

Mapping Calgary's Digital Future:

Tech Employment Opportunities for Displaced Workers



Research By:



Information and Communications
Technology Council (ICTC)

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Preface

About ICTC

ICTC is a national centre of expertise for the digital economy. With over 25 years of experience in research and policy analysis, ICTC has the vision of strengthening Canada's digital advantage in the global economy. Through forward-looking research, evidence-based policy advice, and creative capacity building programs, ICTC fosters innovative and globally competitive Canadian industries, empowered by a talented and diverse workforce.

About Calgary Economic Development

Calgary Economic Development is a not-for-profit corporation funded by the City of Calgary, community partners, other orders of government and the private sector through the Action Calgary program. Calgary Economic Development works with business, government and community partners to position Calgary as the location of choice for the purpose of attracting business investment, fostering trade and growing Calgary's workforce.

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Executive summary

In 2018, 24 Calgary firms topped Canada's 2018 Growth 500 rankings, averaging over 500% growth from 2012-2017¹. Also possessing one of the most favorable cost and quality of living standards among major Canadian cities, Calgary is a prime spot for relocation of highly-skilled workers from around the world. This was showcased in 2018 when Calgary placed amongst the most livable cities on the planet, coming in 4th globally, ahead of both Toronto and Vancouver². From lifestyle, to livability, to culture, Calgary has a lot to offer both job seekers and businesses, alike.

However, despite these features, the Calgary economy has historically been one of ups and downs, primarily tied to the energy sector. As a result of the high dependence on this one sector, the economic downturn in 2015 created significant impacts on the province and the city. **In 2015, Statistics Canada estimated that the province lost nearly 20,000 jobs in the sector – the highest decline since the recession of 1982 which shed 45,000 jobs³. With Calgary making up roughly 30% of Alberta's population, 29% of businesses, and 31% of total employment⁴, this downturn was felt deeply in the city.**

Among the tens of thousands displaced from the economy during this period, a significant number were highly-educated and highly-skilled workers, many with backgrounds in Science, Technology, Engineering and Math (STEM). In 2016, according to the Statistics Canada National Household Survey (NHS), **Calgary⁵ housed nearly 225,000 STEM-educated professionals⁶. Of that figure, nearly half were reported to be skilled in "architecture, engineering, and related technologies"⁷. With the economic downturn, some of the highest rates of displacement⁸ were experienced among highly-skilled occupations such as petroleum engineers and geoscientists, to name a few.**

As the tech sector itself expands, technology is rapidly permeating all sectors of the economy. With digital technology scaling quickly in the city, the potential transition of these workers into digital occupations across Calgary, can prove to be mutually beneficial for both job seekers and businesses.

In this study, software developers, data analysts, UX/UI designers, QA testers and full stack developers topped the list for in-demand digital roles, across Calgary.

These roles require a blend of digital skills and competencies, ranging from proficiency with

¹ "Meet Calgary's Fastest-Growing Companies: 2018 Growth 500" Canadian Business, September 13, 2018. <https://www.canadianbusiness.com/lists-and-rankings/2018-calgary-fastest-growing-companies/>

² Hardingham-Gill, Tamara. "The World's Most Liveable Cities in 2018." CNN, August 14, 2018. <https://www.cnn.com/travel/article/worlds-most-liveable-cities-2018/index.html>

³ Bickis, Ian. "2015 Worst Year for Alberta Jobs Losses since 1982." Global News, January 26, 2016. <https://globalnews.ca/news/2478539/2015-worst-year-for-alberta-jobs-losses-since-1982/>

⁴ "Calgary." Alberta Government. <https://regionaldashboard.alberta.ca/region/calgary/#/percentofalberta>

⁵ Calgary (CMA)

⁶ "Labour 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).

⁷ Idem.

⁸ 2016 unemployment rates for chemical engineers, petroleum engineers, engineering managers, geoscientists: 13%, 14%, 14%, 19%.

a number of programming languages, to experience with data analysis and machine learning algorithms, to name a few. Having a clear idea of not only what these skills are, but also where job seekers can obtain them, is key for anyone seeking to appropriately plan a journey into tech.

At the same time, usually relying on traditional sources of talent supply, **tech employers may not be fully aware of the skills that other supply streams such as displaced workers from other sectors may already have.**

For example, through this study, we have uncovered some of the following key findings, in relation to this displaced group:

- The average geoscientist has nearly 60% of the core skills and competencies needed to become a data analyst
- The average petroleum engineer has more than half of the necessary skills to transition into a QA tester role.
- The average engineering manager has about half of the necessary skills to transition into Project Manager roles, which have been found to be in-demand in the Tech sector.
- The average electrical engineer has more than half of the necessary skills to transition into a software developer role, the most in-demand job in the Calgary Tech sector.
- Many engineers have proficiency with several “hard” skills and technical tools like Matlab. Both based in statistical analysis and numeric processing, Matlab is a scripting language that can be a significant crosswalk to R, which also relies on scripting⁹. R is both an in-demand skill for Data Analyst roles, as well as a pathway to learning Python. While Python is an object-oriented high-level programming language often used for software development, it can also be used for scripting. This scripting experience acts as a strong basis for learners with a Matlab background to eventually learn Python, one of the most in-demand programming languages at this time.
- With many of these displaced workers possessing at least half of the necessary skills to transition into key roles like Data Analysts or QA Testers, upskilling opportunities are promising. The average duration of upskilling for such workers is one year or less.

This report is a first step in building an essential knowledge bridge **by connecting the missing link between job seekers who are planning to transition into in-demand digital occupations, and tech employers who are suffering from a shortage of the skilled talent essential to grow their business in Calgary.**

Utilizing results from this study, in Q1 2019, ICTC and the Calgary Economic Development will be launching an online platform for job seekers and employers. This platform will provide displaced job seekers not only with detailed knowledge of skills for in-demand jobs, but also with educational resources available for upskilling. This platform will also act as a resource for tech employers to gain insight into the skills that these displaced job seekers

⁹ “scripting” refers to the ability to write a code to automate a certain process.

already possess. Making these connections and understanding these nuances is key to unlocking opportunities for meaningful employment in the city, and for spurring business growth as a whole.

Introduction

Calgary is a significant employer for the province of Alberta. Responsible for more than 30% of all employment in the province during 2016 and 44% of the province's tech workers¹⁰, the economic strength of the city cannot be understated. Other sectors, such as oil and gas, are beginning to utilize technology to help shape efficiencies, increase productivity and propel economic growth. Notable examples include shifts like the automation of drilling rigs, the use of underwater remotely operated vehicles (ROVs) in oil and gas extraction, and the increasing reliance on data analytics to influence decision-making. In short, technology is quickly changing our economy, bringing with it the demand for digital talent.

Calgary possesses a wealth of highly-skilled talent with backgrounds like engineering and science; however, with the significant job loss during the recent economic recession, many of these workers are now looking for new opportunities in the technology sector. In early 2017, Calgary Economic Development, in partnership with Rainforest Alberta and the Alberta Ministry of Labour, launched an event called *PivotTECH*. The purpose of the event was to help highlight opportunities for these highly-skilled workers in the technology sector, while simultaneously providing insight to employers about the skills of this talent base¹¹. This event was considered a critical starting point for connecting highly-skilled job-seekers with employers seeking skilled talent.

The key conclusion of this event was that many of the city's displaced workers appear to have an interest in transitioning – or “pivoting” – to in-demand occupations like software development, however are unclear of the steps to take when it comes to making the transition.

No other Canadian city has the wealth of highly-skilled STEM educated talent that Calgary has. Assisting this talent with finding pathways into in-demand roles, while highlighting their existing skillsets to employers, can be a key anchor in supporting meaningful employment for Calgarians. Strategies like these move the city ever closer to strong economic diversification and ultimately, a healthy, sustainable and reliable economic future.

By engaging with employers across Calgary's economy, this report showcases the most in-demand digital occupations in the city, along with their corresponding skill needs. At the same time, the report also provides a fact-based and detailed skills analysis of the city's highly-skilled displaced workers. The results of this study will be incorporated into a web platform that will be developed by ICTC and Calgary Economic Development in early 2019

¹⁰ "Census Profile, 2016 Census." Statistics Canada, Calgary City.

¹¹ "PivotTECH - Calgary." CIPS Alberta. <https://www.cipsalberta.ca/new-events/2017/8/30/pivot-tech-calgary>

to educate displaced Calgarians on how to make the transition to high-tech opportunities.

Methodology

ICTC undertook the following methodologies, during the course of its research to understand how to help transition displaced occupations into in-demand tech-oriented jobs in other industries:

- 1) **Employer survey:** An employer survey was distributed, targeting employers across the economy from the top 12 economic sectors. These sectors included technology, energy, transportation, healthcare, education and others. A total of 187 employers responded across Calgary, with a high representation from the technology and energy sectors. More detail on the survey is available in *Appendix I, Detailed Methodology*.
- 2) **Key informant interviews:** A total of 29 key informant interviews (KIIs) were completed with representatives from industry associations, academic institutions, HR agencies, employers (particularly in the technology and energy sector), and career 'transitioners.' The purpose of these interviews was to extract detailed findings in relation to job and skill needs in the city. More detail on the KIIs is available in *Appendix I, Detailed Methodology*.
- 3) **Advisory committee:** As a means of validating research results and prompting further discussion and consideration, an advisory committee was formed for this study. The committee was comprised of 20 representatives from: government, industry associations, economic development agencies, academic institutions, and industry (employers). The purpose of the committee was to provide feedback and input on the research process and to validate the results of the research. More detail on the Advisory Committee is available in *Appendix I, Detailed Methodology*.
- 4) **Advanced data analytics:** Once in-demand occupations were identified from the primary research and survey, ICTC undertook advanced analytics processes, including web scraping from job boards, and text mining of the skills noted in those job postings. ICTC scraped jobs from 4 different job boards (Indeed, Monster, Glassdoor, Stack Overflow) to identify the number of in-demand jobs in Calgary, as well as the key skills necessary to fill those jobs. ICTC also completed additional analysis to remove irrelevant jobs that fall under a given search (e.g. Pizza Hut manager that is tagged under a "full stack developer" search, because of the need to "stack" boxes); as well as duplicates of job postings. This has been completed in the interest of showcasing the most accurate quantity of job postings for in-demand jobs in the city. More detail on Advanced Analytics is available in *Appendix I, Detailed Methodology*.
- 5) **Literature review and analysis of secondary data:** Complementing primary research findings, an analysis of key literature and secondary data sets were used to

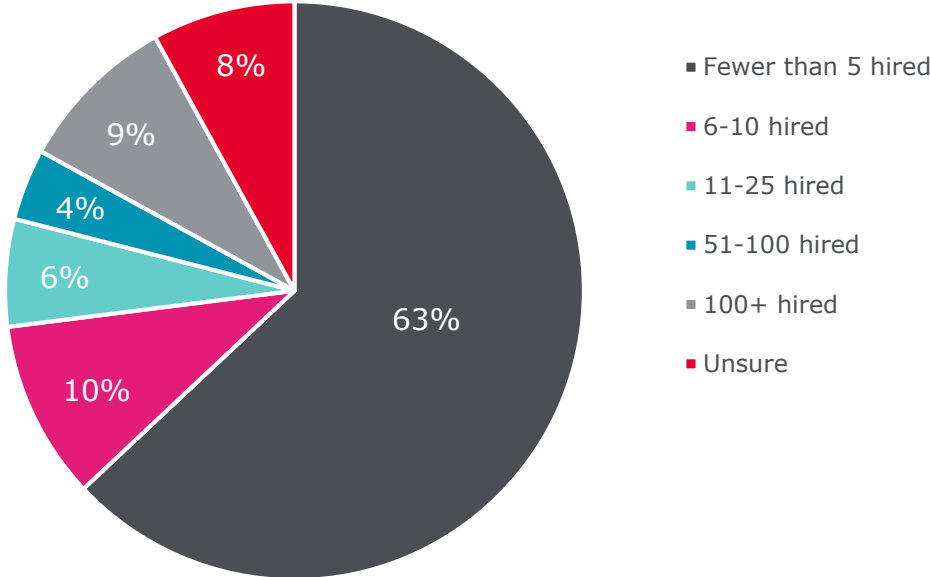
formulate the narrative, craft the story, and provide an understandable and logical background relevant to this study. This research was key in setting the stage and ultimately, why the city of Calgary must focus on finding pathways to employment for its highly-skilled displaced workers. More detail on the literature review is available in *Appendix I, Detailed Methodology*.

Part One: Demand for tech workers in Calgary

Recent hiring trends

We expect the demand for talent to continue to be strong and experience considerable growth prospects. While on average, the majority of employers in the city (63%) hired fewer than 5 employees during the last year, a significant portion of employers identified having undergone significant hiring, between 6-25 roles (16% of employers), and even over 100 roles (9% of employers).

Hiring trends over the last year in Calgary: across the economy



Source: ICTC, 2018 (70 responses)

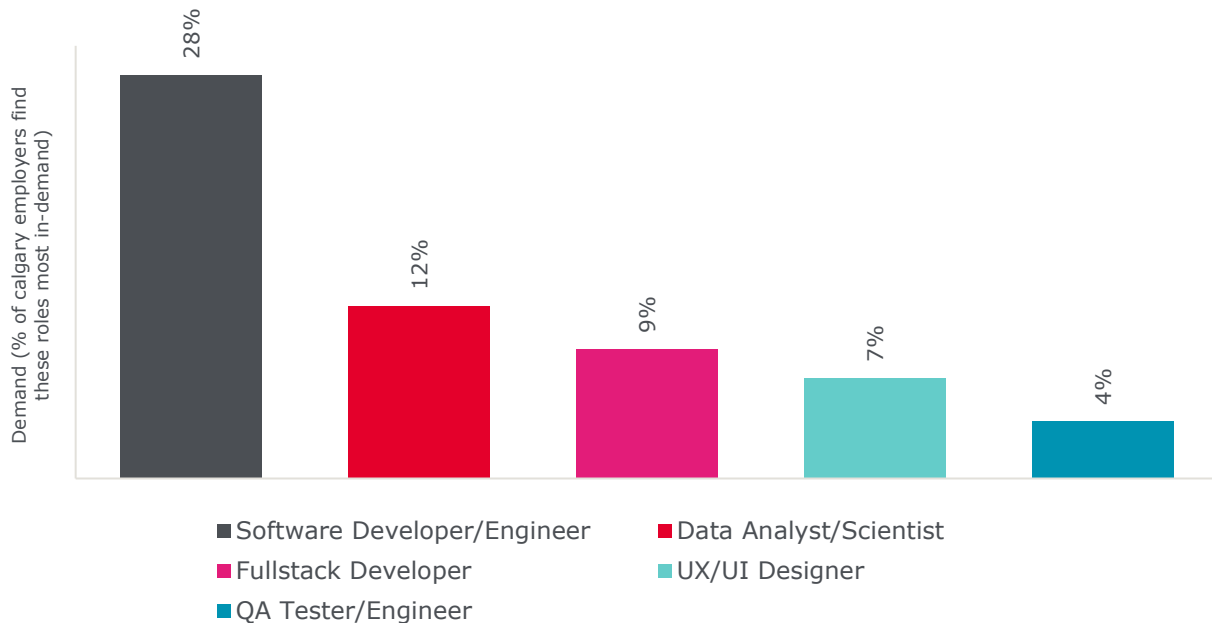
Based on Key Informant Interviews, future projections for hiring among in-demand roles continue to be strong across the Calgary economy, based on consultation with employers. While smaller employers are still expecting to hire around 5 roles or fewer, more established employers noted expecting to hire anywhere from 10 to even 30 for the most in-demand roles.

Top in-demand jobs in Calgary: focusing on a digital future

Mapping economic growth trajectories and hiring trends is an important strategy when it comes to identifying opportunities for growth in Calgary; however, it is still only one piece of the puzzle. Another crucial step rests with sourcing and highlighting the most in-demand occupations across the economy.

In 2018, a national analysis of the 20 most well-paying in-demand occupations found that 7 (35%) required a digital or technical background¹², another 5 (25%) were business-related. Similar to national trends, digital occupations are in high demand across many of Calgary's industry sectors. The top Calgary-based digital roles identified in this study are: software developers or software engineers, data analysts or data scientists, full stack developers, user experience (UX)/user interface (UI) designers and QA testers or QA engineers.

Top digital roles in Calgary



Source: ICTC, 2018 (314 responses).

Other notable digital occupations included general IT support (IT helpdesk), geomatics and GIS analysts, cloud developers, and systems security specialists, which were relevant across the economy though not necessarily considered to be "in-demand" by a greater number of employers. Of particular interest, when it comes to these roles which are considered less in-demand but still relevant, are the potential crosswalks that they offer for workers who are seeking to transition into tech from other sectors. For example, a displaced geoscientist may be a natural fit for a GIS analyst, with some additional short-duration training on topics like

¹² Murray, Doug. "The Highest Paying in-Demand Jobs in Canada for 2018." Slice, January 24, 2018. <https://www.slice.ca/money/photos/highest-paying-in-demand-jobs-canada-2018/#!Pilot-Highest-Paying-In-Demand-Jobs>

data modeling, GIS-specific software like QGIS, and programming languages like PHP, Python or CSS. Likewise, the strong problem-solving and trouble-shooting skills of many in-field engineering occupations like petroleum engineers, may lend well to IT helpdesk occupations.

Calgary’s in-demand digital occupations: advanced analytics

A further analysis of actual occupations in the region showcases the number of job postings in Calgary across time, among the top five in-demand digital occupations. Using a variety of job boards, postings for the top occupations as described by Calgary employers were extracted and analyzed to showcase the total number of actual open jobs in Calgary.

Here, we see that the number of job vacancies found across in-demand roles were somewhat low in the summer months, where hiring tends to stagnate. However, hiring picked up substantially in September and October (hiring tends to accelerate in the fall months), with the exception of software developers and engineers, whose demand stayed high during all months.

July to October 2018

Calgary job postings July to October 2018				
Role	July 2018 Vacancies	August 2018 Vacancies	September 2018 Vacancies	October 2018 Vacancies
Data Scientist or Data Analyst	51	22	29	30
Full stack Developer	6	5	43	39
QA Engineer or QA Tester	16	12	10	28
Software Engineer or Software Developer	148	150	145	164
UX Designer or UI Designer	8	6	9	13

Source: ICTC, July-October 2018.

While every attempt was made to showcase the total number of in-demand jobs in Calgary at a given time, it is possible that job *postings* may underrepresent the actual *number* of jobs available in the market. A key note to point out when it comes to job postings is the reality that one job *post* does not necessarily mean *one job*. That is, one job posting may actually reference several vacancies under that occupation. For example, in October, a senior full stack developer at Solium Capital in October states that they are seeking

"candidates" for the Calgary office in full stack development capacities. A sample of full stack developer postings in October found that roughly 15% of job posts represented more than one vacancy. This nuance was incorporated into the monthly job postings.

This practice of posting one ad for numerous positions was also one reinforced by consultations with employers, where several stated that they were sometimes seeking candidates for more than one role under each job posting. Representatives from established companies like Clio, Benevity, or Solium specifically noted that they attempted to hire anywhere from 10 to 30 software developers over the last year in Calgary. This is a trend that was set to continue, and in some cases accelerate in the coming year due to growing business needs.

At the same time, it is also necessary to consider that some available postings may be circulated via alternate job boards, social media, career fairs, word of mouth, or other mechanisms which can be challenging to capture completely.

October 2018 snapshot: an analysis of duplicated vs. unduplicated job postings

Two important considerations when analyzing the total number of postings for jobs are: 1) removing irrelevant jobs that are tagged under that search; and 2) removing duplicated postings. Oftentimes in a search for a job title, other roles will be contained in the result of the search query. Some examples include more benign results like "data analysts", or "web developers" found under a search for a "software developer"; whereas other examples can include jobs like "pizza hut manager" which was found under a search for a "full stack developer" because the role was available on a *full-time* basis and required the candidate to *stack* boxes. Once these irrelevant postings are removed, duplicated postings (i.e. the same jobs posted more than once or by more than one source) must also be removed. Below is a comparison of the rate of duplication found in the October search for the most in-demand tech jobs in Calgary, after removing irrelevant or incorrectly tagged jobs.

October snapshot job postings: duplicated vs. unduplicated posts						
Role	Calgary jobs (with duplicates)	Calgary jobs (duplicates removed)	% of jobs duplicated	Canada jobs (with duplicates)	Canada jobs (duplicates removed)	% of jobs duplicated
Data Scientist or Data Analyst	42	30	29%	941	573	39%
Fullstack Developer	51	39	24%	865	595	31%
QA Tester or Engineer	50	28	44%	314	229	27%
Software Engineer or Developer	288	164	43%	5360	3620	32%

UX Designer or UI Designer	22	13	41%	283	129	57%
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Source: ICTC, 2018.

October 2018 snapshot: Calgary's portion of in-demand jobs in Canada			
Role	Number of jobs: Calgary	Number of jobs: Canada	Calgary's % of in-demand jobs in Canada
Data Scientist or Data Analyst	30	573	5.2%
Fullstack Developer	39	595	6.6%
QA Tester or Engineer	28	229	12.2%
Software Engineer or Developer	164	3620	4.5%
UX Designer or UI Designer	11	129	10.1%

Source: ICTC, 2018.

A snapshot of October job postings showcases the portion of Canadian in-demand jobs that are located in Calgary. Here we see that Calgary job postings make up anywhere from 4.5% of in-demand roles in Canada (Software developers) to as much as 12.2% of all roles (QA testers). By comparison, Calgary makes up slightly more than 4% of the employed population in Canada¹³. This reemphasizes the growth occurring in the Calgary tech industry.

Top digital roles in Calgary: occupation snapshots

Knowing which jobs are considered in-demand by employers is crucial. This knowledge can provide prospective job seekers with the insight they need to make the best plans and design the most appropriate pathways for future employment. However, even more important than the knowledge of job needs, is a strong understanding of the skills and responsibilities tied to these occupations. The following presents occupational snapshots of the top five in-demand digital jobs in Calgary.

Software developer: For software developers, the familiarity with some components of artificial intelligence or machine learning is becoming somewhat standard in the process of creating software products. In software, a "build" refers to a process that converts files and other data into a software product¹⁴. The process of automating a build requires the ability

¹³ Statistics Canada, Labour Force Survey (November 2017).

¹⁴ "What is Build Automation?" Agile Alliance, 2018. [https://www.agilealliance.org/glossary/automated-build/#q=~\(filters~\(postType~\(page~post~aa_book~aa_event_session~aa_glossary~aa_organizations~aa_research_paper~aa_video\)~tags~\(automated*20build\)\)~searchTerm~sort~false~sortDirection~asc~page~1\).](https://www.agilealliance.org/glossary/automated-build/#q=~(filters~(postType~(page~post~aa_book~aa_event_session~aa_glossary~aa_organizations~aa_research_paper~aa_video)~tags~(automated*20build))~searchTerm~sort~false~sortDirection~asc~page~1).)

to create an algorithm where steps are repeatable and can be performed at any time with no intervention required, and no information needed other than whatever is stored in the source code¹⁵. Additionally, while many software developer roles list a need for proficiency in certain programming languages, another interesting trend is the increasing presence of postings that do not list any specific coding languages. Given the rate of change when it comes to popularity of programming languages, many employers are increasingly requiring a general competency of coding or familiarity, rather than specific expertise in one language.

Data analyst: Data analysts tend to require a blend of competencies, including research and analysis, massaging of big data sets, data translation into meaningful results, and the ability to showcase the data. A recent report by SAS outlines the analytics lifecycle in 5 steps:

- business analysis, including understanding problems and exploring potential solutions with data
- data exploration, including identifying the data required to solve the problem, sourcing it, cleaning it and structuring it.
- quantitative and qualitative analysis, including using advanced analytics to draw trends and results from the data.
- communication of results, including using data visualizations to tell the “story” of the data.
- and data product life-cycle management, including continually ensuring that the data is managed, stored and updated properly¹⁶.

The key competencies of a data analyst go far beyond the ability to extract, structure and prepare data – more importantly, the role’s value is found in the ability to extract and relay the meaning behind the data.

Full stack developer: Full stack developers are developers that have the capabilities to work with both the front and back end of a website¹⁷. Similar to front-end developers, full stack developers also tend to require knowledge with user experience and/or customizing pages that are user friendly or accessible. The reason for this is that the front end of a website or app is the first thing that a user interacts with – in essence, front-end developers are responsible for working on all elements of a website that the user engages with¹⁸. As a result, it is easy to understand why UX/UI skills are important for this role, as is a knowledge of design principles and techniques.

UX/UI designer: User Experience (UX) and User Interface (UI) designers tend to be a blend of technical talent with a strong reliance on “soft” skills, like the ability to communicate well, both written and verbally. The reason behind this is that UX developers

¹⁵ Idem.

¹⁶ “7 Phases of a Data Life Cycle” Bloomberg, July 14, 2015. <https://www.bloomberg.com/professional/blog/7-phases-of-a-data-life-cycle/>

¹⁷ Chapman, Cameron “Front End, Back End, Full Stack – What Does it All Mean?” Skillcrush, November 5, 2018. <https://skillcrush.com/2017/02/27/front-end-back-end-full-stack/>

¹⁸ Lesaca, Dexter “Understanding UX Design & Front-End Development” Code Fellows, September 30, 2014. <https://www.codefellows.org/blog/understanding-ux-design-front-end-development/>

are primarily concerned with how the product feels to a user¹⁹. As a result, UX designers are required to test out various approaches to solving a problem or creating an end product – this includes the ability to develop numerous mockups and trial runs on a case-by-case basis. UX and UI designers are primarily concerned with how a product is “laid out” – meaning how a page or application is put together, with the intent of producing the best user experience²⁰. This can include considerations like where to place content on a page, or designing the template for how a user would scroll through a page.

QA tester: QA testers work with a variety of roles at a given company, including software developers and even sales, marketing or communications teams. Their roles are primarily to ensure that a product or application works correctly before it is sent to an end user or made live²¹. As a result, QA testers need to have experience with automated testing, bug identification and tracking, and much of the time, some experience and proficiency with cybersecurity protocols is required. That said, a QA tester’s “job” is not limited to testing only before the application is live. Instead, QA testers continuously test an application, webpage or software to ensure that it continues to function properly and that any errors or bugs are eliminated. QA testers also measure and track performance metrics of a given application or software on a continual basis.

Other in-demand jobs in Calgary: Electrical Engineers, Business Development Managers, Project Managers

A holistic look at the entire economy also highlights electrical engineers, business development managers, and project managers as in-demand occupations in Calgary.

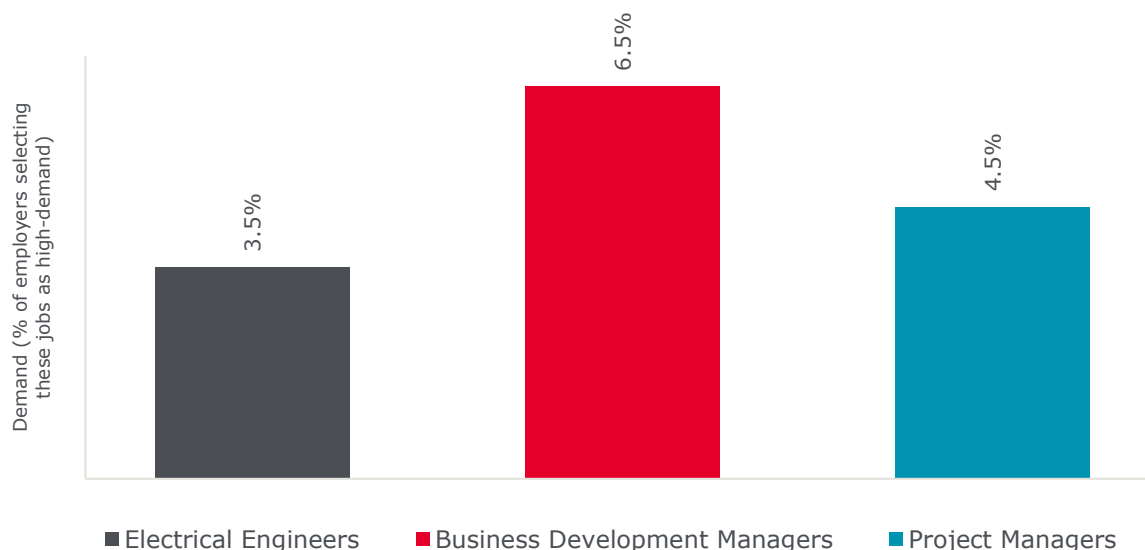
¹⁹ Ming, Lo Min “UI, UX: Who Does What? A Designer’s Guide to the Tech Industry” July 7, 2014.

<https://www.fastcompany.com/3032719/ui-ux-who-does-what-a-designers-guide-to-the-tech-industry>

²⁰ Idem.

²¹ “What Does a Software Quality Assurance Tester Do?” Software Career Today. <http://www.softwarecareertoday.net/faq/what-does-a-software-quality-assurance-tester-do/>

Other in-demand jobs in Calgary



Source: ICTC, 2018 (314 responses).

While these occupations are not under the category of traditional “digital-centric” occupations like software developers, they may have digital components which can lead to them being in demand for technology companies as well. The following are occupational snapshots of other in-demand occupations in Calgary.

Electrical Engineers: One notable example of where the demand for electrical engineers may be higher than average for the technology sector are companies working in the space of autonomous systems. Here, electrical engineers configure the various sensors used in an autonomous vehicle²². Another example is telecommunications, which frequently requires electrical engineers to assemble, test, or make modifications to RF, electrical, or mechanical components of telecom infrastructure²³. These are but two examples of the cross-linkages between electrical engineers and high-growth sectors like technology. With the demand for electrical engineers being considerably higher in the technology sector vs. other engineering occupations, the transition into electrical engineering in the tech sector can be a strong pathway for displaced engineers in Calgary.

Business Development Manager: No matter what the industry, successful business development managers are always in demand. In addition, there can sometimes be a relatively high turnover rate in the business development and sales professions due to the high-pressure and results-driven nature of the job. Potential employers tend to look for three key assets, in particular, when seeking business development talent:

²² Rudolph, Gert; Voelzke, Uwe, “Three Sensor Types Drive Autonomous Vehicles” Sensors Online, November 10, 2017. <https://www.sensorsmag.com/components/three-sensor-types-drive-autonomous-vehicles>

²³ “Electrical Engineering Jobs” Randstad. <https://www.randstad.ca/electrical-engineering-jobs/>

- An existing list of potential customers to build relationships with, and/or a strong network in the field/domain of the business.
- Expert sales skills and a track record of business development success.
- Domain knowledge in the subject-matter of the business. The most successful business development managers will be able to not only possess strong sales and customer relations skills, but have enough of a technical background to speak with authority on the product or service being sold, as well.

Project Managers: Almost all initiatives undertaken by any organization can be classified as projects. This results in a high demand for people with successful project management experience and project management skills and credentials. The Project Management Professional (PMP) has significant cache in most industries, however successful project managers will often possess the following skills:

- Experience bringing successful projects to completion.
- Experience working effectively within budget and time constraints.
- Excellent communication and team working skills, with the ability to communicate and plan effectively across organizational departments.

Project management may also serve as a strong pathway for displaced workers to transition to, with training. HR agencies in Calgary highlighted that transition into project management roles at tech companies was a viable option. This was also a possibility that tech employers appeared open to. Transition to business development roles was seen as less of a viable option given the need for business development managers to have a strong domain expertise (in tech). Additionally, the demand for this talent tended to be most acute at senior level, suggesting that suitable candidates already have extensive experience in this or a similar role.

In-demand skillsets: key foundational skills – Agile vs. Waterfall

Two of the most common development methodologies are agile and waterfall. Although both will lead to a final product, the way in which they arrive at the end product are different.

Waterfall methodology is adopted from Engineering, which is based in the notion that physical changes to a design can be very costly²⁴. As a result, the methodology for waterfall development relies on clear requirements and solid step-by-step processes to reach the end goal²⁵. This methodology is sometimes touted as incongruent with the tech sector, where tasks tend to require a higher rate of fluidity and adaptability, rather than clear built-in processes.

Agile methodology was developed as a “solution” to the disadvantages of waterfall. It functions by starting with a simplistic project design, and then work towards the end product by completing small “sprints” or modules. Each module undergoes a testing period, along with the re-evaluation of project priorities before the next module is run²⁶. In short, agile methodology is grounded in the concept of flexibility during the design process.

²⁴ Lonergan, Kevin “Agile Versus Waterfall?” PMIS Consulting, May 2, 2016. <https://www.pmis-consulting.com/agile-versus-waterfall/>

²⁵ Idem.

²⁶ Idem.

Particularly relevant to this study, a familiarity and comfort with “agile” was referenced by many employers as a *must-have skill* for occupations in the technology sector.

Detailed digital (“hard”) skill needs for top digital jobs in Calgary

In order to understand how to shape transition pathways for displaced occupations in Calgary’s oil and gas sector to in-demand jobs in the technology sector, it is crucial to have a detailed understanding of the critical skills for these in-demand roles. The following represents a detailed breakdown of the most critical “hard” skills for in-demand digital roles in Calgary. This analysis is based on primary findings and data gathered from thousands of job postings.

Software Developer - detailed skills:

- Understanding of data structures, algorithms and logic-based programming.
- Understanding and experience with software development principles and practices like minimum viable products, pair programming, trunk-based development, and testing pyramids.
- Experience with Agile Methodology and Agile software development approaches.
- Experience and comfort with cloud computing principles like enablement, cost-benefit analyses, enterprise risk, and accountability.
- Experience and comfort with cloud computing platforms such as AWS, Microsoft Azure, Google Cloud, IBM Bluemix.
- Experience with test development practices such as defect prevention and detection strategies.
- Comfort and proficiency with a variety of modern programming languages such as C++, Java, JavaScript, C#, Python, SQL, Ruby on Rails.
- Proficiency with build automation tools like Jenkins, CircleCI, Bamboo, Apache Maven.
- Proficiency with version control/continuous integration tools like Helix Core, GitHub, Apache Subversion, Mercurial, and Plastic SCM.
- Experience with building and using APIs, including importing APIs into code and using functions nested within APIs.

Data Analyst - detailed skills:

- Knowledge of data analysis principles and practices including data gathering, data cleaning, data analysis and trend extraction.
- Experience with Agile Methodology and Agile software development approaches.
- Ability to utilize basic Predictive Models to predict statistical outcomes, including using detection theory to estimate probability of outcomes based on input data.
- A strong understanding of mathematics and descriptive statistics.
- A strong understanding of statistical analysis and modeling principles like correlations, variance analyses, factor analyses, regression analyses.
- Ability to look for patterns and trends in data, and define data collection and analysis processes.

- Ability to work with and effectively sort unstructured data such as videos, customer reviews, social media posts, audio files.
- Ability to utilize practices like natural language processing and text mining to perform sentiment analysis on unstructured data and quantify subjective information.
- Ability to utilize machine learning to develop and automate models and algorithms and processes that extract meaningful patterns from unstructured data.
- Strong understanding of modern programming languages for data science applications such as Python, Java, R, SQL, MATLAB, SAS and QGIS.
- Knowledge and experience with data and database management, including proficiency with tools such as Hadoop and Apache Spark.
- Strong Data Visualization skills including proficiency with programs like Tableau, Microsoft PowerBi, D3.js and Node.js.

Full Stack Developer – detailed skills:

- Experience with Agile Methodology and Agile software development approaches.
- Understanding of the software development lifecycle: planning, design, testing, implementation, maintenance.
- Knowledge of full stack development principles such as back-end (source code development, database management, business logic, database interaction) and front-end (user interface development, testing and debugging, creating responsive designs) practices.
- Knowledge of modern programming languages including HTML, CSS, JavaScript, Python, Ruby on Rails, PHP, and Node.js.
- Strong understanding of User Experience principles like discovery, design, wireframes and mockups, testing, launch, and post-launch.
- Strong understanding of User Experience requirements and techniques, including accessibility guidelines, version control, animations and memory usage.
- Experience with Cloud computing processes like backup and recovery, test and development
- Proficiency with modern cloud computing platforms like AWS, Microsoft Azure, iCloud, Open stack and Google Cloud for Developers.
- Proficiency with version Control/Continuous Integration platforms like CVS, SVN, Git, Mercurial.
- Strong Data Management skills, including the ability to implement practices for improved data reliability like data scrubbing and shaping.
- Ability to manage databases using programs like MySQL, MongoDB, and Cassandra.
- Strong understanding of API design and development.

UX/UI Designer - detailed skills:

- Strong understanding of User Experience and User Interface principles and practices including the ability to assess usefulness, usability, ease in navigation, accessibility, and credibility.
- Experience with Agile Methodology and Agile software development.

- Strong understanding of web principles and standards, including best practices for usability.
- Strong understanding of marketing principles such as market-focused strategies, customer experience marketing, and marketing for personalized customer experience.
- Experience with modern design platforms like Adobe InDesign, Flash and Dreamweaver.
- Ability to design static high-profile wireframes for the purpose of structuring information and basic functionalities.
- The ability to use wireframes to create high-quality mockups that provide visual details including colors, typography and interactive elements of a webpage.
- Proficiency with modern cloud computing platforms like AWS, Microsoft Azure, iCloud, and Google Cloud for Developers.
- Proficiency with web development tools like Sublime Text, Google Chrome Developer Tools, jQuery, Twitter Bootstrap, Angular.js.
- Experience creating user interfaces and designs for mobile devices.
- Experience measuring and tracking usability metrics based on user performance, error rates, and user subjective satisfaction.

QA Tester – detailed skills:

- Proficiency with QA testing principles and practices like unit testing, integration testing, system testing, performance testing.
- Experience with Agile Methodology and Agile software development.
- Strong understanding of test design practices according to software needs, such as specification-based tests, structure-based tests, experience-based tests.
- Proficiency with automated testing principles and techniques that playback pre-recorded and predefined actions and compare results to expected behaviour.
- Ability to perform manual and automated testing, including regression testing, to ensure that older code is still functional when new updates are included.
- Ability to measure and track QA performance metrics such as the number of defects when new features are introduced, or time taken to execute commands.
- Experience working with automated testing tools like Selenium, Katalon Studio, Test Complete and Watir.
- Experience with bug tracking best practices such as bug reporting workflows, bug assigning, and creating bug reports.
- Proficiency with bug tracking tools such as Intervals, Monday, Aceproject, Wrike.
- Knowledge of version control/continuous integration practices such as maintaining code repositories, automating builds, testing in clone production environments, and automating deployments.
- Experience with software quality assurance.

Top programming languages

Complementing critical skills with in-demand programming languages for occupations from software developers to QA testers is important. Increasingly, employers require workers

that have competency with a broader range of programming languages. This is something that showcases the employee's flexibility, ability to continually upskill and learn, and utilize the language most appropriate for a given task. However, certain programming languages have been identified by employers as the most critical for in-demand roles at their companies. Echoing its current global popularity²⁷, tech employers agreed that currently, Python was one of the most in-demand programming languages for jobs like software developers in Calgary. Yet, other system-level languages like JavaScript, Java, SQL, C# and C++ were also found to be very relevant. These other languages tended to be regarded as in-demand based on specific business operations or the purpose of the project. For example, C# is regarded to be one of the most widely-used languages for developing apps or games on a Microsoft platform²⁸.

Other open-source software like GitHub – where developers can post repositories of tricks, tools and code lines for use by the general population of developers – are also scaling in terms of popularity, with the growth of open-source programming languages like Python, R or SQL.

While the majority of engineers outside of tech may not have extensive experience with programming languages like JavaScript, C# or Python, a good portion of engineers have some basis in MatLab. Matlab, with a strong basis of mathematical, scientific, and statistical data calculation and manipulation, is a tool that can serve as a basis for transition to R. Both Matlab and R access math functions and statistics to analyze and visualize data, and both are scripting languages. Scripting languages are those which can be used to automate certain functions or commands. R is currently one of top in-demand tools for data analysis roles. This common basis between Matlab and R is important, as is the mutual basis in scripting. Matlab can serve as an initial bridge to R, R can then serve as a bridge to Python. While Python is an object-oriented high-level language often used for software development, it can *also* be used for scripting (similar to R and Matlab), to automate certain functions. This common basis makes the eventual transferability to Python easier for many learners with a basis in Matlab and/or R. In fact, many data science courses and certificates tend to *start* learners with R before transitioning to Python. The following represents the top programming languages and tools according to each in-demand digital occupation. These languages were extracted based on the frequency with which they were found in job ads. Please see *Appendix V, In-demand Languages & Tools* for details.

Top languages & tools: Software Developer:

For software engineers and developers, the most popular programming languages as found in job postings were SQL, Java, C (#, ++) and JavaScript.

Top languages & tools: Data Analyst:

For data analyst roles, the most in-demand programming languages were Python, SQL, R, and Java.

²⁷ "PYPL: Popularity of Programming Language" Github, Nov 2018. <http://pypl.github.io/PYPL.html>

²⁸ Mkhitarian, Armina "Why is C# Among the Most Popular Programming Languages in the World?" Medium, October 7, 2017. <https://medium.com/sololearn/why-is-c-among-the-most-popular-programming-languages-in-the-world-ccf26824ffcb>

Top languages & tools: Full stack Developer

Fullstack developer roles, similar to software developers, had a high presence of languages like JavaScript, Java, SQL, HTML, and C.

Top languages & tools: UX/UI Designer:

UX/UI developer jobs tended to be based less in programming languages and more in concepts related to design capabilities. As a result, UX and UI skills were the most prevalent skills found in job postings. When it came to programming languages specifically, JavaScript and HTML were most relevant.

Top languages & tools: QA Tester

For QA roles, the most prevalent programming languages were Java, SQL, Python, JavaScript and Linux.

Top “soft” skills for in-demand digital jobs in Calgary

Often viewed as complementary to technical or “hard” skills, recent research indicates that employers are starting to place more emphasis on “soft” skills.

The demand for soft-skills was also echoed in feedback gathered from employer consultations in Calgary. Here, employers frequently quoted the ability to be flexible and agile as crucial skills for candidates for in-demand digital roles. Open-mindedness, as well as the “ability to learn how to learn” were also seen as critical. Moreover, employers are increasingly focusing on candidates who *showcase* their capacity for lifelong learning in their applications, such as candidates who are already taking upskilling courses, or working on “passion projects” in their free time.

This is something that bodes well for workers transitioning into tech careers. The very nature of the oil and gas industry requires that workers possess the ability to think quickly and solve urgent problems under constrained timelines. Engineers working with pipelines specifically, often need to solve problems related to issues like permafrost, or create pressure solutions for the control of heat exchange. Engineers with this kind of in-field oil experience would likely come equipped with a strong basis of problem solving and time management skills that can be valuable assets to the technology sector. The below represent a detailed list of critical soft skills for the in-demand digital jobs.

Software Developer – soft skills:

- Excellent project management skills, with the ability to track project progress.
- Ability to prioritize tasks, analyze user needs and create workflows.
- Ability to work independently or in groups.
- Strong analytical and strategic thinking skills.
- Strong oral and written communication skills.
- High attention to detail.
- Demonstrated ability to understand projects from the client’s and business’ perspectives.
- High level of flexibility and adaptability.
- Excellent time management skills, with the ability to meet tight deadlines.

Data Analyst:

- Strong problem-solving skills and ability to prioritize tasks.
- Strong analytical skills, with the ability to collect, organize, and analyze large amounts of data with accuracy.
- High attention to detail.
- Excellent communication skills, with the ability to dissect technical data and translate it into easily digestible trends and meaning.
- Strong presentation skills, with the ability to produce clear and organized documentation.
- Advanced investigative skills, with the ability to show creativity in the data extraction process.
- High level of flexibility and adaptability.
- Strong critical thinking skills.
- Ability to describe complex data and outcomes in everyday language.

Fullstack developer:

- Strong project management skills, with the ability to compartmentalize tasks according to priority and work on multiple projects at one time.
- Excellent communication skills with the ability to explain technical processes and work cross-functionally with other parts of organizations such as marketing and sales.
- High level of flexibility, with the ability to adapt to change rapidly.
- Strong analytical and problem-solving skills.
- Strong business acumen, with the ability to understand business needs and make recommendations.
- Ability to work independently, while collaborating with a team.
- High degree of open-mindedness and creativity, with the ability to combine technical needs and best practices for enhanced user experiences.

UX/UI Designer:

- Strong sense of creativity and trend analysis, with the ability to stay abreast with competitive UX-techniques like eye movement tracking, field studies, usability testing, remote usability testing, and user personas.
- Exceptional communication skills, with the ability to explain technical concepts and best practices to clients and customers.
- Strong customer relations skills with the ability to quickly solve problems and suggest solutions.
- Ability to lead projects and suggest practical solutions to management.
- Creative and empathetic, with the ability to consider situations from multiple perspectives.
- Ability to work collaboratively within a team.
- Ability to implement feedback and seek continuous design improvement.
- High attention to detail.

QA Tester:

- Ability to create clear test plans (including input actions and expected results) based on verbal communications and client needs.

- Strong communication skills, both written and verbal.
- High attention to detail, with the ability to write detailed documentation of tests.
- Strong problem-solving skills, with the ability to exercise critical thinking to solve complex problems.
- Excellent teamworking skills, with the ability to collaborate with developers and other team members to troubleshoot issues.
- Strong project management skills, with the ability to shape test plans, execute and track tests.
- Advanced investigative skills.
- High degree of flexibility and patience, with the ability to adapt to changing needs and priorities.

Part two:

Cross-over between displaced and in-demand occupations

Part two of this report highlights areas of opportunity and challenges for highly-skilled displaced workers attempting to transition into these in-demand tech roles. This study identified the below high-skilled occupations as having the highest rates of unemployment in the Calgary area.

Profiles snapshots

In this section, a *Profile Snapshot* for each of the top five occupations is provided:

- Geoscientist
- Chemical Engineer
- Petroleum Engineer
- Engineering Manager
- Electrical Engineer (both displaced in the energy sector and in-demand in the tech sector)

A general profile leveraging selected skills from the Canada Job Bank is included, as well as a more detailed skills profile derived from individual workers' profiles. With the profiles established, the occupation's skills are then matched to the top digital jobs with supporting transitioning strategies recommended to bridge any skill gaps.

Job match: the crossover between displaced and in-demand

As seen in the table below, many of Calgary's highly-skilled but displaced occupations from oil and gas *already possess some key skills* and competencies to help them transition into in-demand roles in high-growth sectors like technology. Specifically, many engineering and science-based disciplines focus on skills that develop operational technology (OT) skills vs. information technology (IT) skills. Operational technology focuses more on technology that can be implemented for tasks like designing industrial plants and factories, understanding supply chain logistics; and for technical needs in areas like aerospace, energy, transportation or resources exploration, among others. Conversely, a focus on information technology (IT) helps to shape skills related to web platforms, computer services and systems, data management systems and data visualization platforms²⁹. While these skillsets do possess differences, they also have some significant overlaps, with skills and competencies that are complementary to in-demand digital occupations like software developers or data analysts.

The table below examines various core skillsets such as math, statistical analysis, coding, research, data analysis, design thinking, problem solving and others to determine the

²⁹ Michel, Roberto "The Operations Technology (OT) vs. Information Technology (IT) Debate Turns to Better Security" Modern Materials Handling, April 10, 2017.
https://www.mmh.com/article/the_operations_technology_ot_vs_information_technology_it_debate_turns_to

transferability or “match” between displaced and in-demand occupations. This is done by first assessing the rate (%) of displaced occupations which we have found to possess these and other key skills and competencies, according to a representative sample. Using this sample, we are able to attest to the skills possessed by the *average* displaced occupation, with each skill assigned a weight (i.e. the average petroleum engineer has a strong competency for math; and math skills have a weighting of x). This is then compared to in-demand skillsets (e.g. coding), which are also assigned a weight, according to their demand (for example, coding skills for software developers may be weighted at three times the value of research skills). Using this method, a match is calculated according to the total skills that displaced workers in each occupation possess in reference to each in-demand job.

Using this method, we have found that many displaced occupations possess at least 50% of the critical skillsets needed to transition into in-demand roles like Data Analysts or QA Testers. While the level of upskilling will vary on a case-by-case basis, the average trajectory of such a worker is relatively short, oftentimes taking one year or less.

	Data Scientist	Data Analyst	Software Engineer/ Developer	UX/UI Designer	QA Tester/ Engineer	Project Manager	Business Development Manager
Chemical Engineer	59%	59%	38%	26%	58%	50%	23%
Engineering Manager	45%	38%	32%	21%	52%	49%	22%
Geoscientist	55%	38%	31%	21%	51%	17%	13%
Petroleum Engineer	53%	50%	32%	22%	52%	34%	19%
Electrical Engineer	67%	68%	54%	44%	70%	48%	22%

Source: ICTC, 2018.

Detailed profile snapshots

Geoscientist

General skills:

- Conduct theoretical and applied research to extend knowledge of the surface and subsurface features of the earth, including its history and the operation of physical, chemical and biological systems that control its evolution.
- Plan and conduct seismic, electromagnetic, magnetic, gravimetric, radiometric, radar and other remote sensing programs.
- Plan, direct and participate in analyses of geological, geochemical and geophysical survey data, well logs and other test results, maps, notes and cross sections.
- Develop models and applied software for the analysis and interpretation of data.
- Supervise technicians, technologists and other engineers

Geoscientists have many skills desirable for in-demand roles like data analysts and data scientists. Their experience collecting and analyzing complex data sets positions them well for these careers. In particular, their skills around geo-spatial mapping and geographic information systems (GIS) tools like ArcGIS in particular are important. Proficiency with these skills can place geoscientists in high demand for transition to data scientist roles, as there is a general scarcity of the “mapping” skill in the data professional community.

Transition strategy – Geoscientists

Displaced Occupation	“Good Fit” In-demand Occupation (50%+ match)	Skills that Match	Upskilling Needs	Example resources for Upskilling	Duration of resources for upskilling
Geoscientist	Data Scientist/ Analyst	<ul style="list-style-type: none"> Experience with geological mapping processes, including creating hot spots and heatmaps. Proficiency with the Petrel Geology & Modeling software platforms. Skilled in project management practices and principles, including Microsoft Project, Access. Proficiency with GIS software like ArcGIS and open-source alternatives like QGIS. Understanding of log analysis and analysis of geospatial data. Strong research skills, including analysis of detailed and complex data sets. Proficiency with MatLab and oftentimes basic proficiency with R. Strong database management skills, including proficiency with programs like ProSource. 	<p>OVERALL NEEDS:</p> <ul style="list-style-type: none"> Gain a holistic understanding of data science and data analysis <p>SPECIFIC NEEDS:</p> <ul style="list-style-type: none"> Learn Agile methodology Become proficient in geospatial data analysis software like QGIS Become proficient with GIS scripting languages like JavaScript, Arcade Become proficient with FME data integration software Become proficient in scripting languages like Python or SQL used to analyze unstructured data like videos, pictures, audio files, social media posts, etc. Become proficient working with and categorizing unstructured data via programs like Hadoop, Spark or Pig Become proficient with data visualization tools like Tableau, Microsoft PowerBI, DJ3.js, Node.js 	<p>OVERALL PROGRAMS:</p> <p>DATA SCIENCE/DATA ANALYTICS (OVERALL):</p> <p>University of Calgary: Certificate in Fundamental Data Science & Analytics (based on taking 4 courses per semester).</p> <p>SAIT: Certificate in Business Intelligence – Data Analysis & Reporting ~6 months (based on full course load).</p> <p>Bow Valley College: Certificate in Data Management & Analytics</p> <p>The Knowledge Academy: Course - Data Science Analytics</p> <p>SPECIFIC COURSES</p> <p>AGILE:</p> <p>Coursera: Agile Development Specialization</p> <p>University of Calgary: BMC 348 – Agile Project Management (the Basics)</p>	<p>OVERALL PROGRAMS:</p> <p>University of Calgary: Certificate in Fundamental Data Science & Analytics: ~4 months (based on taking 4 courses per semester).</p> <p>SAIT: Business Intelligence – Data Analysis & Reporting: ~6 months (based on full course load).</p> <p>Bow Valley College: Certificate in Data Management & Analytics: ~ 8 months (based on full course load).</p> <p>The Knowledge Academy: Course - Data Science Analytics: 1 day (intended as intro course).</p>

Displaced Occupation	"Good Fit" In-demand Occupation (50%+ match)	Skills that Match	Upskilling Needs	Example resources for Upskilling	Duration of resources for upskilling
Geoscientist (Continued)	Data Scientist/ Analyst (Continued)			<p>SPECIFIC COURSES:</p> <p>AGILE: FME Data Integration: Consortech: Basic FME</p> <p>PYTHON: SAIT: Python Programming Certificate</p> <p>University of Calgary: ICT 781 – Python Level 1</p> <p>SQL: The Knowledge Academy: Introduction to SQL</p> <p>New Horizons Computer Learning Centres: SQL Querying Fundamentals</p> <p>UNSTRUCTURED DATA: Courseara: Leveraging Unstructured Data with Cloud Dataproc on Google Cloud Platform</p> <p>DATA VISUALIZATION: SAIT: Analyzing Data with PowerBI:</p> <p>University of Calgary: ICT 774 – Visual Analytics:</p>	<p>SPECIFIC COURSES:</p> <p>AGILE: Courseara: Agile Development Specialization: ~6 months (based on average learners).</p> <p>University of Calgary: BMC 348 – Agile Project Management (the Basics): ~4 months (1 semester).</p> <p>FME DATA INTEGRATION: Consortech: Basic FME: 2 days (intended to be an intro course).</p> <p>PYTHON: SAIT: Python Programming Certificate: ~ 8 months (2 semesters).</p> <p>University of Calgary: ICT 781 – Python Level 1: ~4 months (1 semester).</p> <p>SQL: The Knowledge Academy: Introduction to SQL: 1 day (intended to be an intro course).</p>

Displaced Occupation	"Good Fit" In-demand Occupation (50%+ match)	Skills that Match	Upskilling Needs	Example resources for Upskilling	Duration of resources for upskilling
Geoscientist (Continued)	Data Scientist/Analyst (Continued)				<p>SPECIFIC COURSES:</p> <p>New Horizons Computer Learning Centres: SQL Querying Fundamentals: 1 day (intended to teach only SQL querying basics).</p> <p>UNSTRUCTURED DATA:</p> <p>Coursera: Leveraging Unstructured Data with Cloud Dataproc on Google Cloud Platform: ~1 week (based on average learners).</p> <p>DATA VISUALIZATION :</p> <p>SAIT: Analyzing Data with PowerBI: ~3 months (1 semester).</p> <p>University of Calgary: ICT 774 – Visual Analytics: ~3 months (1 semester).</p>
Geoscientist (Continued)	QA Tester	<ul style="list-style-type: none"> • Skilled in project management practices and principles, including Microsoft Project, Access. • Strong research and analytical skills, including analysis of detailed and complex data sets. • Strong database management skills. 	<p>OVERALL NEEDS</p> <ul style="list-style-type: none"> • Gain a holistic understanding of quality assurance skills, processes and practices <p>SPECIFIC NEEDS</p> <ul style="list-style-type: none"> • Learn Agile methodology • Become proficient with continuous integration and automation principles 	<p>OVERALL PROGRAMS</p> <p>QA TESTING (OVERALL):</p> <p>Udacity: Software testing</p> <p>The Knowledge Academy: ISTQB – Software Testing Foundation</p>	<p>OVERALL PROGRAMS</p> <p>Udacity: Software testing course ~1 month (based on average learners).</p> <p>The Knowledge Academy: ISTQB – Software Testing Foundation: 3 days (intended to be an intro course).</p>

Displaced Occupation	"Good Fit" In-demand Occupation (50%+ match)	Skills that Match	Upskilling Needs	Example resources for Upskilling	Duration of resources for upskilling
Geoscientist (Continued)	QA Tester (Continued)	<ul style="list-style-type: none"> Strong problem-solving skills. Basic knowledge of bug tracking and testing. 	<ul style="list-style-type: none"> Learn modern software languages for bug tracking like Javascript, CSS, HTML 	<p>SPECIFIC COURSES</p> <p>AGILE: See above</p> <p>CONTINUOUS INTEGRATION: Trainup.com: Continuous integration boot camp</p> <p>TESTING LANGUAGES: SAIT: Introduction to JavaScript and jQuery – CMPP 257</p> <p>University of Calgary: ICT 580 HTML5 and CSS3</p>	<p>SPECIFIC COURSES:</p> <p>AGILE: Coursera: Agile Development Specialization: ~6 months (based on average learners).</p> <p>University of Calgary: BMC 348 – Agile Project Management (the Basics): ~4 months (1 semester).</p> <p>CONTINUOUS INTEGRATION: Trainup.com – Continuous integration boot camp: 3 days (intended to be an intro course).</p> <p>TESTING LANGUAGES: SAIT: Introduction to JavaScript and jQuery – CMPP 257: ~2 months (based on average learner).</p> <p>University of Calgary: ICT 580 HTML5 and CSS3: ~4 months (1 semester).</p>

Source: ICTC, 2018.

Chemical Engineer:
General skills

- Conduct research into the development or improvement of chemical engineering processes, reactions and materials.
- Conduct economic and technical feasibility studies in areas related to chemical, petroleum, pulp and paper, food or other processing industries.
- Supervise technicians, technologists and other engineers.

Chemical engineers have experience in process simulation and with process simulation tools like Aspen HYSYS. This positions them for opportunities in the data sciences, in particular AI and machine learning algorithms. Job opportunities within AI and machine learning are increasingly seen across many sectors of the economy, as even traditional industries begin utilizing AI to create efficiencies and shape decision-making. Examples of in-demand roles include machine learning engineers, business analysts, AI architects, and AI researchers. Their experience in managing data and simulations mirrors that of machine learning development. Chemical engineers also have valuable research experience in complex processes, such as the identification of complex problems and testing hypotheses, troubleshooting tactics, and the analysis of various complex data sets that can be applied outside of the oil and gas industry.

Transition strategy – Chemical Engineers:

Displaced Occupation	“Good Fit” In-demand Occupation (50%+ match)	Skills that Match	Upskilling Needs	Example resources for Upskilling	Duration of resources for upskilling
Chemical Engineer	Data Scientist/Analyst	<ul style="list-style-type: none"> • Knowledge and proficiency with project management practices, including completing feasibility studies, project lifecycles. • Proficiency with Microsoft Office, including creating complex Excel macros. • Proficiency with Matlab. • Strong research skills, including experience conducting complicated technical research. • Experience with process simulation tools like Aspen HYSYS, and basic understanding of machine learning/automation. 	<p>OVERALL NEEDS:</p> <ul style="list-style-type: none"> • Gain a holistic understanding of data science and data analysis <p>SPECIFIC NEEDS:</p> <ul style="list-style-type: none"> • Learn Agile methodology • Become proficient in statistical analysis scripting languages like R • Become proficient in scripting languages like Python or SQL used to analyze unstructured data like videos, pictures, audio files, social media posts, etc. • Become proficient with data visualization tools like Tableau, Microsoft PowerBI, DJ3.js, Node.js 	<p>OVERALL PROGRAMS:</p> <p>DATA SCIENCE/DATA ANALYTICS (OVERALL):</p> <p>University of Calgary: Certificate in Fundamental Data Science & Analytics</p> <p>SAIT: Big Data & Analytics – CMPN 128</p> <p>Bow Valley College: Data Management & Analytics Certificate</p> <p>The Knowledge Academy: Data Science Analytics</p>	<p>OVERALL PROGRAMS:</p> <p>University of Calgary: Certificate in Fundamental Data Science & Analytics: ~3 months (based on taking 4 courses per semester).</p> <p>SAIT: Business Intelligence – Data Analysis & Reporting: ~6 months (based on full course load).</p> <p>Bow Valley College: Certificate in Data Management & Analytics: ~ 6 months (based on full course load).</p> <p>The Knowledge Academy: Course - Data Science Analytics: 1 day (intended as intro course).</p>

Displaced Occupation	"Good Fit" In-demand Occupation (50%+ match)	Skills that Match	Upskilling Needs	Example resources for Upskilling	Duration of resources for upskilling
Chemical Engineer	Data Scientist/ Analyst (Continued)	<ul style="list-style-type: none"> • Knowledge of basic principles of data analytics, with some experience analyzing large data sets. • Basic understanding of automated functions and machine learning. 		<p>SPECIFIC:</p> <p>AGILE:</p> <p>Coursera: Agile Development Specialization</p> <p>University of Calgary: BMC 348 – Agile Project Management (the Basics)</p> <p>R:</p> <p>Accelebrate: Calgary R Training</p> <p>Udemy: R Basics – R Programming Language Introduction</p> <p>PYTHON:</p> <p>SAIT: Python Programming Certificate 1</p> <p>University of Calgary: ICT 781 – Python Level 1</p> <p>SQL:</p> <p>The Knowledge Academy: Introduction to SQL</p> <p>New Horizons Computer Learning Centres: SQL Querying Fundamentals</p> <p>DATA VISUALIZATION:</p> <p>SAIT: Analyzing Data with PowerBI</p> <p>University of Calgary: ICT 774 – Visual Analytics</p>	<p>OVERALL PROGRAMS:</p> <p>SPECIFIC COURSES:</p> <p>AGILE:</p> <p>Coursera: Agile Development Specialization: ~6 months (based on average learners).</p> <p>University of Calgary: BMC 348 – Agile Project Management (the Basics): ~3 months (1 semester).</p> <p>R:</p> <p>Accelebrate: Calgary R Training: ~1.5-2 months (based on average learner for all courses).</p> <p>Udemy: R Basics – R Programming Language Introduction: ~4 hours (based on average learner).</p> <p>PYTHON:</p> <p>SAIT: Python Programming Certificate: ~ 6 months (2 semesters).</p> <p>University of Calgary: ICT 781 – Python Level 1: ~3 months (1 semester).</p> <p>SQL:</p> <p>The Knowledge Academy: Introduction to SQL: 1 day (intended to be an intro course).</p>

Displaced Occupation	"Good Fit" In-demand Occupation (50%+ match)	Skills that Match	Upskilling Needs	Example resources for Upskilling	Duration of resources for upskilling
Chemical Engineer	Data Scientist/Analyst (Continued)				<p>SQL:</p> <p>New Horizons Computer Learning Centres: SQL Querying Fundamentals: 1 day (intended to teach only SQL querying basics).</p> <p>DATA VISUALIZATION:</p> <p>SAIT: Analyzing Data with PowerBI: ~3 months (1 semester).</p> <p>University of Calgary: ICT 774 – Visual Analytics: ~3 months (1 semester).</p>
Chemical Engineer	QA Tester	<ul style="list-style-type: none"> • Basic understanding of automated functions and machine learning. • Strong problem-solving skills and basic knowledge of troubleshooting. • Strong research skills, including experience conducting complicated technical research. 	<p>OVERALL NEEDS:</p> <ul style="list-style-type: none"> • Gain a holistic understanding of quality assurance skills, processes and practices <p>SPECIFIC:</p> <ul style="list-style-type: none"> • Learn Agile methodology • Become familiar with test automation and bug tracking tools like Jira, Wrike, Asana, Selenium • Gain knowledge of version control and database management via tools like MySQL, Oracle, MongoDB 	<p>OVERALL:</p> <p>QA TESTING (OVERALL):</p> <p>Udacity: Software testing</p> <p>The Knowledge Academy: ISTQB – Software Testing Foundation</p> <p>SPECIFIC:</p> <p>AGILE: See above</p> <p>BUG TRACKING & TEST AUTOMATION:</p> <p>Udemy: Bug Tracking with Jira</p> <p>IT Institute of Calgary: Fast Track Test Automation</p>	<p>OVERALL PROGRAMS:</p> <p>Udacity: Software testing course ~1 month (based on average learners).</p> <p>The Knowledge Academy: ISTQB – Software Testing Foundation: 3 days (intended to be an intro course).</p> <p>SPECIFIC COURSES:</p> <p>AGILE:</p> <p>Coursera: Agile Development Specialization: ~6 months (based on average learners).</p>

Displaced Occupation	"Good Fit" In-demand Occupation (50%+ match)	Skills that Match	Upskilling Needs	Example resources for Upskilling	Duration of resources for upskilling
Chemical Engineer	QA Tester			<p>VERSION CONTROL:</p> <p>Coursera: Version Control with Git</p> <p>Lyda.com: Software version control</p> <p>DATABASE MANAGEMENT:</p> <p>SAIT: Database Administrator Certificate</p>	<p>AGILE:</p> <p>University of Calgary: BMC 348 – Agile Project Management (the Basics): ~3 months (1 semester).</p> <p>BUG TRACKING & TEST AUTOMATION:</p> <p>Udemy: Bug Tracking with Jira: ~7 hours (based on average learner).</p> <p>IT Institute of Calgary: Fast Track Test Automation: ~2 months (1 day/week).</p> <p>VERSION CONTROL:</p> <p>Coursera: Version Control with Git: ~ 1 month (based on average learner).</p> <p>Lyda.com: Software version control: ~5-6 hours (based on average learner).</p> <p>DATABASE MANAGEMENT:</p> <p>University of Calgary: BMC 348 – Agile Project Management (the Basics): ~3 months (1 semester).</p>



Displaced Occupation	"Good Fit" In-demand Occupation (50%+ match)	Skills that Match	Upskilling Needs	Example resources for Upskilling	Duration of resources for upskilling
Chemical Engineer	QA Tester				<p>BUG TRACKING & TEST AUTOMATION:</p> <p>Udemy: Bug Tracking with Jira: ~7 hours (based on average learner).</p> <p>IT Institute of Calgary: Fast Track Test Automation: ~2 months (1 day/week).</p> <p>VERSION CONTROL:</p> <p>Coursera: Version Control with Git: ~ 1 month (based on average learner).</p> <p>Lyda.com: Software version control: ~5-6 hours (based on average learner).</p> <p>DATABASE MANAGEMENT:</p> <p>SAIT: Database Administrator Certificate: ~9 months (3 semesters).</p>
Chemical Engineer	Project Manager	<ul style="list-style-type: none"> Strong project management skills, with knowledge of the project lifecycle. Strong management skills, including management of staff. 	<ul style="list-style-type: none"> Obtain a PMP certificate 	<p>PMP CERTIFICATE:</p> <p>Mount Royal University: PMP Certificate</p> <p>University of Calgary: Project Management Fundamentals Certificate</p> <p>SAIT: Applied Project Management Certificate</p>	<p>Mount Royal University: PMP Certificate: 136 hours (max duration is 3 years).</p> <p>University of Calgary: Project Management Fundamentals Certificate: ~2 years (based on 1-2 courses per term; can be completed faster if more courses are taken).</p>

Displaced Occupation	"Good Fit" In-demand Occupation (50%+ match)	Skills that Match	Upskilling Needs	Example resources for Upskilling	Duration of resources for upskilling
Chemical Engineer	Project Manager (Continued)				SAIT: Applied Project Management Certificate: 144 hours (1-2 years on average).

Source: ICTC, 2018.

Petroleum Engineer:

General skills

- Direct and monitor the completion and evaluation of wells, well testing and well surveys.
- Analyze reservoir rock and fluid data to design optimum recovery methods and to predict reservoir performance and reserves.
- Analyze reservoir rock and fluid data to design optimum recovery methods and to predict reservoir performance and reserves.

Similar to chemical engineers, petroleum engineers' experience in simulation also positions them for opportunities in the data sciences, and again in particular AI and machine learning algorithms. Their experience in managing data and simulations mirrors that of machine learning development. Petroleum engineers also have valuable research experience in complex processes that can be applied outside of the oil and gas industry.

Transition strategy – Petroleum Engineers:

Displaced Occupation	"Good Fit" In-demand Occupation (50%+ match)	Skills that Match	Upskilling Needs	Example resources for Upskilling	Duration of resources for upskilling
Petroleum Engineer	Data Scientist/ Analyst	<ul style="list-style-type: none"> Strong project management skills. Strong problem-solving skills, with the ability to quickly respond to challenges. Proficiency with Microsoft Office, including Excel. Experience with reservoir modeling and process simulation, including software like Petrel. Proficiency with Matlab, with some basic knowledge of R. Basic knowledge of data analysis principles and practices. Strong research skills, including proficiency using research to put forward Recommendations for policy or practices. 	<p>OVERALL:</p> <ul style="list-style-type: none"> Gain a holistic understanding of data science and data analysis <p>SPECIFIC:</p> <ul style="list-style-type: none"> Learn Agile methodology Become proficient in scripting languages like Python, SQL or Scala used to analyze unstructured data like videos, pictures, audio files, social media posts, etc. Become knowledgeable with Python panda tables for plotting data Become proficient with Machine Learning processes and logic Become proficient with natural language processing Become proficient with data visualization tools like Tableau, Microsoft PowerBI, DJ3.js, Node.js 	<p>OVERALL:</p> <p>DATA SCIENCE/DATA ANALYTICS (OVERALL):</p> <p>University of Calgary: Certificate in Fundamental Data Science & Analytics</p> <p>SAIT: Big Data & Analytics – CMPN 128</p> <p>Bow Valley College: Data Management & Analytics Certificate</p> <p>The Knowledge Academy: Data Science Analytics</p> <p>SPECIFIC:</p> <p>AGILE:</p> <p>Coursera: Agile Development Specialization</p> <p>University of Calgary: BMC 348 – Agile Project Management (the Basics)</p> <p>PYTHON:</p> <p>SAIT: Python Programming Certificate</p> <p>University of Calgary: ICT 781 – Python Level 1</p> <p>SQL:</p> <p>The Knowledge Academy: Introduction to SQL</p> <p>New Horizons Computer Learning Centres: SQL Querying Fundamentals</p>	<p>OVERALL PROGRAMS:</p> <p>University of Calgary: Certificate in Fundamental Data Science & Analytics: ~3 months (based on taking 4 courses per semester).</p> <p>SAIT: Business Intelligence – Data Analysis & Reporting: ~6 months (based on full course load).</p> <p>Bow Valley College: Certificate in Data Management & Analytics: ~ 6 months (based on full course load).</p> <p>The Knowledge Academy: Course - Data Science Analytics: 1 day (intended as intro course).</p> <p>SPECIFIC COURSES:</p> <p>AGILE:</p> <p>Coursera: Agile Development Specialization: ~6 months (based on average learners).</p> <p>University of Calgary: BMC 348 – Agile Project Management (the Basics): ~3 months (1 semester).</p>

Displaced Occupation	"Good Fit" In-demand Occupation (50%+ match)	Skills that Match	Upskilling Needs	Example resources for Upskilling	Duration of resource for upskilling
Petroleum Engineer	Data Scientist/Analyst			<p>SCALA:</p> <p>Courseera: Functional Programming Principles in Scala</p> <p>Udemy: Beginning Scala Programming</p> <p>PYTHON PANDA: Panda tutorials</p> <p>DataCamp: Pandas Tutorials – DataFrames in Python</p> <p>MACHINE LEARNING:</p> <p>edX: Machine Learning for Data Science & Analytics</p> <p>NATURAL LANGUAGE PROCESSING:</p> <p>The Knowledge Academy: NLP Foundation Course</p> <p>DATA VISUALIZATION:</p> <p>SAIT: Analyzing Data with PowerBI</p> <p>University of Calgary: ICT 774 – Visual Analytics</p>	<p>PYTHON:</p> <p>SAIT: Python Programming Certificate: ~ 6 months (2 semesters).</p> <p>University of Calgary: ICT 781 – Python Level 1: ~3 months (1 semester).</p> <p>SQL:</p> <p>The Knowledge Academy: Introduction to SQL: 1 day (intended to be an intro course).</p> <p>New Horizons Computer Learning Centres: SQL Querying Fundamentals: 1 day (intended to teach only SQL querying basics).</p> <p>SCALA:</p> <p>Courseera: Functional Programming Principles in Scala: ~4 weeks (based on average learner).</p> <p>Udemy: Beginning Scala Programming: ~5 hours (intended to be an intro course).</p> <p>PYTHON PANDA: Panda tutorials: Undetermined (self-learning based on 9 chapters of reading materials, 11 lessons, and 10 exercises).</p> <p>DataCamp: Pandas Tutorials – DataFrames in Python: Undetermined (self-learning based on 11 lessons).</p>

Displaced Occupation	"Good Fit" In-demand Occupation (50%+ match)	Skills that Match	Upskilling Needs	Example resources for Upskilling	Duration of resource for upskilling
Petroleum Engineer (Continued)	Data Scientist/ Analyst (Continued)				<p>MACHINE LEARNING:</p> <p>edX: Machine Learning for Data Science & Analytics: ~5 weeks (based on 7-10 hours per week).</p>
					<p>NLP:</p> <p>The Knowledge Academy: NLP Foundation Course: 2 days (intended as an intro course).</p> <p>DATA VISUALIZATION:</p> <p>SAIT: Analyzing Data with PowerBI: ~3 months (1 semester).</p> <p>University of Calgary: ICT 774 – Visual Analytics: ~3 months (1 semester).</p>
Petroleum Engineer	QA Tester	<ul style="list-style-type: none"> • Strong project management skills. • Strong problem-solving skills, with the ability to quickly respond to challenges. • Experience with reservoir modeling and process simulation, including software like Petrel and Aspen HYSYS. 	<p>OVERALL:</p> <ul style="list-style-type: none"> • Gain a holistic understanding of quality assurance skills, processes and practices <p>SPECIFIC:</p> <ul style="list-style-type: none"> • Learn Agile methodology • Become familiar with test automation and bug tracking tools like Jira, Wrike, Asana, Selenium 	<p>OVERALL:</p> <p>QA TESTING (OVERALL):</p> <p>Udacity: Software testing</p> <p>The Knowledge Academy: ISTQB – Software Testing Foundation</p>	<p>OVERALL PROGRAMS:</p> <p>Udacity: Software testing course ~1 month (based on average learners).</p> <p>The Knowledge Academy: ISTQB – Software Testing Foundation: 3 days (intended to be an intro course).</p>

Displaced Occupation	"Good Fit" In-demand Occupation (50%+ match)	Skills that Match	Upskilling Needs	Example resources for Upskilling	Duration of resource for upskilling
		<ul style="list-style-type: none"> Strong research skills, including proficiency using research to put forward recommendations for policy or practices. 	<p>SPECIFIC:</p> <ul style="list-style-type: none"> Become proficient with continuous integration principles Learn modern software languages like Javascript, CSS, HTML 	<p>SPECIFIC:</p> <p>AGILE: See above</p> <p>CONTINUOUS INTEGRATION: Trainup.com: Continuous integration boot camp</p> <p>TESTING LANGUAGES:</p> <p>SAIT: Introduction to JavaScript and jQuery – CMPP 257</p>	<p>SPECIFIC COURSES:</p> <p>AGILE:</p> <p>Coursera: Agile Development Specialization: ~6 months (based on average learners).</p>
Petroleum Engineer	QA Tester			<p>University of Calgary: ICT 580 HTML5 and CSS3</p>	<p>University of Calgary: BMC 348 – Agile Project Management (the Basics): ~3 months (1 semester).</p> <p>CONTINUOUS INTEGRATION:</p> <p>Trainup.com Continuous integration boot camp: 3 days (meant to be an intro course).</p> <p>TESTING LANGUAGES:</p> <p>SAIT: Introduction to JavaScript and jQuery – CMPP 257: ~2 months (based on average learner).</p> <p>University of Calgary: ICT 580 HTML5 and CSS3: ~4 months (1 semester).</p>

Source: ICTC, 2018.

Engineering Manager:
General Skills

- Oversee the analysis of data and information.
- Consult and advise clients on best practices and business solutions.
- Advise senior management on solutions to problems and business practices.
- Plan, organize, direct, control and evaluate daily engineering operations.

Engineering managers have skills that position them well for management positions outside of the oil & gas industry. They are well matched for emerging automated manufacturing plants as they are deeply experienced in the management and monitoring of highly automated processes. Additionally, engineering managers have strong management skills, which position them well for project management opportunities. Lastly, with six sigma certifications, many engineering managers also possess an understanding of defect detection, similar to bug tracking in QA roles.

Transition strategy – Engineering Managers:

Displaced Occupation	“Good Fit” In-demand Occupation (50%+ match)	Skills that Match	Upskilling Needs	Example resources for Upskilling	Duration of resource for upskilling
Engineering Manager	QA Tester	<ul style="list-style-type: none"> • Strong project management skills and knowledge of project management procedures. • Strong project planning skills and time management capabilities. 	<p>OVERALL:</p> <ul style="list-style-type: none"> • Gain a holistic understanding of quality assurance skills, processes and practices <p>SPECIFIC:</p> <ul style="list-style-type: none"> • Learn Agile methodology 	<p>OVERALL: QA TESTING (OVERALL):</p> <p>Udacity: Software testing</p> <p>NAIT: Software Testing Certificate</p>	<p>OVERALL PROGRAMS:</p> <p>Udacity: Software testing course ~1 month (based on average learners).</p>

Displaced Occupation	"Good Fit" In-demand Occupation (50%+ match)	Skills that Match	Upskilling Needs	Example resources for Upskilling	Duration of resource for upskilling
		<ul style="list-style-type: none"> • Lean manufacturing (waste reduction in manufacturing) knowledge. • Proficiency with industrial control systems, including proficiency with SCADA. • Six Sigma certification, with strong ability to identify errors or defects in a process and eliminate them. 	<ul style="list-style-type: none"> • Become familiar with test automation and bug tracking tools like Jira, Wrike, Asana, Selenium • Gain knowledge of version control and test automation via tools like MySQL, Oracle, MongoDB • Become proficient with continuous integration principles • Learn modern software languages like Javascript, CSS, HTML 	<p>The Knowledge Academy: ISTQB – Software Testing Foundation</p> <p>SPECIFIC:</p> <p>AGILE: Coursera: Agile Development Specialization</p> <p>University of Calgary: BMC 348 – Agile Project Management (the Basics)</p> <p>BUG TRACKING & TEST AUTOMATION: Udemy: Bug Tracking with Jira</p> <p>IT Institute of Calgary: Fast Track Test Automation</p> <p>CONTINUOUS INTEGRATION: Trainup.com: Continuous integration boot camp</p> <p>TESTING LANGUAGES: SAIT: Introduction to JavaScript and jQuery – CMPP 257</p> <p>University of Calgary: ICT 580 HTML5 and CSS3</p>	<p>The Knowledge Academy: ISTQB – Software Testing Foundation: 3 days (intended to be an intro course).</p> <p>SPECIFIC COURSES:</p> <p>AGILE: Coursera: Agile Development Specialization: ~6 months (based on average learners).</p> <p>University of Calgary: BMC 348 – Agile Project Management (the Basics): ~3 months (1 semester).</p> <p>BUG TRACKING & TEST AUTOMATION: Udemy: Bug Tracking with Jira: ~7 hours (based on average learner).</p> <p>IT Institute of Calgary: Fast Track Test Automation: ~2 months (1 day/week).</p>
Engineering Manager	QA Tester				<p>CONTINUOUS INTEGRATION: Trainup.com: Continuous integration boot camp: 3 days (meant to be an intro course).</p> <p>TESTING LANGUAGES: SAIT: Introduction to JavaScript and jQuery – CMPP 257: ~2 months (based on average learner).</p>

Displaced Occupation	"Good Fit" In-demand Occupation (50%+ match)	Skills that Match	Upskilling Needs	Example resources for Upskilling	Duration of resource for upskilling
Engineering Manager (Continued)	QA Tester (Continued)				University of Calgary: ICT 580 HTML5 and CSS3: ~4 months (1 semester).
Engineering Manager (Continued)	Project Manager	<ul style="list-style-type: none"> • Strong project management skills and knowledge of project management procedures. • Strong project planning skills and time management capabilities. • Strong management skills, including management of staff. • Some knowledge of business development practices and experience with sales (specifically related to the industry). • Six Sigma certification, with strong ability to identify errors or defects in a process and eliminate them. • PMP certification. 	Complete project management courses with ICT focus	<p>IT PROJECT MANAGEMENT:</p> <p>Coursera: IT Project Management</p> <p>American Management Association: Technical Project Management</p> <p>Lynda.com: Project Management – Technical Projects</p>	<p>Coursera: IT Project Management: ~4 weeks (based on the average learner).</p> <p>American Management Association: Technical Project Management: 3 days (intended as an intro course).</p> <p>Lynda.com: Project Management – Technical Projects: 1h 20 mins (online lectures).</p>

Source: ICTC, 2018.

Electrical Engineer: General skills

- Conduct research into the feasibility, design, operation and performance of electrical generation and distribution networks, electrical machinery and components and electronic communications, instrumentation and control systems, equipment, and components.
- Prepare material cost and timing estimates, reports and design specifications for electrical and electronic systems and equipment.
- Design electrical and electronic circuits, components, systems and equipment.
- Supervise and inspect the installation, modification, testing and operation of electrical and electronic systems and equipment.

- Develop maintenance and operating standards for electrical and electronic systems and equipment.
- Investigate electrical or electronic failures.
- Prepare contract documents and evaluate tenders for construction or maintenance.
- Supervise technicians, technologists, programmers, analysts, and other engineers.

Electrical engineers have various skills that position them well for digital economy positions outside of the oil & gas industry. They are well matched for Data Science, Software development and QA roles. Many also have significant project management capabilities.

Transition strategy – Electrical Engineers:

Displaced Occupation	“Good Fit” In-demand Occupation (50%+ match)	Skills that Match	Upskilling Needs	Example resources for Upskilling	Duration of resource for upskilling
Electrical Engineer	Data Scientist/ Analyst	<ul style="list-style-type: none"> • Knowledge and proficiency with project management practices, including completing feasibility studies, project lifecycles. • Proficiency with Microsoft Office, including creating complex Excel macros. • Proficiency with Matlab and Simulink. • Strong research skills, including experience conducting complicated technical research. • Experience with simulation & modelling tools like Verilog, and basic understanding of machine learning/automation. • Knowledge of basic principles of data analytics, with some experience analyzing large data sets. 	<p>OVERALL:</p> <ul style="list-style-type: none"> • Gain a holistic understanding of data science and data analysis <p>SPECIFIC:</p> <ul style="list-style-type: none"> • Learn Agile methodology • Become proficient in statistical analysis scripting languages like R • Become proficient in scripting languages like Python or SQL used to analyze unstructured data like videos, pictures, audio files, social media posts, etc. • Become proficient with data visualization tools like Tableau, Microsoft PowerBI, DJ3.js, Node.js 	<p>OVERALL:</p> <p>DATA SCIENCE/DATA ANALYTICS (OVERALL):</p> <p>University of Calgary: Certificate in Fundamental Data Science & Analytics</p> <p>SAIT: Big Data & Analytics – CMPN 128</p> <p>Bow Valley College: Data Management & Analytics Certificate</p> <p>The Knowledge Academy: Data Science Analytics</p> <p>SPECIFIC</p> <p>AGILE:</p> <p>Coursera: Agile Development Specialization</p> <p>University of Calgary: BMC 348 – Agile Project Management (the Basics)</p> <p>R:</p> <p>Accelebrate: Calgary R Training</p>	<p>OVERALL PROGRAMS:</p> <p>University of Calgary: Certificate in Fundamental Data Science & Analytics: ~3 months (based on taking 4 courses per semester).</p> <p>SAIT: Business Intelligence – Data Analysis & Reporting: ~6 months (based on full course load).</p> <p>Bow Valley College: Certificate in Data Management & Analytics: ~ 6 months (based on full course load).</p> <p>The Knowledge Academy: Course - Data Science Analytics: 1 day (intended as intro course).</p>

Displaced Occupation	"Good Fit" In-demand Occupation (50%+ match)	Skills that Match	Upskilling Needs	Example resources for Upskilling	Duration of resource for upskilling
Electrical Engineer (Continued)	Data Scientist/Analyst (Continued)			<p>Udemy: R Basics – R Programming Language Introduction</p> <p>PYTHON: SAIT: Python Programming Certificate</p> <p>University of Calgary: ICT 781 – Python Level 1</p> <p>SQL: The Knowledge Academy: Introduction to SQL</p> <p>New Horizons Computer Learning Centres: SQL Querying Fundamentals</p> <p>DATA VISUALIZATION: SAIT: Analyzing Data with PowerBI</p> <p>University of Calgary: ICT 774 – Visual Analytics</p>	<p>SPECIFIC COURSES:</p> <p>AGILE: Courseera: Agile Development Specialization: ~6 months (based on average learners).</p> <p>University of Calgary: Calgary: BMC 348 – Agile Project Management (the Basics): ~3 months (1 semester).</p> <p>R: Accelebrate: Calgary R Training: ~1.5-2 months (based on average learner for all courses).</p> <p>Udemy: R Basics – R Programming Language Introduction: ~4 hours (based on average learner).</p> <p>PYTHON: SAIT: Python Programming Certificate: ~ 6 months (2 semesters).</p> <p>University of Calgary: Calgary: ICT 781 – Python Level 1: ~3 months (1 semester).</p> <p>SQL: The Knowledge Academy: Introduction to SQL: 1 day (intended to be an intro course).</p> <p>New Horizons Computer Learning Centres: SQL Querying Fundamentals: 1 day (intended to teach only SQL querying basics).</p>

Displaced Occupation	"Good Fit" In-demand Occupation (50%+ match)	Skills that Match	Upskilling Needs	Example resources for Upskilling	Duration of resource for upskilling
Electrical Engineer (Continued)	Data Scientist/ Analyst (Continued)				<p>DATA VISUALIZATION:</p> <p>SAIT: Analyzing Data with PowerBI: ~3 months (1 semester).</p> <p>University of Calgary: ICT 774 – Visual Analytics: ~3 months (1 semester).</p>
Electrical Engineer	Software Engineer/ Developer	<ul style="list-style-type: none"> Experience programming in Assembler and C/C++. Knowledge and proficiency with project management practices, including completing feasibility studies, project lifecycles. Proficiency in CAD and PCB tools. Strong research skills, including experience conducting complicated technical research. Experience with simulation & modelling tools like Verilog, and basic understanding of machine learning/automation. 	<p>OVERALL:</p> <ul style="list-style-type: none"> Gain a holistic understanding of software development practices, processes and tools. <p>SPECIFIC:</p> <ul style="list-style-type: none"> Learn Agile methodology Become proficient with cloud computing platforms such as AWS, Microsoft Azure, Google Cloud, IBM Bluemix. Become proficient in a variety of modern programming languages such as Python, SQL, Ruby on Rails. Become proficient with build automation & continuous integration tools like Jenkins, CircleCI, Bamboo, Apache Maven. 	<p>OVERALL:</p> <p>SOFTWARE DEVELOPMENT (OVERALL):</p> <p>Lighthouse Labs: Web development bootcamp</p> <p>University of Calgary: Certificate in IT Fundamentals</p> <p>SAIT: Object-Oriented Software Development Certificate</p> <p>Bow Valley College: Software Development Post-diploma Certificate</p> <p>SPECIFIC AGILE:</p> <p>COURSERA: Agile Development Specialization</p> <p>University of Calgary: BMC 348 – Agile Project Management (the Basics)</p>	<p>OVERALL PROGRAMS:</p> <p>Lighthouse Labs: Web development bootcamp: 10 weeks (mandatory 40h+ weeks).</p> <p>University of Calgary: Certificate in IT Fundamentals: ~1 year (based on the average learner).</p> <p>SAIT: Object-Oriented Software Development Certificate: ~8 months (based on the average learner).</p> <p>Bow Valley College: Software Development Post-diploma certificate: ~1 year (based on the average learner).</p> <p>SPECIFIC COURSES:</p> <p>AGILE:</p> <p>Coursera: Agile Development Specialization: ~6 months (based on average learners).</p>

Displaced Occupation	"Good Fit" In-demand Occupation (50%+ match)	Skills that Match	Upskilling Needs	Example resources for Upskilling	Duration of resource for upskilling
Electrical Engineer (Continued)	Software Engineer/ Developer (Continued)		<ul style="list-style-type: none"> Become proficient with version control/continuous integration tools like Helix Core, GitHub, Apache Subversion, Mercurial, and Plastic SCM. Gain experience related to building and using APIs 	<p>CLOUD COMPUTING: Innotech College: Cloud Security Certification</p> <p>Evergreen College: Cybersecurity & Cloud Computing Diploma</p> <p>AWS Certification</p> <p>PYTHON : SAIT: Python Programming Certificate</p> <p>University of Calgary: ICT 781 – Python Level 1</p> <p>SQL: The Knowledge Academy: Introduction to SQL</p> <p>New Horizons Computer Learning Centres: SQL Querying Fundamentals</p> <p>RUBY ON RAILS: CodeCore: Full-stack Bootcamp</p> <p>Noble Prog: Developing Web Applications with Ruby on Rails</p> <p>BUILD AUTOMATION & CONTINUOUS INTEGRATION: Accelerbrate: Continuous Integration with Maven, Jenkins, and Artifactory</p> <p>Udemy: Learning Apache Maven</p>	<p>University of Calgary: BMC 348 – Agile Project Management (the Basics): ~3 months (1 semester).</p> <p>CLOUD COMPUTING: Innotech College: Cloud Security Certification: 5 days (intended as an intro course).</p> <p>Evergreen College: Cybersecurity & Cloud Computing Diploma: ~2 years (based on the average learner).</p> <p>AWS Certification: ~3 months (based on the average learner).</p> <p>PYTHON: SAIT: Python Programming Certificate: ~ 6 months (2 semesters).</p> <p>University of Calgary: ICT 781 – Python Level 1: ~3 months (1 semester).</p> <p>SQL: The Knowledge Academy: Introduction to SQL: 1 day (intended to be an intro course).</p> <p>New Horizons Computer Learning Centres: SQL Querying Fundamentals: 1 day (intended to teach only SQL querying basics).</p>

Displaced Occupation	"Good Fit" In-demand Occupation (50%+ match)	Skills that Match	Upskilling Needs	Example resources for Upskilling	Duration of resource for upskilling
Electrical Engineer (Continued)	Software Engineer/ Developer (Continued)			<p>VERSION CONTROL:</p> <p>Courseera: Version Control with Git</p> <p>Lyda.com: Software version control</p> <p>APIs:</p> <p>Udemy: APIs: Crash Course</p>	<p>RUBY:</p> <p>CodeCore: Full-stack Bootcamp: ~3 months (based on the average learner).</p> <p>Noble Prog: Developing Web Applications with Ruby on Rails: ~5 days.</p> <p>BUILD AUTOMATION & CONTINUOUS INTEGRATION:</p> <p>Accelebrate: Continuous Integration with Maven, Jenkins, and Artifactory: ~3 days (based on the average learner).</p> <p>Udemy: Learning Apache Maven: ~5 hours (intended as an intro course).</p> <p>VERSION CONTROL:</p> <p>Courseera: Version Control with Git: ~ 1 month (based on average learner).</p> <p>Lyda.com: Software version control: ~5-6 hours (based on average learner).</p> <p>APIs:</p> <p>Udemy: APIs: Crash Course: ~2 hours (intended as an intro course).</p>

Displaced Occupation	"Good Fit" In-demand Occupation (50%+ match)	Skills that Match	Upskilling Needs	Example resources for Upskilling	Duration of resource for upskilling
Electrical Engineer	QA Tester	<ul style="list-style-type: none"> Experience with simulation & modelling tools like Verilog, and basic understanding of machine learning/automation Strong problem-solving skills and basic knowledge of troubleshooting. Strong research skills, including experience conducting complicated technical research. Knowledge of source management tools like Git and Team Foundation. 	<p>OVERALL:</p> <ul style="list-style-type: none"> Gain a holistic understanding of quality assurance skills, processes and practices <p>SPECIFIC:</p> <ul style="list-style-type: none"> Learn Agile methodology Become familiar with test automation and bug tracking tools like Jira, Wrike, Asana, Selenium Gain knowledge of version control and database management via tools like MySQL, Oracle, MongoDB 	<p>OVERALL:</p> <p>QA Testing (overall):</p> <p>Udacity: Software testing</p> <p>The Knowledge Academy: ISTQB – Software Testing Foundation</p> <p>SPECIFIC:</p> <p>AGILE: See above</p> <p>BUG TRACKING & TEST AUTOMATION:</p> <p>Udemy: Bug Tracking with Jira</p> <p>IT Institute of Calgary: Fast Track Test Automation</p> <p>VERSION CONTROL:</p> <p>Coursera: Version Control with Git</p> <p>Lyda.com: Software version control</p> <p>DATABASE MANAGEMENT:</p> <p>SAIT: Database Administrator Certificate</p>	<p>OVERALL PROGRAMS:</p> <p>Udacity: Software testing course ~1 month (based on average learners).</p> <p>The Knowledge Academy: ISTQB – Software Testing Foundation: 3 days (intended to be an intro course).</p> <p>SPECIFIC COURSES:</p> <p>AGILE:</p> <p>Coursera: Agile Development Specialization: ~6 months (based on average learners).</p> <p>University of Calgary: BMC 348 – Agile Project Management (the Basics): ~3 months (1 semester).</p> <p>BUG TRACKING & TEST AUTOMATION:</p> <p>Udemy: Bug Tracking with Jira: ~7 hours (based on average learner).</p> <p>IT Institute of Calgary: Fast Track Test Automation: ~2 months (1 day/week).</p> <p>VERSION CONTROL:</p> <p>Coursera: Version Control with Git: ~ 1 month (based on average learner).</p>

Displaced Occupation	"Good Fit" In-demand Occupation (50%+ match)	Skills that Match	Upskilling Needs	Example resources for Upskilling	Duration of resource for upskilling
Electrical Engineer (Continued)	QA Tester (Continued)				<p>VERSION CONTROL (CONTINUED):</p> <p>Lyda.com: Software version control: ~5-6 hours (based on average learner).</p> <p>DATABASE MANAGEMENT:</p> <p>SAIT: Database Administrator Certificate: ~9 months (3 semesters).</p>

Source: ICTC, 2018.

Part three:

Challenges for transitioning workers

Problems with cultural fit

Despite the higher presence of workers with STEM backgrounds in Calgary in comparison to many other Canadian cities, the process of transitioning displaced workers with technical backgrounds from the energy sector into the high-tech sector is challenging.

Tech employers noted that one of the major challenges for displaced energy sector workers relates to culture. Specifically, they referenced the distinct lack of *cultural fit* and the different working styles of these displaced workers as a significant barrier. Some of the challenges to cultural fit are tied to the following features:

1. Hierarchical workplace structure of engineering companies (top-down leadership, clearly defined roles and responsibilities);
2. Process-driven task completion (clearly defined processes to complete tasks; lack of flexibility to change processes; lack of collaboration across company lines for development of new methods/practices);
3. Compartmentalized (or niche) competencies and skillsets of workers from this sector (workers with very specific – though technical – skillsets, used to doing a specific job; difficulty of workers to extend beyond immediate job requirements).
4. Regimented work structure and workdays

The initial perception of many technology companies was that these factors presented considerable limitations to the transferability of these workers to in-demand jobs in tech. With tech companies often being more focused on collaboration, teamwork and collective problem-solving, many tech employers noted that they were looking for employees who are flexible, self-motivated, open to change and able to “wear different hats” (complete a variety of different tasks).

As a result of these perceptions, the sourcing of talent from this demographic was relatively low among tech companies. While more than half of tech companies stated hiring these workers at some point, they were not a frequently-accepted source of talent, with hiring taking place about 5-10% of the time.

Tech employers’ perceptions: broadening the lens

Offering a different perspective, employment and HR agencies expressed the possibility of a bias when it comes to companies from other sectors considering employees from the energy sector – particularly oil and gas. Here, the employment agencies noted that several of their clients had or were in the process of taking skill upgrading courses in relevant areas and were very willing to transition to other opportunities. Yet, despite these efforts, many of them did not receive invitations for interviews when applying to tech roles.

Additionally, although many engineers would have likely been trained under waterfall methodology, the notion that there cannot be a crosswalk from waterfall to agile is a bit of a

misnomer. The strengths of waterfall rest in its superior management capabilities and its comprehensive documentation and process mapping skills. These strengths were specifically referenced by HR organizations as valuable assets, suggesting that technology companies may in fact benefit from workers with experience in management and meticulous documentation of changes – particularly for roles like QA analysts.

Lack of on-the-job skill upgrading and training

Investing in training is key to ensuring that employees possess the skills they need to remain successful not only in their current roles, but to become adaptable to changes in occupational needs, and trends in the marketplace.

Our research found that nearly one quarter of employers in Calgary do not offer training programs and services to their employees. Another interesting distinction that is notable for this study are the trends associated with training programs offered by technology employers vs. employers in the energy sector. While fewer than 20% of tech employers in Calgary stated that they did *not* offer training opportunities for their employees, 47% of employers in the energy sector reported not offering training opportunities for staff.

Employers offering training opportunities: technology vs. energy employers



Source: ICTC, 2018 (64 responses, 49 responses).

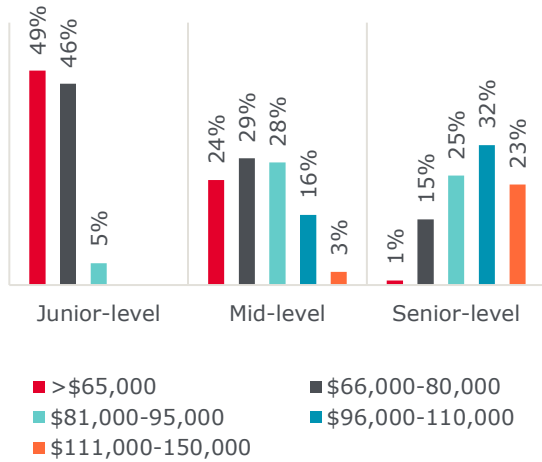
Salary levels of displaced oil and gas workers as a barrier for entry into Tech

One of the most significant barriers to transitioning from oil and gas to tech was salaries – that is, the higher than average salaries of former oil and gas employees vs. other sectors of the economy.

During the course of consultations with tech employers, the high salaries of the oil and gas sector were confirmed to be a significant deterring factor for both employers seeking to hire

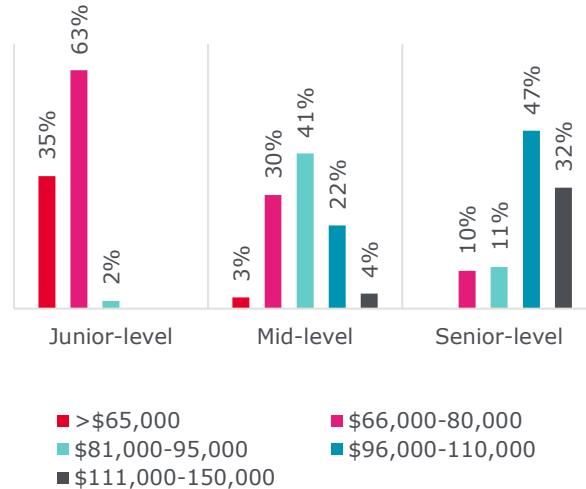
transitional workers, as well as transitional workers looking for new opportunities. As one tech employer put it: "some of these people are used to making \$150,000 a year – it's a hard sell to go from that to maybe \$70,000 as a junior developer."

Average salaries - technology sector



Source: ICTC, 2018 (154 responses).

Average salaries - energy sector



Source: ICTC, 2018 (154 responses).

However, while salaries were underlined as a challenge by employers, in speaking with HR agencies and even workers who have actually made the transition themselves, many have suggested that this is not a consistent challenge – that is, some workers will be dissuaded by the lower initial salaries on their journey to transition. Yet, it is also unlikely that those who are not willing to accept a lower initial salary are truly fully *committed* to transitioning.

Two workers who had made the transition themselves both stated that they took a substantial pay-cut to do so at the beginning – each citing a pay reduction of about 30% from their jobs in the oil and gas sector to their first jobs in the technology sector. However, both workers were also *committed* to the change and understood that an initial pay-cut would be part of the sacrifice, but that it would not remain a constant reality. One worker specifically highlighted that while the pay-cut was substantial upon first transitioning, he was able to move up rather quickly in the organization and eventually make a salary similar to the one he had at his oil and gas job.

The importance of "selling yourself": marketability of oil and gas workers

One last significant challenge found for energy workers was their ability to "sell themselves" and accentuate the skills that they did actually have, which may be relevant to technology companies. One HR agency specifically identified that some oil and gas workers actually began to *dilute* the detail of their resumes and exclude specific terminology and practices related to oil and gas – they did so on the assumption that employers from other sectors like technology may be more open to considering them if they changed their "brand" away from one directly associated with oil and gas. However, in the process, the HR agency noted

that these candidates inadvertently also removed some useful details from their previous jobs that may catch the eye of hiring companies. These include details related to their project management, time management, problem-solving or stakeholder management skills.

Part four:

Next steps – facilitating the crosswalk between displaced occupations and in-demand jobs in Tech

The opportunity

While not without hurdles, there are certainly opportunities for displaced workers from sectors like oil and gas to transition into in-demand jobs in high growth sectors like tech. However, ultimately the ease with which this transition can take place is dependent on a two-fold effort. First, the effort must be made on behalf of the job seeker to understand that the transition may not be easy, and in some cases, it may even mean “starting from scratch”. This is something that can come with the need to gain new and very different skills, work within new and very different environments, and even accept pay reductions.

The same type of understanding and flexibility must also be shown by tech employers. Whether this flexibility means understanding that transitioning workers have different but relevant skills, or even simply choosing to consider candidates who come from outside of the common supply streams for tech jobs. Doing so can not only help fill jobs for which there is insufficient local supply, but can also enrich the culture and diversity of many tech organizations.

Connecting Calgarians to in-demand jobs in Tech: skill mapping web platform

Stemming from the results of this study, ICTC in partnership with the Calgary Economic Development will be creating a web platform that provides pathways for transition to displaced workers seeking opportunities in the tech sector. Set to be released by March 2019, the web platform will offer job seekers the opportunity to compare the skills that they have with the necessary skills for in-demand jobs in the technology sector. By clearly stipulating the critical skills for each in-demand job, users will have the opportunity to understand the “match” between key displaced occupations and in-demand jobs. At the same time, the platform will clearly articulate the pathways for transition, showing job-seekers not only which skills they will need to gain to be considered for certain roles, but where they can go to gain those skills – that is, which short-duration training courses are available and useful to obtain those skills.

This web platform will act as a basis to fill the gap for displaced workers who want to transition into new opportunities in the tech sector, but are not quite sure of how to do so. Moreover, it can help tech employers get a more robust glimpse into the skills and competencies that displaced workers already possess which may be relevant for in-demand roles at their companies.

Conclusion

Given the global headwinds of change, the energy sector in Calgary has experienced a decline in the last number of years. In some cases, this decline has led to the tightening of resources for many of the city's biggest employers and as a result, significant job loss for a number of workers. Although Calgary's economy experienced a rebound in 2017, many are finding that the recent downturn has reshaped the needs of the economy as a whole. Forced to do more with less, many employers in the energy sector today are considering the potential of technological advancements to revamp the sector, create efficiencies, and improve productivity. In short, this means "different jobs, new skills, and a changed industry"³⁰. Digital skills are increasingly playing a significant role in Calgary across sectors, and will continue to be a determining factor in maintaining the strength of the economy.

Shaping the workforce of the future is a multi-layered process, with many different moving parts and considerations. It is now more imperative than ever to understand not only which skills are in demand when it comes to top occupations, but to design and shape the pathways that workers can use to gain those skills. Calgary has a wealth of highly-skilled talent with backgrounds in Engineering or Science, many of whom found themselves displaced following the economic downturn of 2015. As a result, these workers are seeking pathways to transition into new in-demand occupations in tech.

Increasingly, employers will need to look to all supply streams to meet industry demand, including traditionally underrepresented groups like workers who are transitioning from one career to another. Willing to "pivot" their careers, these highly-skilled displaced workers come equipped with a strong balance of technical skills – many of which are also relevant to in-demand digital occupations like software developers, data analysts, or QA testers. Highlighting these skills they already possess, and providing a roadmap for gaining additional skills needed for high-demand digital occupations is imperative. Doing so will take the city one step closer to supporting a diversified economy and enabling a long-term and sustainable economic future.

³⁰ Fletcher, Robson "Why Alberta's economic 'recovery' feels so different this time" CBC News. January 10, 2018. <https://www.cbc.ca/news/canada/calgary/alberta-oil-layoffs-jobs-recovery-harsh-reality-1.4474862>

Appendices

1. Detailed methodology

Attempting to understand the potential pathway for transition for displaced workers in the energy sector (and oil and gas in particular) into in-demand jobs in the technology sector, ICTC undertook the following methodologies:

Employer survey: An employer survey was created and disseminated via online channels, covering questions related to recruitment trends, hiring needs, in-demand occupations, in-demand skillsets, salary levels, training programs and other relevant questions. Entitled the *Calgary Tech and Digital Skills Gap Survey*, the targeted employers across the economy, focusing on the top 12 economic sectors, including technology, energy, transportation, healthcare, education and several others.

The survey remained open for over four months, and received responses from a total of 187 employers across Calgary. The highest representation was found to come from the technology (34%) and energy sector (26%), followed most closely by the manufacturing and trade sectors, each comprising 6% of all responses. A variety of company sizes responded to the survey, with 33% of companies employing fewer than 10, and 19% employing 500 or more.

The results of this survey were critical in gathering primary quantitative data from employers in the region, and formed the basis of ICTC's analysis in relation to in-demand occupations, critical skillsets, key challenges to hiring transitional workers, and more. Results from the survey were calculated for the overall economy, and where relevant, further segmented for the technology sector and for the energy sector as a specific focus.

Key Informant Interviews: A total of 29 key informant interviews (KIIs) were completed during the research process of this report. These interviews were comprised of a series of questions related to recruitment trends, skill needs, in-demand occupations, quality of supply (to fill occupations), future economic outlooks, the skills gap, and their perception on the transferability of displaced energy sector worker into in-demand occupations in other sectors. These interviews were conducted with representatives from industry associations, academic institutions, HR agencies, and industry (particularly the technology and energy sector). Intended to extract in-depth qualitative data from relevant stakeholders in the region, these interviews were conducted mostly in person and lasted approximately 30-50 minutes in length. Combined, these highlighted the specific experiences and feedback of the Calgary ecosystem. The following represents a detailed breakdown of interviews:

Name	Position	Organization Name	Organization Type
Peter Bishop	Creative Director	Digital Alberta	Industry Association (technology)
Jason Switzer	Executive Director	ACTia	Industry Association (clean technology)
Alex Jackson	Chapter President – AB (now CEO of Hone Virtual Education)	AR/VR Association	Industry Association (technology)
Claudine Vidallo	Lead Economist	Energy Safety Canada – Petro LMI	Sector Council (oil & gas)
Cherylyn Cameron	Dean (Community Studies & Creative Technology)	Bow Valley College	Academia
Amos Ngai	Associate Dean (Community Studies & Creative Technology)	Bow Valley College	Academia
Frank Maurer	Associate Dean (Innovation & Strategic Partnerships)	University of Calgary	Academia
Alan Fedoruk	Chair (Department of Math & Computing)	Mount Royal University	Academia
Jason Fisher	ICT Professor	SAIT	Academia
John Pitchko	Associate Dean (School of Information & Communications Technologies)	SAIT	Academia
Charlyne Fothergill	Director of Career Services	Lighthouse Labs	Training Institute
Nancy Foster	SVP, Human & Corporate Services	Husky Energy	Oil & Gas
Tys van Gaza	Director of Development	Clio	Tech Employer
Nav Shergill	COO	VizWorkX inc.	Tech Employer
Kevin Swan	VP, Corporate Development	Solium	Tech Employer
Greg Hart	Co-founder	AlwaysBLU	Renewable Energy
Steven Pilz	Co-founder	Rainforest Group	Innovation Hub
Ken Brizel	CEO	ACAMP	Innovation Hub
Dan Giurescu	Founder	TerraHub	Blockchain Accelerator
Heiko Peters	Founder	TekEitri	Tech Employer
David Nagy	Founder	EcoDiva	Tech Employer
Marius Ghinescu	Systems Engineer	Raytheon	Defense
Chris Schulze	Director of Business Engagement – Upstream	Suncor Energy	Oil & Gas
Peter Legeyt	Managing Partner	Alpin Executive Search	HR Agency
Jackie Rafter	President & Founder	Higher Landing	HR Agency
Alistair Shepherd-Cross	Owner	Agile Recruiting	HR Agency
Brianne Risley	Delivery Manager, Western Canada	Eagle Professional Services	HR Agency
John Pitchko	Associate Dean (School of Information & Communications Technologies)	SAIT	Transitioned oil & gas worker
Adam Coderre	Software Developer	Solium	Transitioned oil & gas worker

Advisory Committee: As a means of validating research results and spurring further discussion and consideration, an advisory committee was formed for this study. The committee was comprised of 20 of representatives from various stakeholder groups including: government, industry associations, economic development agencies, academic institutions, and employers. The purpose of the committee was to provide feedback and input on the research process, findings and to validate results. Throughout the course of the project, the committee met twice in Calgary – once in the spring of 2018 where the scope and methodology of the study were presented, along with results from secondary analysis and literature reviews; and once more in the summer of 2018, where preliminary results from primary research (survey, KIIs), along with preliminary results from web scraping and text analysis were presented. The committee validated research findings and engaged in a discussion period on key questions at the end of each meeting. The advisory committee was comprised of the following representatives:

Name	Title	Organization	Organization Type
Cheryl Probert	Talent Acquisition Manager	Solium	Tech Employer
Chris Schulze	General Manager & VP of Special Projects	Suncor Energy	Oil & Gas
Tys von Gaza	Director of Development	Clio	Tech Employer
Abbas Sarraf	Co-founder & Head of Product	Aimsio	Tech Employer
Margaux Myers	People Operations Manager	Aimsio	Tech Employer
Nav Shergill	COO	VizworkX	Tech Employer
Michael Jegen	VP of Development	3esi-Energisht	Tech Employer
Dave Thomas	Software Development Manager	Benevity	Tech Employer
Anette Ceraficki	Director of Talent & People Development	Benevity	Tech Employer
Eric Rasmussen	Operations & Research Analyst	TerraHub	Blockchain Accelerator
Raynie Wood	Dean, School of Information & Communications Technologies	SAIT	Academia
Amos Ngai	Associate Dean, School of Creative Technologies	Bow Valley College	Academia
Kim Lawrence	Associate VP, Marketing	University of Calgary	Academia
Frank Maurer	Head of Department, Faculty of Computer Science & Engineering	University of Calgary	Academia
Rafael de la Pena	Director, Centre for Learning	St. Mary's University	Academia
Jeremy Shaki	CEO	Lighthouse Labs	Academia
Jason Cameron	Program Lead, Resilience Strategy	City of Calgary	Municipal government
Tracey Johnson	Industry Workforce Partnerships Advisor	Alberta Ministry of Labour	Provincial government
David Ducasses	Research Manager	Calgary Economic Development Agency	Economic Development Agency
Jeanette Sutherland	Workforce & Partnerships Manager	Calgary Economic Development Agency	Economic Development Agency

Advanced data analytics: Once in-demand occupations were identified from the primary research, ICTC undertook advanced analytics processes, including 1) web scraping of in-demand jobs from job boards; followed by 2) text mining. Web scraping was completed in order to obtain a comprehensive idea of the volume of in-demand jobs in Calgary, and text mining was completed, to identify the most prominent skills in those jobs.

Web Scraping: ICTC scraped thousands of jobs from 4 different job boards (Indeed, Monster, Stack Overflow, Glassdoor) over the months of June to October 2018. This was done to identify the number of in-demand jobs in Calgary (and nationally – for comparison).

Text mining – critical skills for in-demand jobs: ICTC completed text mining on the thousands of jobs scraped to identify critical hard skills, programming languages, soft skills, assets, etc. This was completed by first “marking” text by category, clusters (categories of text marked for specific meaning) and sentiment analysis breakdowns (extracting meaning from subjective information like beliefs or values – this was used particularly to identify elements of “culture” relevant to postings).

Text mining – available skills of displaced occupations: An analysis to source the actual skills that highly-skilled displaced workers in Calgary currently possess was also completed. ICTC analyzed worker profiles of 1,204 geologists, 373 chemical engineers, 663 petroleum engineers, and 1,708 engineering managers. This was done with the intent of understanding the “skills match” and mismatches between displaced occupations and in-demand occupations (i.e. what skills they have which are relevant to in-demand jobs).

Removing job posting duplicates and incorrectly tagged jobs: ICTC also completed additional analysis to remove incorrectly tagged jobs and duplicates of job postings (encountered at a rate of 70% - sometimes even with the same job identifier) in the interest of showcasing the most accurate quantity of job postings for in-demand jobs in the city.

Accounting for job postings referencing more than one job: Throughout the course of our primary research, many employers noted that they were sometimes seeking to fill more than one position via one posting. Taking this into account, ICTC completed an additional analysis to find job postings that specifically referenced more than one vacancy. These postings were found to occur roughly 15% of the time. As a result, we have assumed that 15% of each posting for an in-demand job was intended to fill 2 open positions.

Literature review and analysis of secondary data: Complementing primary research findings, an analysis of key literature and secondary data sets (e.g. Statistics Canada, Alberta Provincial data, Open Data Calgary) were used to formulate the narrative, craft the story, and provide an understandable and logical background relevant to this study. This research was key in setting the stage for why

this research is necessary, and ultimately, why the city of Calgary must focus on finding pathways to employment for its highly-skilled displaced workers.

2. Limitations of research

While ICTC had attempted to ensure that the research process of this study was as inclusive as possible, a few limitations arose in the process. These limitations are minor in nature, with a very minimal impact on overall findings. These include:

Less than desired survey response rate: ICTC had benchmarked a survey response rate of 200+. Based on a Calgary business count totaling 58,870 in December 2016, ICTC calculated that, using a confidence level of 95%, and a margin of error of 7%, the appropriate sample size of respondents to this survey totaled 196. However, with a total response rate of 186, the survey results are still within an 8% margin of error, meaning that at most, only 8% (~15) of responses should show deviation from the sample.

Limited primary research available in the form of primary insight on actual skill competencies of highly-skilled displaced workers (at a granular level):

In attempting to “match” the actual skills of displaced workers with the skills required for in-demand occupations in Calgary, ICTC completed profile analyses of displaced highly-skilled displaced workers with the highest rates of unemployment in the city. However, the majority of this data was captured via secondary sources such as the Canada Job Bank, as well as websites where job seekers can post their profiles and skills. While over 3,000 profiles of displaced occupations were used to identify skillsets, the quality of data coming from the latter is not verifiable as it depends on the self-reporting of skills by each individual. ICTC had complimented this secondary data with primary insights extracted via four HR/staffing organizations, most of which are also working with displaced workers from this background. These organizations were able to provide some insights on challenges faced by job seekers, as well as challenges and opportunities that employers face when it comes to hiring transitioning workers. In order to also understand potential strategies for transition and ways of alleviating challenges of transition, ICTC had also reached out to employers who hired displaced workers that had successfully made the transition. These employers put ICTC in touch with two workers that had successfully transitioned – these workers were able to provide insight into the tactics they took to transition from an oil and gas engineering background to digital jobs such as software developers. While detailed primary data was gathered via a variety of stakeholders, future opportunities to elaborate on these findings may be highlighted by conducting more interviews with job seekers and even workforce development agencies.

Number and quality of job boards searched: In the process of completing advanced analytics including web extraction and text mining to identify the volume of actual job postings in the city of Calgary for in-demand jobs, ICTC completed analysis of a total of 4 job boards (Indeed, Monster, Glassdoor, Stack Overflow). However, in analyzing preliminary results, Glassdoor and the City of Calgary job

board were eventually removed from further analysis. This was done for two different reasons: 1) Glassdoor was found to post a significant number of incorrectly tagged or duplicated jobs (near 90% duplication – all of which also existed on other job boards used like Indeed) and/or jobs which were not in Calgary; and 2) The City of Calgary job board did not have many postings in general, let alone for in-demand roles identified. Therefore, in the interest of quality assurance, only Indeed, Monster, and Stack Overflow were used to extract jobs and complete text analysis to determine the skills necessary for those jobs.

Educational institutions offering skill training: It is possible that only a fraction of resources have been identified in terms of educational institutions offering skill upgrading courses or programs in areas relevant to in-demand jobs. With the aim of identifying additional resources, Calgary Economic Development and ICTC have drafted a survey that will be distributed to educational institutions in Calgary in the near future.

Quickly evolving skill needs: Due to the quickly evolving skill needs of many in-demand occupations (particularly those of a digital nature), it is possible that skills deemed in demand at the current time may not be so in the medium or long-term future. Continual analysis and refreshing of data is critical to ensuring that in-demand skillsets remain up to date.

3. Resources: skill upgrading in Calgary

In some cases, job seekers attempting to transition into in-demand digital occupations in Calgary may need to upgrade current skill or develop new ones in order to be considered viable candidates for these roles. The following are some examples of training programs and courses offered by educational institutions and/or other training institutions in the Calgary region that are relevant to the in-demand digital occupations of this study.

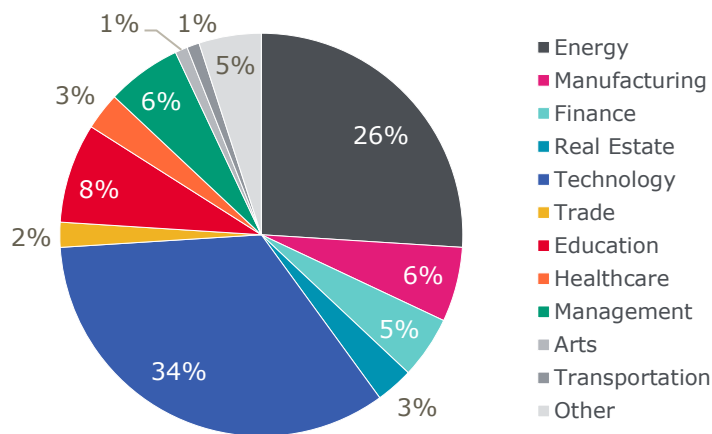
Institution Name	Skill	Course
University of Calgary	Software Development	Certificate in IT Fundamentals Certificate in .Net Application Development Bachelors in Computer Science
	Data Analysis	Certificate in Business Intelligence and Analytics Certificate in Data Science and Analytics Diploma in Data Science and Analytics
	UX/UI Design	Certificate in Integrated Digital Media Certificate in Front-end Web Development
Mount Royal University	Software Development	Bachelor of Computer Information Systems Bachelor of Science – Computer Science
Southern Alberta Institute of Technology – SAIT	Software Development	Java Development Certificate Android Application Development Certificate
	Data Analysis	Business Intelligence Certificate
	UX/UI Design	Graphic Design Certificate Web Design Certificate
Bow Valley College	Software Development	Diploma in Software Development Software Development Post-Diploma Certificate

Institution Name	Skill	Course
Bow Valley College (Continued)	Software Development	Data Management and Analytics Post-graduate Diploma
	UX/UI Design	Diploma in Digital Design
Lighthouse Labs	Software Development	Web Development Bootcamp
EvolveU	Fullstack Development	Full Stack Developer Program
Open Classrooms	Fullstack Development	Fullstack Developer Program
Jumpstart Calgary	UX/UI Design	UX/UI Design

4. Summary of additional survey findings

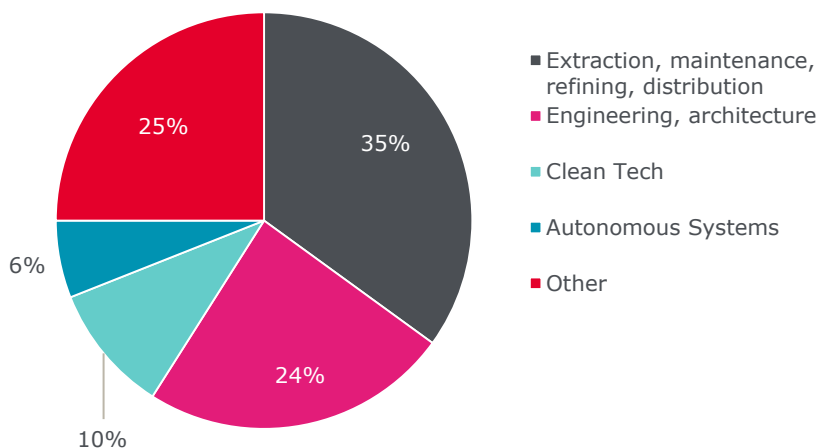
Company type

Company breakdown: industry type



Source: ICTC, 2018 (187 responses)

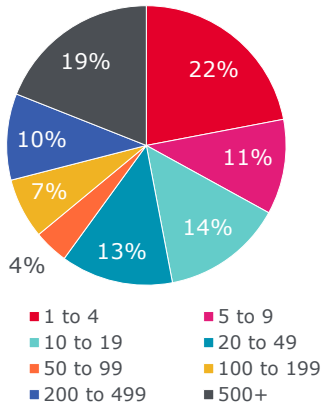
Company type: energy companies



Source: ICTC, 2018 (49 responses)

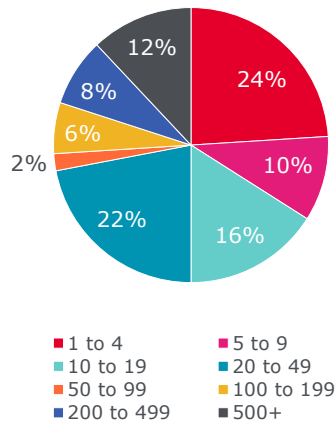
Company size

**Size breakdown:
all companies**



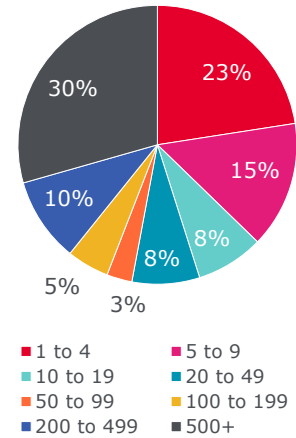
Source: ICTC, 2018 (187 responses).

**Size breakdown:
technology
companies**



Source: ICTC, 2018 (63 responses).

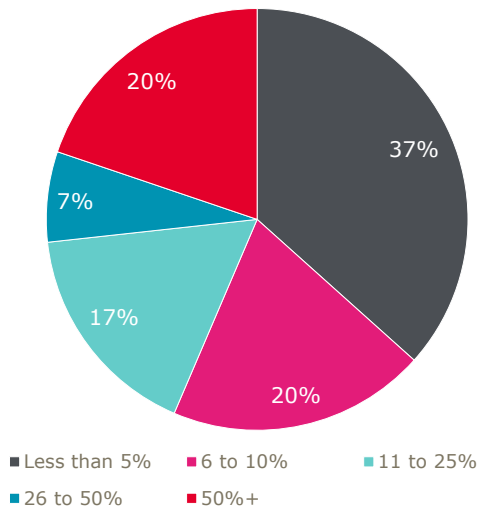
**Size breakdown:
energy companies**



Source: ICTC, 2018 (49 responses).

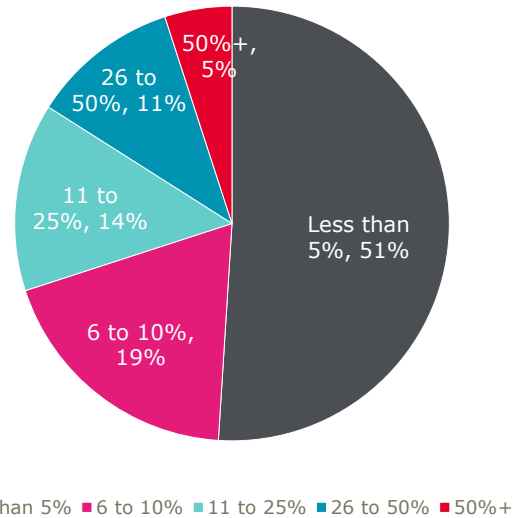
Economic growth over the last year

**Economic growth over the last
year: technology companies**



Source: ICTC, 2018 (63 responses).

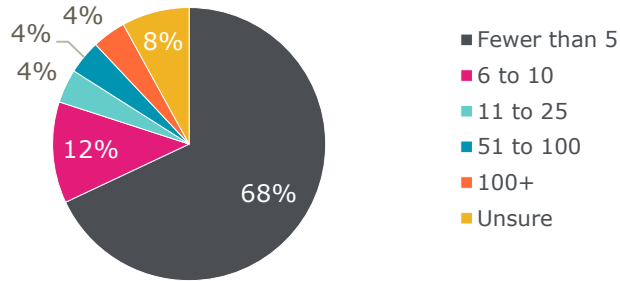
**Economic growth over the last year:
energy companies**



Source: ICTC, 2018 (49 responses).

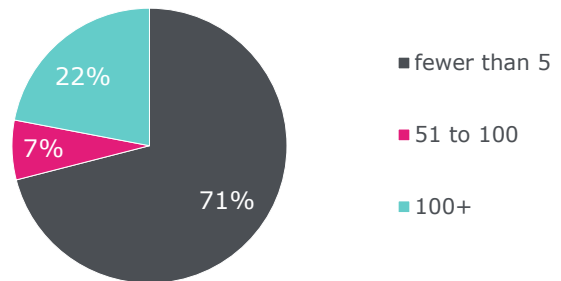
Employment growth over the last year

Employment growth over the last year: technology companies



Source: ICTC, 2018 (63 responses).

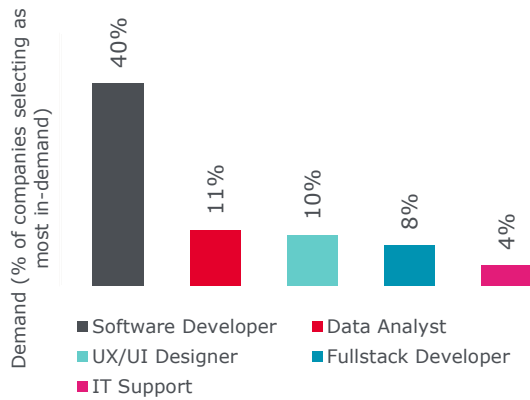
Employment growth over the last year: energy companies



Source: ICTC, 2018 (49 responses).

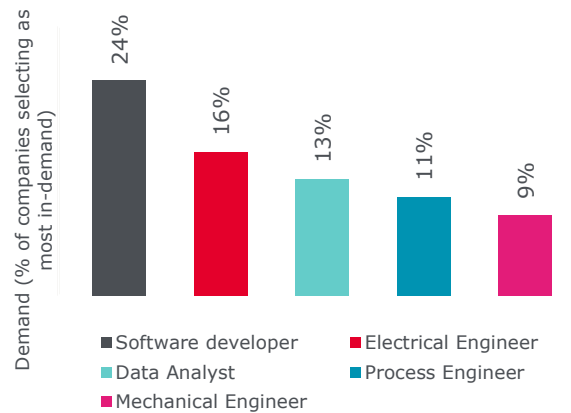
In-demand jobs by sector

Top roles: technology companies



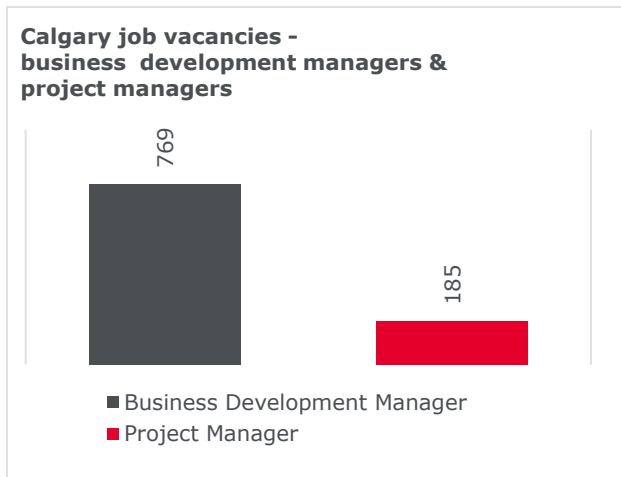
Source: ICTC, 2018 (83 responses).

Top jobs: energy companies

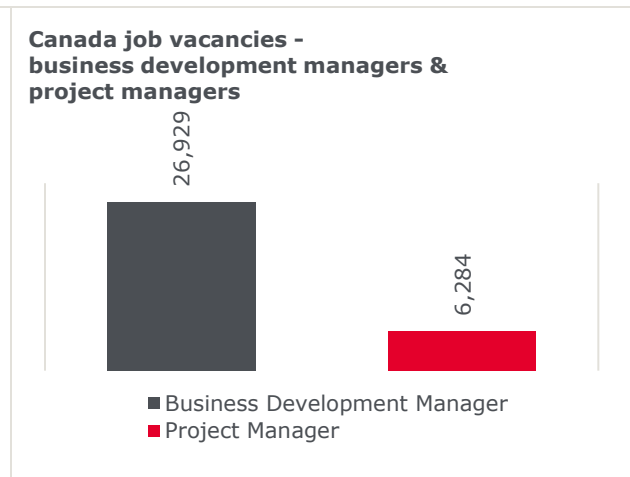


Source: ICTC, 2018 (45 responses).

October 2018 vacancies for Business Development Managers & Project Managers



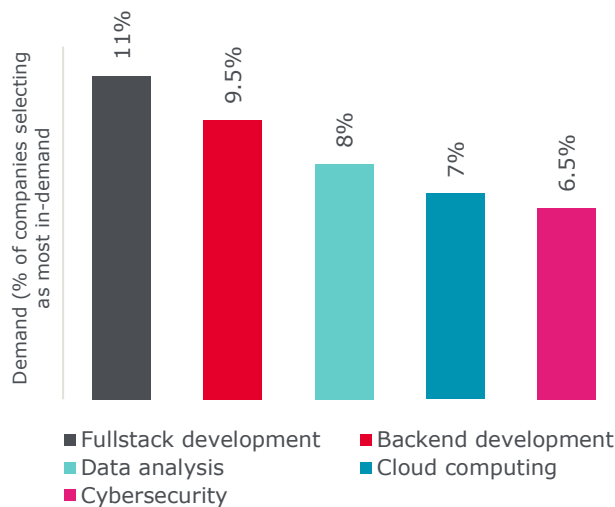
Source: ICTC, October 2018.



Source: ICTC, October 2018.

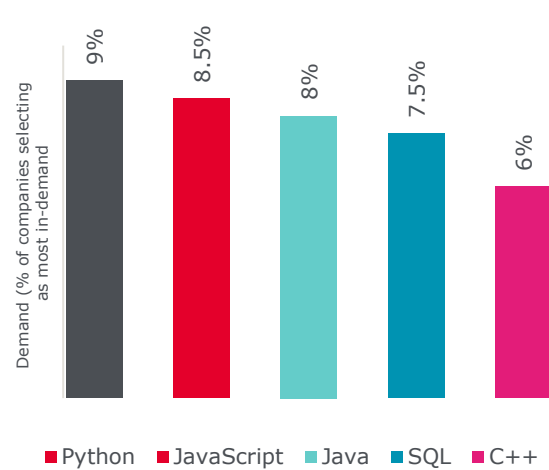
Critical digital skills & in-demand programming languages

Critical digital or technical skillsets: entire economy



Source: ICTC, 2018 (76 responses, 335 "high-demand").

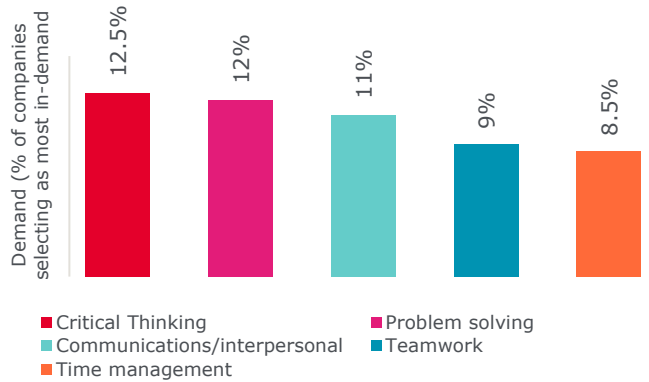
High-demand programming languages: entire economy



Source: ICTC, 2018 (82 responses, 217 "high-demand").

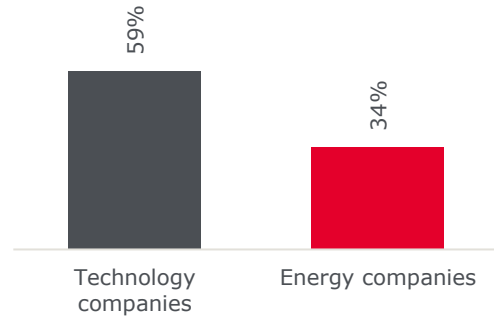
In-demand soft skills & difficulty sourcing senior talent

High-demand soft skills: entire economy



Source: ICTC, 2018 (73 responses, 473 "high-demand").

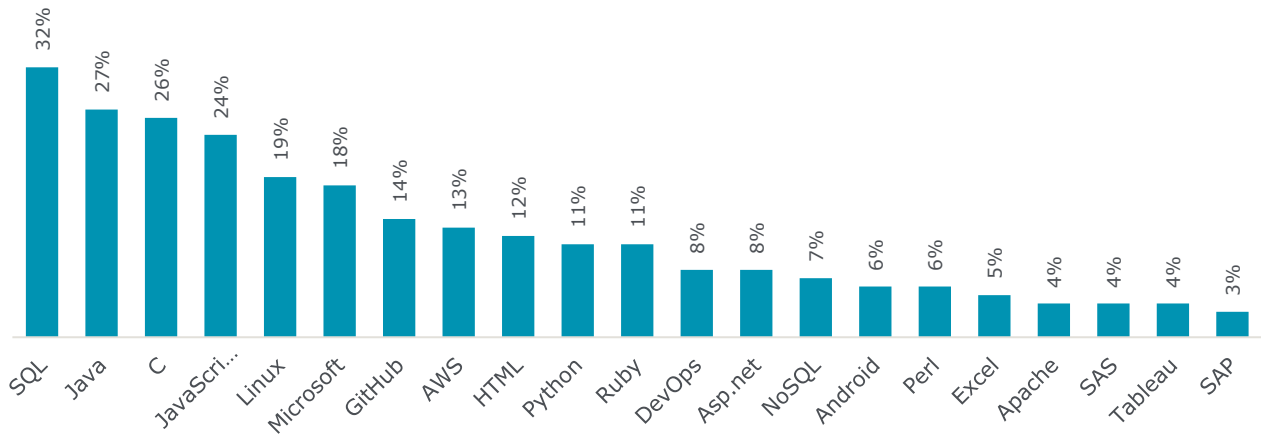
Difficulty in sourcing senior talent: technology vs. energy companies



Source: ICTC, 2018 (83 responses).

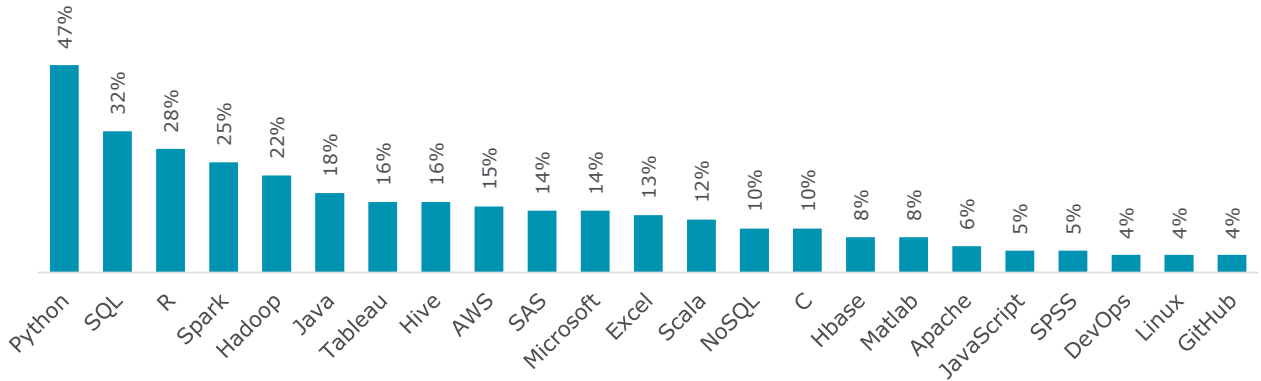
5. In-demand languages & tools

Portion of software developer job ads with key programming languages & tools



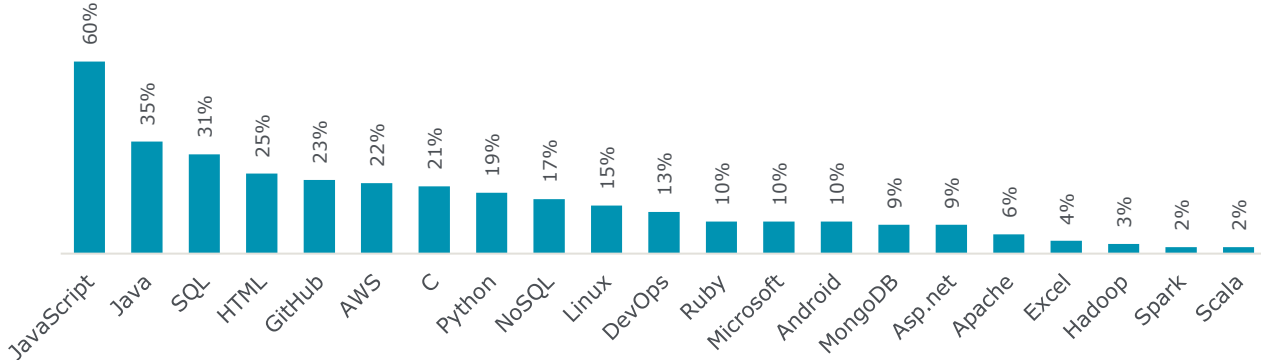
Source: ICTC, 2018.

Portion of data analyst job ads with key programming languages & tools



Source: ICTC, 2018.

Portion of full stack developer job ads with key programming languages & tools

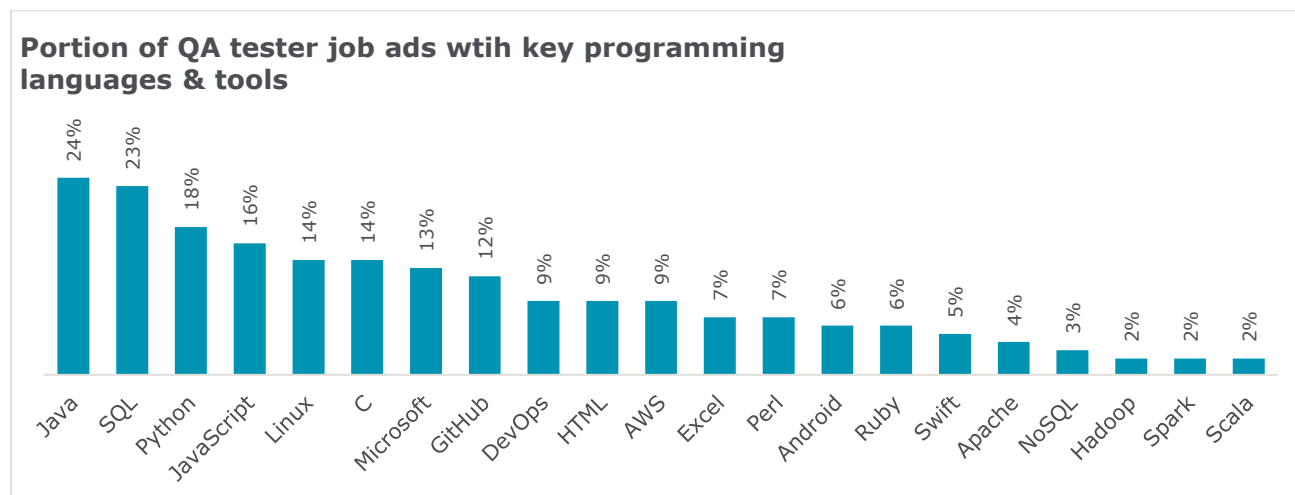


Source: ICTC, 2018.

Portion of UX/ui designer job ads with key programming languages & tools



Source: ICTC, 2018.



Source: ICTC, 2018.

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