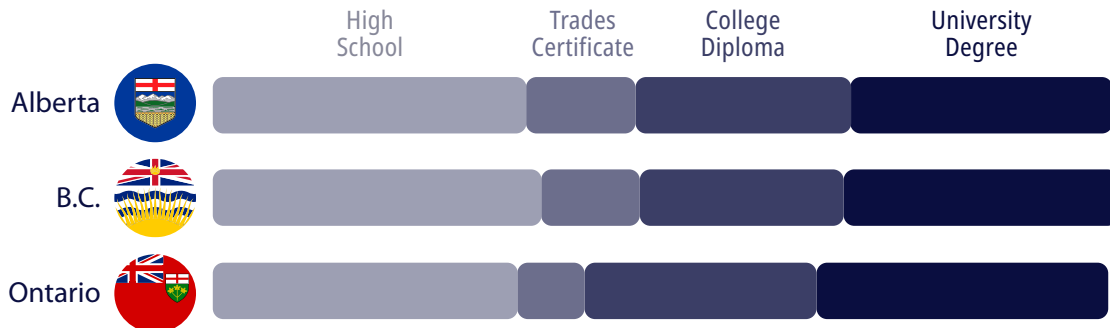
While jurisdictions like Calgary have the highest representation of STEM-educated professionals in the province, Alberta as a whole has been on an upward trajectory in terms of educational attainment over the past decade. In 2013, the total number of Albertans with a graduate degree surpassed those with only some high school education; and later in 2015, the number of adults with bachelor degrees surpassed those with only a high school diploma for the first time.

Figure 46: Educational Background of 25-64-Year-Olds in Alberta, 2008-2017



On the whole, Alberta's educational makeup differs from other large provinces in Canada. While there are fewer Albertans with university degrees than in BC or Ontario (23% in Alberta, vs. 25% in BC and 26% in Ontario), there are substantially more with certificates – approximately 35% in 2016, with nearly 30% of those being trade-based.

Figure 47: Education Levels by Province, Aged 15+ in 2016



Source: Alberta Ministry of Education, 2018

One of the reasons for this high degree of trades certificates in the province may be tied to the historical strength of the oil and gas sector. Certificates such as NAIT's Rig Technician program were essential in training individuals to work in various drilling roles in the sector – from motorhands, to derrickhands, to drillers⁴⁸. With drilling roles making up a significant portion of employment during economic boom periods, coupled with salaries reaching nearly \$100,000 a year⁴⁹, certificates such as these saw considerable growth over the last decade.

Program Enrolment in Alberta

From 2013 to 2014, there was a sharp increase among enrolments in the trades – a growth of more than 13% in those 2 years alone. 2015-2016 saw enrolment in such programs slow (at a rate of 2%), and in 2016-2017, they saw a sharp decline of more than 7%.

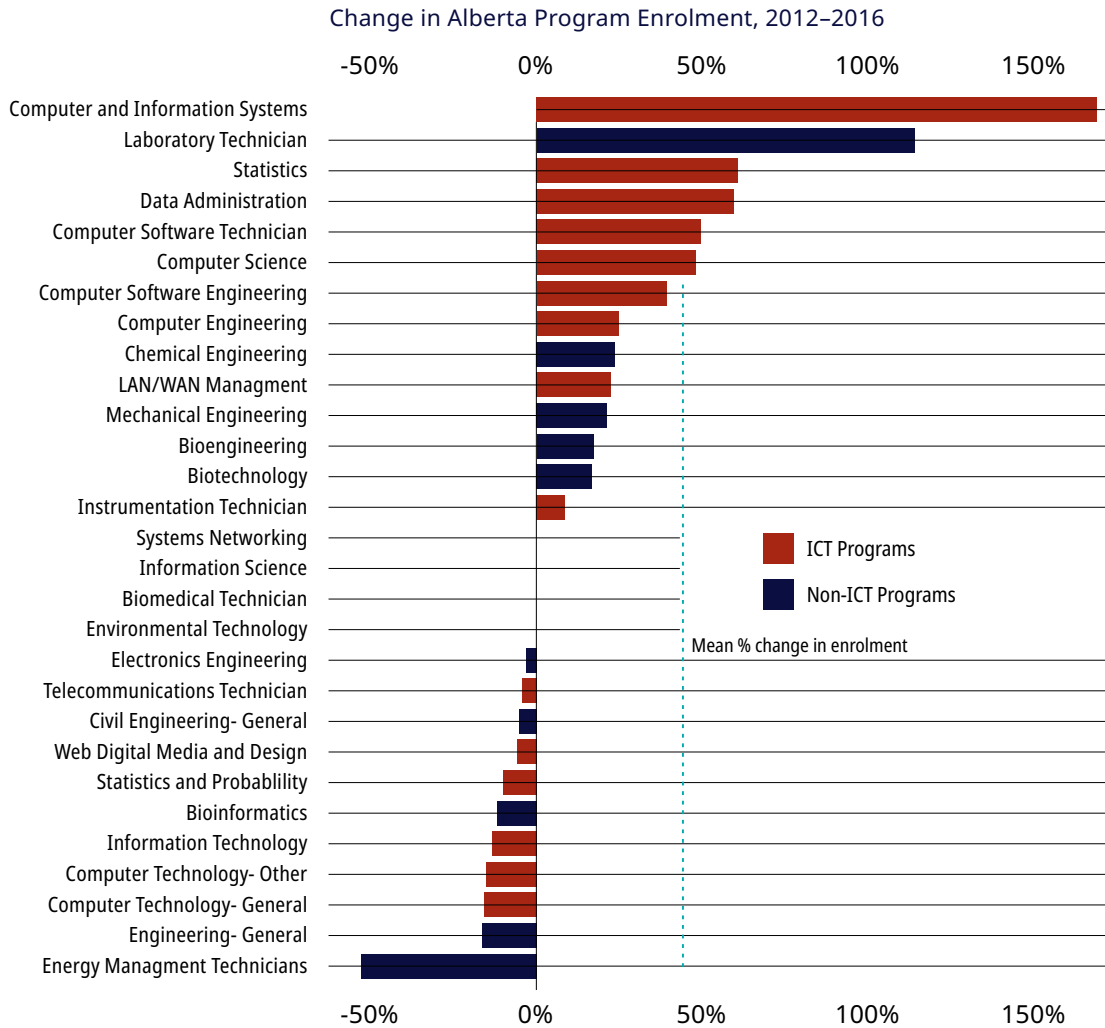
At the same time, from 2015 onward, enrolment increased among a number of other programs. From 2015 to 2017, enrolments in educational programs rose by more than 14%. Similarly, enrolments in business, as well as physical, natural and applied sciences, along with health sciences also saw considerable increase during this period. Each of these programs saw growth of 8%, 6% and 5% respectively, as students looked for alternative areas of study in the wake of the oil crash.

A granular analysis of enrolment trends across Classification of Instructional Programs (CIP) codes in Alberta from 2012 to 2016 highlights significant changes related to digital and critical technical programs. By far, the highest growth in enrolment seen over this four-year period in Alberta is among Computer and Information Systems programs – in four years, enrolment in this program grew by more than 150%. This was followed by the laboratory technician program, seeing enrolment growth of more than 100%, statistics, as well as data administration/data modeling programs which grew by 61% and 60% respectively. With roles like data scientists (requiring a background in data modeling and statistics) and cybersecurity analysts (requiring a background in information systems) being among the most in-demand roles in the province, these trends are positive.

⁴⁸Programs & Courses: Rig Technician (NAIT, 2019) http://www.nait.ca/program_home_81322.htm.

⁴⁹Steve Hargraves, Oil rig workers make nearly \$100,000 a year (CNN Money, May 10, 2012) https://money.cnn.com/2012/05/10/news/economy/oil_workers/index.htm

Figure 48: Enrolment Trends in Alberta by CIP code, 2012-2016



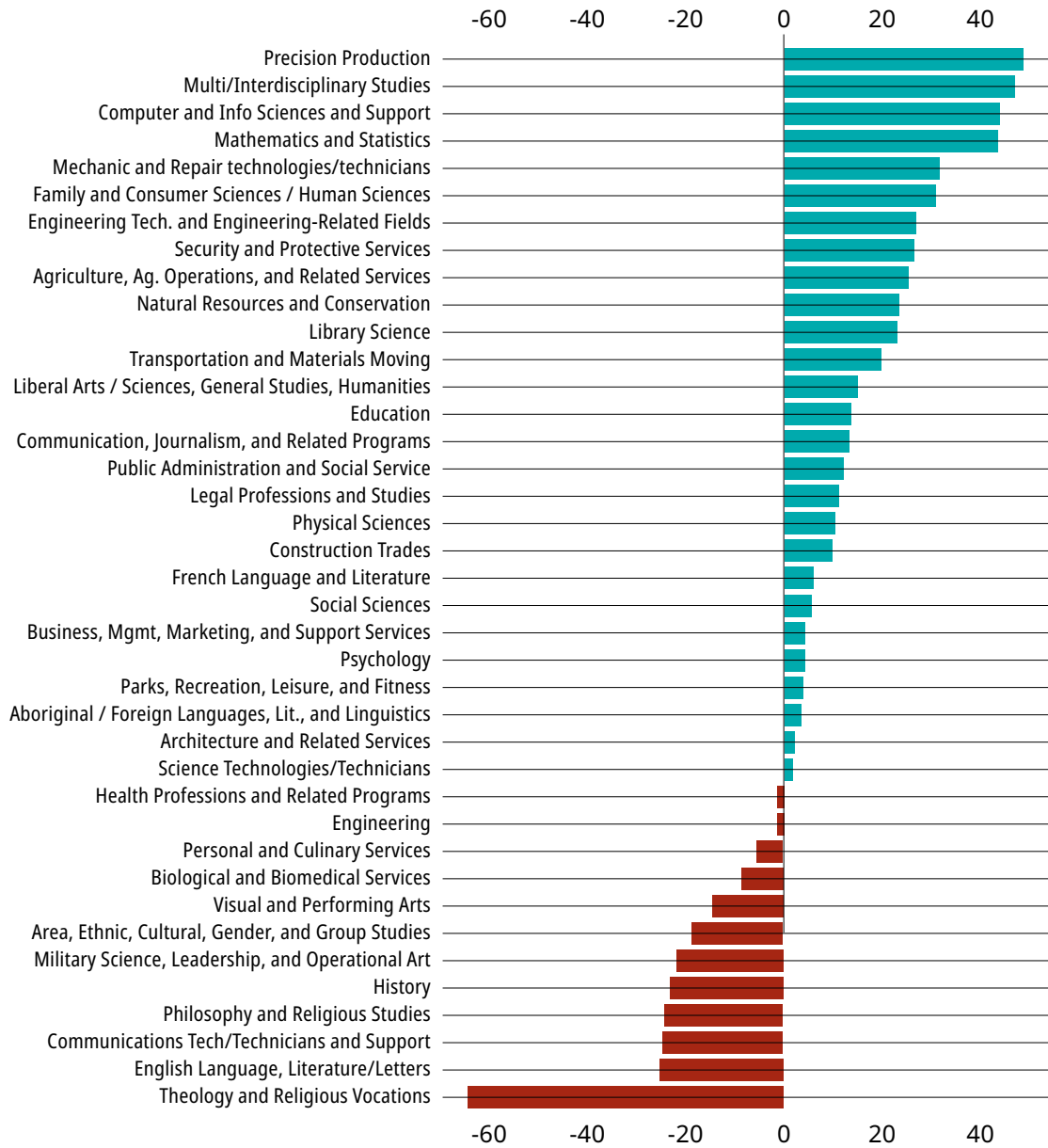
Source: Invest in Canada, 2019

Program Completion Trends in Alberta

Enrolment trends can provide insight into long-term supply availability, whereas an analysis of completions by CIP codes offers an idea of current and near-term supply available for in-demand roles in Alberta. 2013-2017 saw fast growth for a number of digital and technical occupations, suggesting positive supply for junior-level roles.

Growing by nearly 48% in a 4-year period (from 2013-2017), graduates from this program possess skills and competencies needed to design tools and processes that boost output and improve process control. These are among the skills required in the advanced manufacturing sector. Other programs that saw significant completion growth were computer and information sciences, and mathematics and statics – both being highly relevant to roles in software development and data science. From 2013-2017 completions in the above programs grew by nearly 43%.

Figure 49: Completion Trends by CIP code in Alberta, 2013 to 2017



Source: Alberta Ministry of Education, 2018

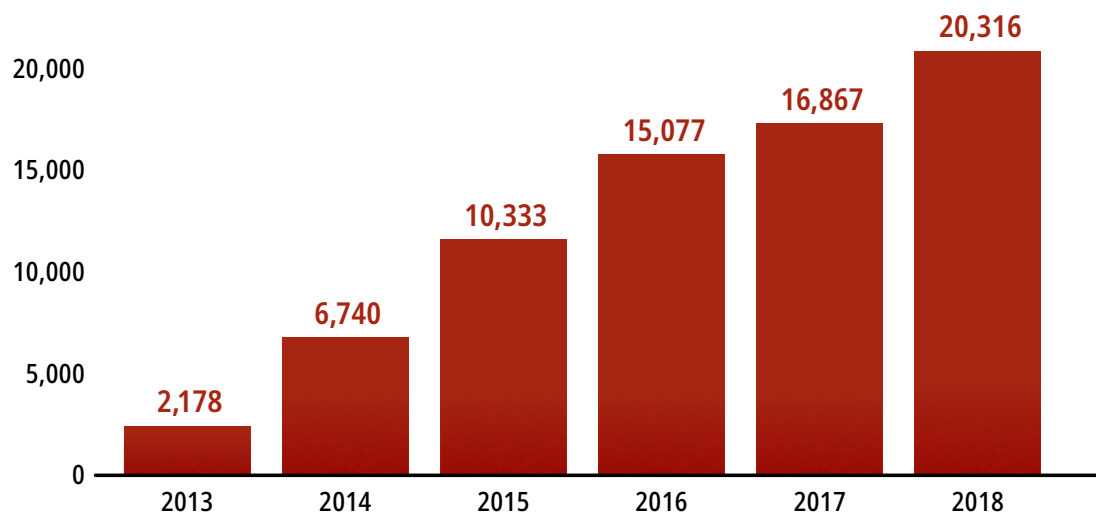
Spotlight on Alternative Education Pathways

The Growing Presence of Bootcamps and Short-Duration Training

While the majority of Alberta employers seeking digitally-skilled talent still rely heavily on traditional educational pathways, bootcamps and short duration training programs are increasingly popular in Canada and around the world.

Coding bootcamps in Canada and the US are estimated to be a \$240 million business, producing more than 20,000 graduates between 2013 and 2018⁵⁰. Teaching a number of in-demand coding languages identified in this report like JavaScript, Java, Python, Ruby and others, the majority of bootcamps averaged slightly more than 3 months to complete⁵¹. Canadian bootcamp success stories include institutions like Lighthouse Labs and Evolve U, the latter having graduated their first cohort of students in Calgary in early 2019.

Figure 50: Coding bootcamp graduation growth in Canada and the US, 2013-2018



Source: Course Report, *The Growth of Coding Bootcamps 2018*

Founded only six years ago in 2013, Lighthouse Labs has already produced substantial results. During this period, Lighthouse graduated more than 1,500 students from Web and iOS bootcamp programs across Canada. Among job-seeking graduates, the impact on employment is significant. Within four months of graduation, 93% of students were able to find employment. Of that figure, more than half were able to find employment within the first month following graduation. In Calgary, Lighthouse Labs' only Alberta location, the Web Development bootcamp produced 23 graduates in 2017, with all 91% of them finding employment within the first 3 months of graduation.

⁵⁰Liz Eggleston, 2018 Coding Bootcamp Market Size Study (Course Report, 2018) <https://www.coursereport.com/reports/2018-coding-bootcamp-market-size-research>

⁵¹Idem.

Figure 51: Employment outcomes for Lighthouse Labs graduates, 2013-2018



Source: Lighthouse Labs 5-year Student Outcomes Report, 2018

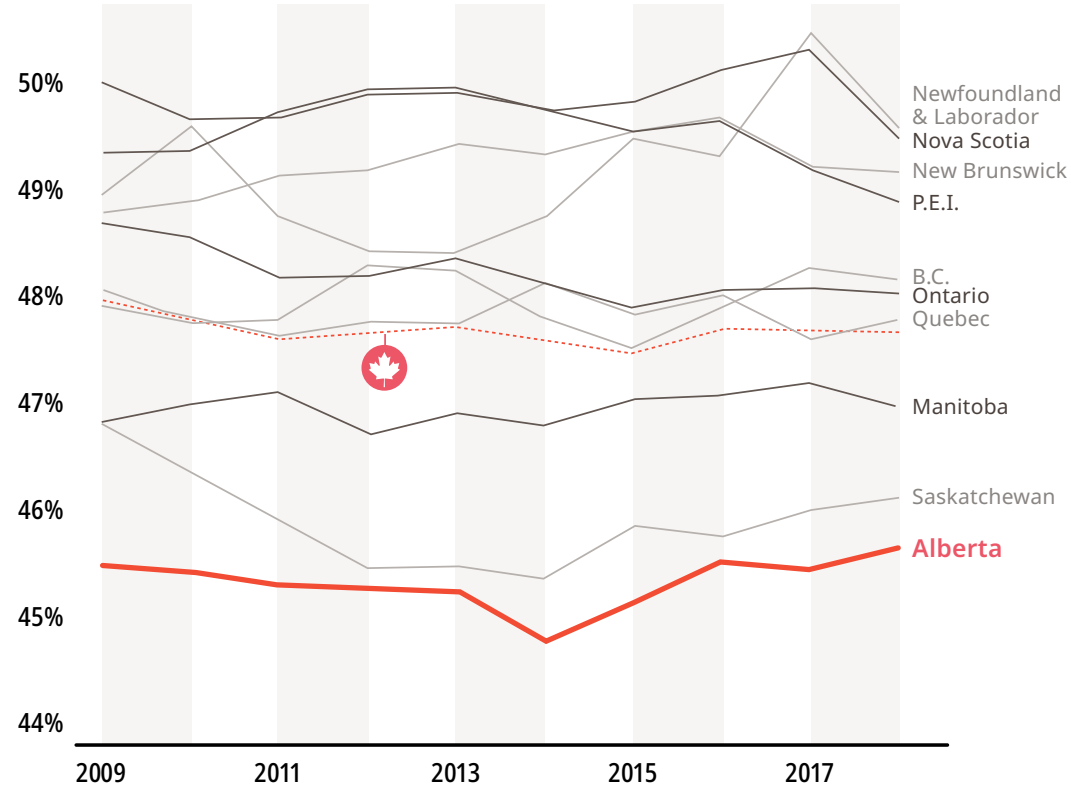
Similarly, Alberta’s own EvolveU is another coding bootcamp that is gaining momentum. 6 months long, EvolveU offers a full stack development program, teaching learners a variety of skillsets such as HTML, Python, JavaScript, REACT and others. At the same time, the program hosts a variety of tech sector guest speakers and allows students to practice interview skills with industry partners in the city. With nearly 65% students finding employment within one week of graduation at EvolveU, coding bootcamps are quickly gaining ground in Alberta and across Canada.



Women

Making up more than 45% of the Alberta workforce in 2018, women represent a key supply stream to fill in-demand roles in the province over the coming years. However, representing slightly more than 45% of the workforce, Alberta has among the lowest female employment rate of any province.

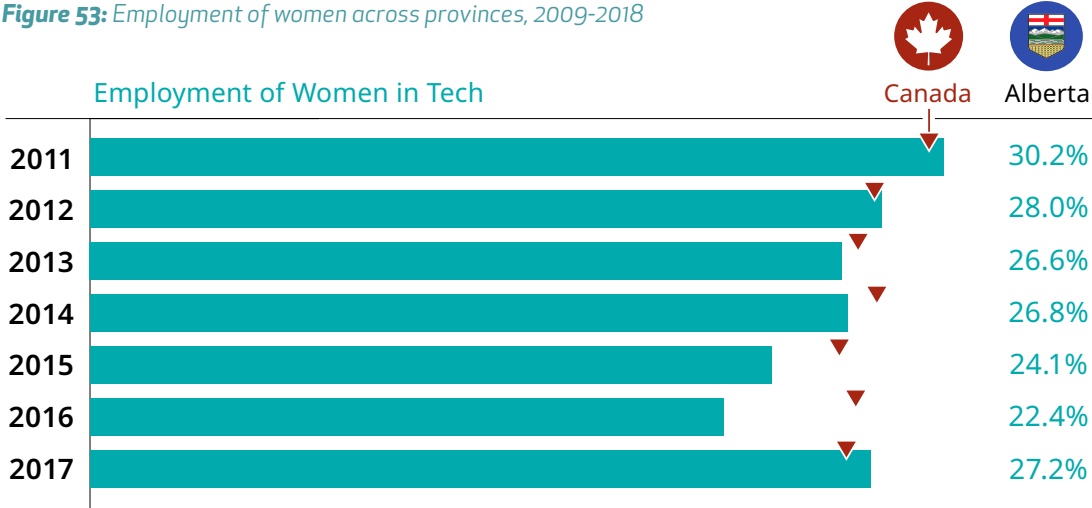
Figure 52: Employment of women across provinces, 2009-2018



Source: Statistics Canada

The employment of women in digital occupations shows mixed results in Alberta. While in 2017, the employment of women in such roles was slightly higher than the Canadian average (27.6% vs. 26.7%) these figures have declined since 2011. In 6 years from 2011-2017, female employment in top digital roles declined by a CAGR of -1.2%.

Figure 53: Employment of women across provinces, 2009-2018



Source: WCT, 2019

The attraction and engagement of women into the digital space is critical to fill the demand for talent in the province. Consultations with top academic institutions in Alberta like the University of Calgary, the University of Alberta, SAIT and NAIT have confirmed that there is a clear effort to attract more women into technology-related programs such as computer science, data analytics, and others. Alternatively, with a ratio of nearly 40% female students in the first cohort of the full stack developer program, short-duration training offered by institutions like EvolveU may be another avenue by which to draw more women into digital occupations.



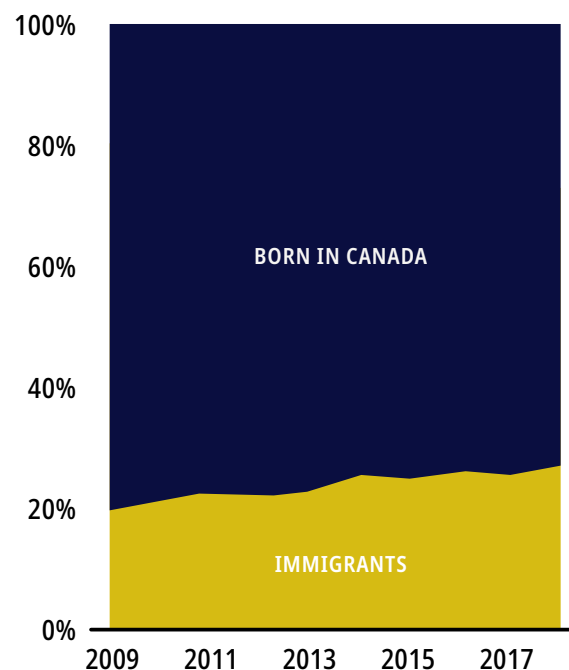
Immigrants

An aging workforce, coupled with an insufficient local supply to fill labour demand have caused governments from around the world turn to immigration as a solution.

In 2009, 80% of the Albertan workforce was born in Canada – a figure that dropped to 74% in 2018. Net interprovincial migration also turned negative following the recent recession, and many highly-skilled workers like petroleum engineers found themselves seeking opportunities elsewhere. Following the 2016 recession, BC alone saw an influx of more than 5,000 migrants from other provinces – half of those being from Alberta⁵². With interprovincial migration to Alberta not expected to reach previous levels in the near future, a focus on sourcing skilled immigrants is pertinent to the economic prospects of the province.

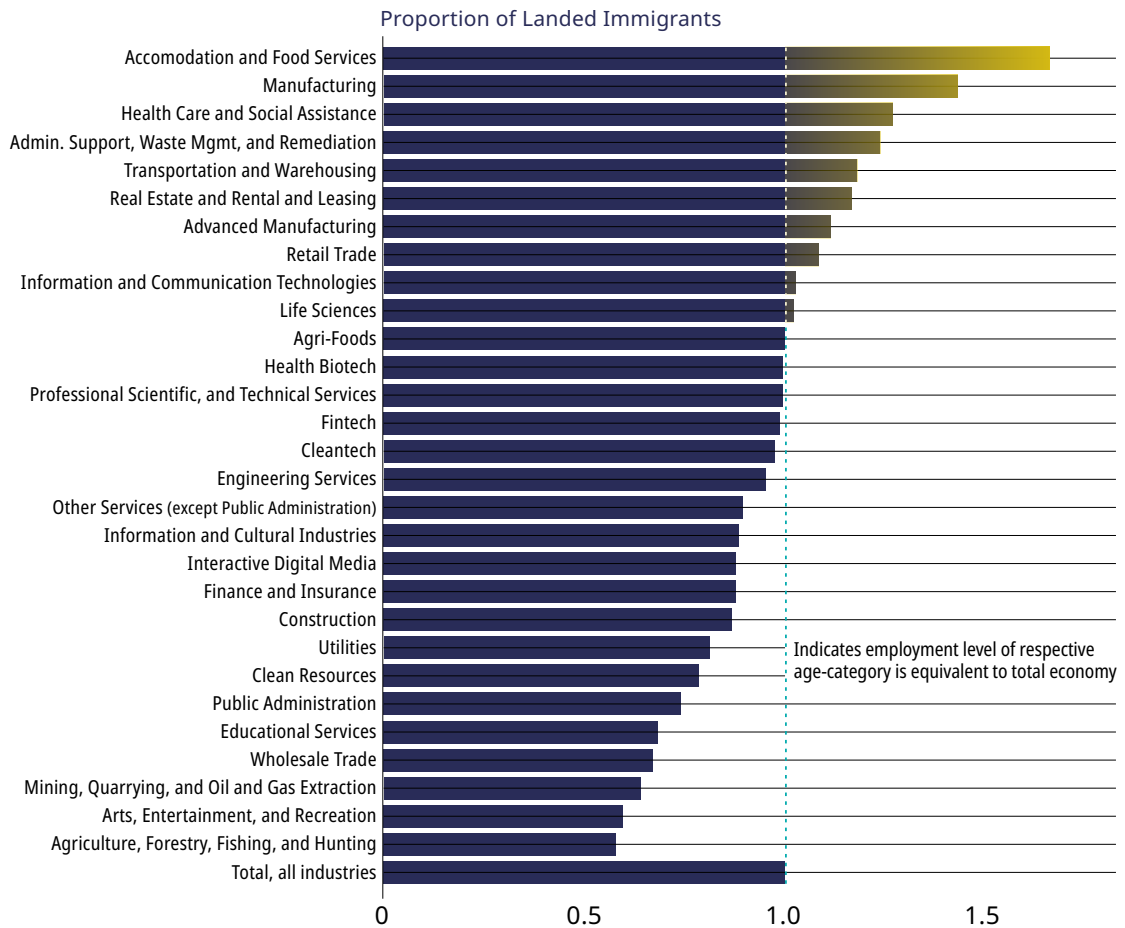
Many sectors in the province are already reliant on internationally-sourced workers. While there is a large portion of immigrants working in Alberta's accommodation and food services as well as the manufacturing sector (their representation being 1.5 times that seen across the rest of the economy), there is also a high representation of immigrant workers in growth sectors like healthcare, and advanced manufacturing. In these two sectors, immigrants were represented 1.3 and 1.1 times higher than they were across the overall economy.

Figure 54: Employment of immigrants vs. Canadian-born workers in Alberta, 2009-2018



⁵²Quarterly demographic estimates – January to March 2016: BC (Statistics Canada, 2016) <https://www150.statcan.gc.ca/n1/pub/91-002-x/2016001/t330-eng.pdf>

Figure 55: Employment Over- and Underrepresentation of Immigrants Across Sectors in Alberta, 2018



Source: Statistics Canada

Making up nearly 40% of all technology-based occupations in Canada, immigrants play a central role to our ability as a country to support economic growth and propel forward new opportunities. Destinations like Calgary and Edmonton are among top locations for skilled migrants, with each city bringing in nearly 13,000 immigrants from 2017 to 2018⁵³ alone. The continued growth of sectors like healthcare and advanced manufacturing can function to attract highly-skilled workers from around the world to the province.

⁵³Migration Statistics: June 1, 2017 – June 30, 2018: Calgary, Edmonton (Statistics Canada, 2018) <https://www.calgaryeconomicdevelopment.com/research-and-reports/demographics-1p/migration/>



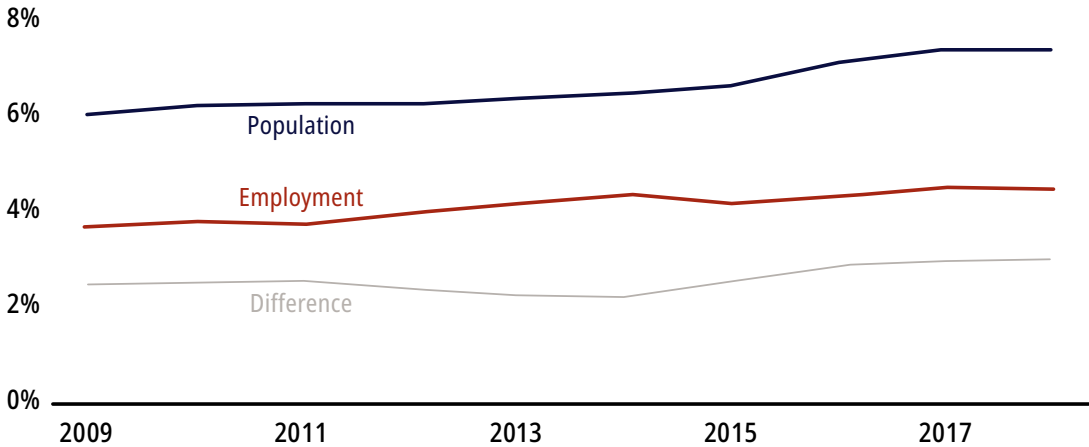
Indigenous Peoples

Indigenous peoples in Alberta comprise a variety of unique cultures and traditions. With nearly 1 in 6 Indigenous peoples in Canada living in Alberta, the province is home to more 115,000 First Nations, nearly 100,000 Metis and 2,000 Inuit⁵⁴. Population growth among Indigenous peoples in the province has been substantial over the last decade, climbing by a CAGR of nearly 2.5% since 2011. However, while Indigenous peoples now represent approximately 7.5% of Alberta's population, they still only represent about 4.5% of all employment.

Indigenous peoples in Alberta

115,000 First Nations
100,000 Metis
2,000 Inuit

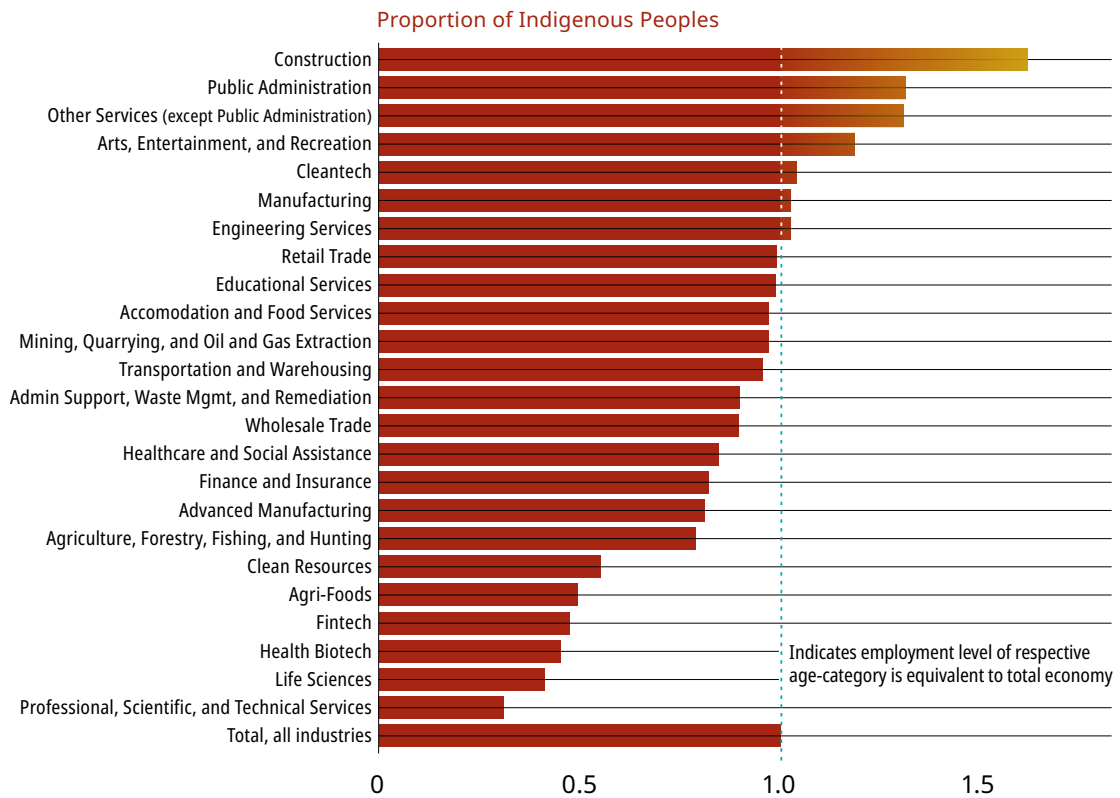
Figure 56: Indigenous Population and Employment as a Portion of Total Population and Total Employment in Alberta, 2018



In Alberta, Indigenous peoples are heavily represented in the construction sector, at a rate that is 1.6 times their representation across the overall economy. Other sectors with a higher than average representation of Indigenous peoples include public administration and the arts. The only high-growth sector that Indigenous peoples are somewhat represented in is cleantech.

⁵⁴Aboriginal Peoples: Fact Sheet for Alberta (Statistics Canada, 2016) <https://www150.statcan.gc.ca/n1/pub/89-656-x/89-656-x2016010-eng.htm>

Figure 57: Employment Over- and Underrepresentation of Indigenous Peoples Across Sectors in Alberta, 2018



With Indigenous peoples playing an essential role in filling employment demand across the economy and in high-growth sectors, there is a need to focus on inclusion efforts that can attract and develop more digitally-skilled Indigenous workers. Such efforts will not only enable sustainable development and self-determination prospects for Indigenous communities across Alberta, but will bolster the ability of the province itself to grow and remain competitive. Some existing programs have been very effective in helping to drive interest in technology and engagement among Indigenous communities in other provinces. The Foundations & Futures in Innovation Technology program (FiiT) administered by the First Nations Technology Council (FNTC) in BC is one such example. A 12-week exploratory program, FiiT offers Indigenous peoples across the province the opportunity to familiarize themselves with technology by exploring a number of verticals ranging from computer basics, to web development, GIS, and even digital marketing, among others⁵⁵. The development of similar programs, based on the unique needs and opportunities in Alberta, may be one way to bolster this locally-available supply stream.

⁵⁵Foundations & Futures in Innovation & Technology (First Nations Technology Council, 201) <http://www.technologycouncil.ca/talent-development>



Persons with disabilities

In 2017, approximately 425,000 working-age Albertans reported having a disability⁵⁶. This is roughly 17% of Alberta’s total working age population, up from nearly 15% in 2001⁵⁷. Of the total female workforce in the province, more than 20% identify as persons with disabilities (PWDs), whereas of the total male workforce, only slightly more than 8% identified as such.

Labour force participation is relatively low amongst those with disabilities, and it tends to further decline with age. For those with disabilities aged 25–44, labour force participation in Alberta was 65%, compared to a 50% for those aged 45–64. These figures decline further for people with disabilities who work in digital roles. In 2017, roughly 4.8% of persons with disabilities in Alberta were working in technology-related occupations⁵⁸.

Figure 58: Gender breakdown of PWDs employed in digital occupations in Alberta, 2017



Source: ICTC 2019

Similarly, a comparison of all occupations within the technology sector showcases that persons with disabilities may represent a significant source of supply. In 2017, persons with disabilities in Alberta represented nearly 15% of the total workforce in province’s tech sector⁵⁹.

Figure 59: Employment of PWDs in the tech sector in Alberta, 2017



Source: ICTC 2019

⁵⁶Canadian Survey on Disability (Statistics Canada, 2017). “Disability” is a very broad category, referring to persons whose daily activities are limited due to a long-term condition or health-related problem.

⁵⁷Canadian Survey on Disability: Participation and Activity Limitation Survey, (Statistics Canada, 2017).

⁵⁸Canadian Survey on Disability and Digital Employment (Statistics Canada, ICTC, 2019).

⁵⁹This includes all occupations in the technology sector – i.e. both digital and non-digital roles. (Statistics Canada, ICTC 2019).

On March 11th 2010, Canada ratified the United Nations Convention on the Rights of Persons with Disabilities⁶⁰. The guiding principles of the convention call for respect for individual autonomy, non-discrimination, accessibility, and full and effective participation and inclusion in society (including employment) for PWDs⁶¹.

Inclusive employment provides economic, social, and psychological benefits both to new labour forces and to employers and society as a whole. Research has already shown that an increase in diversity, accessibility, and inclusion in the workplace enhances profits, lowers employee turnover, and increases positive employee sentiment⁶². The integration of people with disabilities in high-growth sectors in Alberta can prove beneficial not only from the lens of filling a need for in-demand roles, but for the economic growth prospects of the province as a whole.

⁶⁰UN Treaty Collection: Status of Treaties (United Nations, 2019).

⁶¹Convention on the Rights of Persons with Disabilities: Guiding Principles of the Convention (United Nations, 2008).

⁶²Diversity Dividend: Canada's Global Advantage (The Centre for International Governance Innovation and the Pierre Elliott Trudeau Foundation, 2017); Tech for All: Breaking Barriers in Toronto's Innovation Community (MaRS, September 2018).

Conclusion

Recent economic diversification investments made in Alberta will help build a future economy that is robust and sustainable.

With technological development and digital skills at the helm of these changes, the need to focus on building a strong supply of workers with critical skillsets is clear. Digital skills will play an increasingly important role across the economy as the demand for top roles like software developers, data scientists, full stack developers and others increases and scales across sectors. These roles will support business growth, enhance entrepreneurialism, and propel economic success in Alberta.

At the same time, certain sectors of the economy are expected to show fast growth both in terms of economic development as well as employment over the next few years. Healthcare, advanced manufacturing, cleantech, and interactive digital media will be the drivers of significant job growth and demand for high-skilled roles like cybersecurity analysts, backend developers, UX/UI designers and a number of others. These sectors will be top employers of digital talent, creating thousands of new employment opportunities over the next few years.

With the demand for such roles expected to reach nearly 9,000 by 2023, Alberta must act now to begin exploring relevant pathways to bolster the availability of digitally-skilled talent. By 2023, meeting this demand will mean the employment of more than 77,000 people in top digital roles across the economy. Filling these roles will create enormous economic opportunities for the province, all the while supporting high-quality, innovation-centric, and well-paying jobs for Albertans.

Appendices

- I. Research Methodology
- II. Forecast Methodology
- III. Limitations of Research
- IV. In-demand jobs mapped to NOCs
- V. Examples of Low-growth sectors: Top 4 Trends

I Research Methodology

The research methodology used in the development of this report consisted of a combination of **primary** and **secondary** research.

Primary Research: The primary research portion of this study was comprised of three main elements. These are: an employer survey, key informant interviews, and a project advisory committee.

The employer survey was targeted at employers across a variety of sectors in Alberta. The reason for this broad reach was to understand the impact of digital roles not just in the technology sector, or technology-heavy sectors, but holistically. The survey was useful in highlighting important trends witnessed by employers in a number of different sectors as they related to the demand for talent, skills, barriers encountered, talent attraction strategies, and others. The survey was kept open for approximately 6 months, in that time receiving 134 responses.

Key informant interviews played another important role in gathering primary insights on trends and needs as they relate to digital employment in Alberta. A total of 30 key informant interviews were completed with employers, industry associations, and academic institutions across Alberta. Interviews were first targeted to a broad category of stakeholders, and were then narrowed to employers operating in the high-growth sectors (once they were identified). Interviews took place either in person or over the phone and lasted an average of 40 minutes, each. Interview questions focused on understanding in-demand roles and skillsets, current and anticipated future talent needs, the perception of supply availability and quality in Alberta, business development strategies and plans, perceived barriers to growth and talent attraction, among other factors.

Lastly, the project and its findings were assessed and validated by an advisory committee. The committee was made up of 30 members from industry, academia, industry associations, economic development agencies, and government. The advisory committee met three times throughout the course of the project for approximately 1.5 to 2 hours each time. During these meetings, the committee received a presentation on recent research findings and outcomes, and were engaged in discussion on said findings. With the purpose of the committee being to review results and suggest areas for further investigation, feedback and insights were gathered which were later incorporated, where appropriate, into the report. The advisory committee was key in providing review, guidance and validation of the research.

Secondary Research: The secondary research component of this study focused on an analysis of existing data and literature, as well as the use of advanced analytics for the purpose of identifying trends on job vacancy, skill needs, and skill availability.

The first method utilized was a literature review and analysis of secondary data. Complementing primary research findings, an analysis of available and relevant literature and data sets (e.g. Statistics Canada, Alberta Provincial data, Alberta Open Government, Educational data- Alberta government and private institutions, etc.) were used to formulate the background upon which the primary research findings would be based. The analysis of the mentioned datasets were useful in tracking

previous economic and employment trends, supply trends among a number of talent streams, along with recent developments and investments related to economic diversification.

Once in-demand occupations were identified from the primary research, ICTC used advanced analytics to extract job vacancies, in-demand skills and skill availability of supply. This was done via 1) web scraping of in-demand jobs from job boards; and 2) text mining for critical skills. Web scraping was completed in order to obtain a comprehensive idea of the volume of in-demand jobs in Alberta on a monthly basis, and text mining was completed to identify the most prominent skills for those jobs.

Web Scraping: ICTC scraped thousands of jobs off of 3 different job boards from January to April 2019. This was done to identify the number of vacancies posted for in-demand jobs in the province, along with any relevant changes across roles during this period. In this process, ICTC also removed incorrectly tagged jobs and duplicates of postings in the interest of showcasing the most accurate quantity of vacancies for in-demand jobs in the province. At the same time, ICTC also completed an additional analysis to find job postings that specifically referenced more than one vacancy. These postings were found to occur at a rate of approximately 15%. As a result, we have assumed that 15% of each posting for an in-demand job was intended to fill 2 open positions, and adjusted figures accordingly.

Text mining

Critical skills for in-demand jobs:

ICTC mined the text of jobs scraped to identify in-demand broad digital skills (such as agile development or cloud computing) as well as specific skillsets and competencies (such as proficiency with JavaScript, or knowledge of REACT) for each of the in-demand jobs identified.

Text mining

Available skills of workers in in-demand occupations in Alberta:

In a preliminary effort to compare or quantify the skillsets and competencies of talent working in in-demand roles in the province, an analysis of employee profiles was completed. This involved mining profiles for self-attributed (tagged) key skills identified (for example, Python, JavaScript, etc.) A more in-depth analysis is required to assess actual skills (vs. simply those self-selected) of local supply in those roles.

II Forecast Methodology

For this study, forecasts are derived using Vector Autoregressive (VAR) and Ordinary Least Squares regression models. The models largely exploit historical correlations across economic variables to predict variation, and in this case, they have been combined with primary research to estimate future outcomes. Future change in employment is modeled as a function of past fluctuations in salaries, trends in employment, the unemployment rate, Albertan GDP, the Western Canadian Select oil price, and a few other variables, along with primary research trends. These forecasting models have been applied to the overall economy, as well as high-growth sectors (custom NAICs) and high-demand occupations (mapped to NOCs). Time-series smoothers are sometimes used to reduce statistical noise and fill in missing values. Data is obtained from a variety of sources including primary research (survey and key informant interviews), Statistics Canada, the Province of Alberta, and job boards.

III Limitations of Research

While ICTC had attempted to ensure that the research process for this study was as exhaustive as possible, a few limitations exist. These include:

Lower than desired survey response rate: ICTC had benchmarked a survey response rate of 200+. Based on an estimate of Alberta business counts totaling approximately 175,000 in June 2017, using a confidence interval of 95%, and a margin of error of 7%, the appropriate sample size of respondents to this survey totaled 200. However, while not meant to be statistically significant, at a total response rate of 134, the survey results are still within an 8% margin of error. This means that at most, only 8% (~11) of responses should show deviation from the overall sample. The margin of error is calculated in relation to response rates for the entire economy across all sectors, not for each high-growth sector.

Data scarcity at the CMA level: Attempts were made to forecast digital and technical employment at the CMA level for this report. However, even for larger CMAs such as Calgary or Edmonton, data scarcity was significant beyond overall employment – meaning that results under a threshold were suppressed, leaving considerable missing values. While some data existed for digital employment in some months, it was overall too unreliable to calculate trends with a degree of acceptable accuracy. Therefore, only overall employment was forecasted at the city level.

Historical volatility of Alberta economy and employment: The historical volatility of the Alberta economy – i.e. periods of significant upswings followed by periods of substantial downturn in both GDP and employment – may make forecasting future trends more difficult than other provinces. This is coupled with the fact that notable efforts for diversification were recently made, which differ from previous times, and new technological advancements are taking shape across the economy that are likely to dull future drastic rebounds in the oil and gas sector. Forecasting relies on the ability to infer future events in large part based on past results. As a result, forecasted employment trends and the impact of technology on future growth in the province may be conservative and subject to change.

IV In-demand jobs mapped to NOCs

For the purposes of forecasting employment in digital and technical roles deemed in-demand in the province, specific jobs had to be mapped back to National Occupational Codes (NOCs) which contain enough historical data to do so.

The following NOCs were used to forecast digital employment in “core digital roles” and “core technical roles” across the economy and the top high-growth sectors:

Sector	Digital Roles
Overall economy, advanced manufacturing, cleantech, interactive digital media sectors	0213 Computer and information systems managers, 2147 Computer engineers (except software engineers and designers), 2171 Information systems analysts and consultants, 2172 Database analysts and data administrators, 2173 Software engineers and designers, 2174 Computer programmers and interactive media developers, 2175 Web designers and developers, 2281 Computer network technicians, 2282 User support technicians, 2283 Information systems testing technicians, 5223 Graphic arts technicians

Healthcare sector	0213 Computer and information systems managers, 2147 Computer engineers (except software engineers and designers), 2171 Information systems analysts and consultants 2172 Database analysts and data administrators, 2173 Software engineers and designers, 2174 Computer programmers and interactive media developers, 2175 Web designers and developers, 2281 Computer network technicians, 2282 User support technicians, 2283 Information systems testing technicians, 3211 Medical laboratory technologists, 3219 Other medical technologists and technicians (except dental health), 5223 Graphic arts technicians
Overall economy, advanced manufacturing, sector	2132 Mechanical engineers, 2133 Electrical and electronics engineers, 2134 Chemical engineers, 2221 Biological technologists and technicians, 2252 Industrial designers
Engineering sector	2132 Mechanical engineers, 2133 Electrical and electronics engineers, 2134 Chemical engineers, 2221 Biological technologists and technicians, 2252 Industrial designers, 3212 Medical laboratory technicians and pathologists' assistants
Cleantech sector	2131 Civil engineers, 2132 Mechanical engineers, 2133 Electrical and electronics engineers, 2134 Chemical engineers, 2211 Chemical technologists and technicians, 2232 Mechanical engineering technologists and technicians, 2255 Technical occupations in geomatics and meteorology
Interactive Digital Media Sector	5224 Broadcast technicians, 5225 Audio and video recording technicians, 5226 Other technical and co-ordinating occupations in motion pictures, broadcasting and the performing arts, 5241 Graphic designers and illustrators

V Examples of Low-growth sectors: Top 4 Trends

Low-growth sectors in this study are defined as those expected to grow at a rate that is slower than the general economy's forecasted growth rate of 1.7%.

The Agriculture, Forestry, Fishing and Hunting sector has generally declined as a percentage of total employment in all provinces since 2009. In Alberta, this sector is expected to decline in employment by a CAGR of 1.5% from 2018 to 2023.

Growth in the Retail Trade sector is expected to decline from previous levels over the course of the next few years. While employment in this sector grew by 1.6% from 2001 to 2018, this is expected to slow in the next few years. From 2018 to 2023, employment growth in this sector is estimated to steady at a CAGR of 1%.

From 2001 to 2018, the Accommodation and Food Services sector grew by a rate of 1.6% in total employment. From 2018 to 2023, this sector is expected to grow by a CAGR of slightly under 1%.

While employment in the Finance and Insurance sector is expected to grow at a higher rate than 2001 to 2018 levels, it is still under that of the national average. From 2018 to 2023, employment in the finance sector is expected to grow by a CAGR of 1.6%. Currently, Fintech developments including online banking, Apple Pay, or robo-advisors like Wealthsimple and ModernAdvisor have automated jobs like bank tellers and middle management positions. It is possible that future developments in this quickly-developing space will create new opportunities for employment within the financial sector.