

DATA ANALYTICS, MACHINE LEARNING, AND ARTIFICIAL INTELLIGENCE IN CALGARY

Calgary Economic Development's collaborative energy makes us a conduit, connector, catalyst and storyteller for the City of Calgary.

2020

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EXECUTIVE SUMMARY

The digitization of our economies means we are awash in increasing volumes of data.

Organizations that can analyze and interpret substantial information gain immense perspectives to decipher current and future possibilities. While the practice has existed for many years, the rise of artificial intelligence (AI) and machine learning (ML) is enabling data to be analyzed at breadths, depths and efficiencies previously unimaginable. The availability of quality data, access to algorithms, supply of software infrastructure and increasing computational power has resulted in more accurate and useful insights for companies. The operational spectrum for data analytics is predicated on five main steps:

- Data collection and data cleaning
- Descriptive data analytics and data visualization
- Forecasting and prescription of actionable steps
- Autonomous systems and machine learning
- Artificial intelligence and decision-making

The role of AI in data analytics has a place in each step on the spectrum and has allowed companies and organizations to increase revenues, reduce costs and improve key performance indicators including order-delivery time, response time and time to market. It is predicted that by 2030, 70 per cent of companies worldwide will have adopted some form of AI in their operations, with the potential to deliver additional economic activity of approximately \$13 trillion US.¹

The high-tech landscape in Calgary continues to develop at a rate that signals a willingness of companies to embrace digital transformation. Companies demonstrate expertise in creating practical solutions for business-to-business (B2B) markets, having taken an early lead in using enhanced decision-making capabilities of intelligent systems in the energy industry. As Calgary's economy diversifies, more companies are using AI to provide solutions in industries including energy, financial services, marketing, construction, insurance, retail, agriculture, transportation, life sciences, aerospace and digital media.

Calgary businesses must continue to embrace digital transformation and agile business practices. By promoting a culture where data is viewed as a key input for smart decision-making, businesses stand to benefit from the massive growth and efficiency potential offered by new technologies. Having a strong AI ecosystem is critical to moving fast and smart. To achieve this, we need to address the following challenges:

- **Talent** | Growth Area: Evident Talent Gaps | Next Step: Increase Training Efforts
- **Financing** | Growth Area: Investment Climate | Next Step: Meet Needs of Startups

¹ McKinsey Global Institute, Notes from the AI frontier: Modeling the impact of AI on the world economy (2018), <https://www.mckinsey.com/featured-insights/artificial-intelligence/notes-from-the-ai-frontier-modeling-the-impact-of-ai-on-the-world-economy>

- **Scaling** | Growth Area: Market Penetration | Next Step: Support Pilot Projects
- **IP Ownership** | Growth Area: IP Grey Space | Next Step: Rework Status Quo
- **Collaboration** | Growth Area: Open Labs | Next Step: Long-Term Commitments

This paper outlines the state of Calgary’s digital ecosystem related to AI and ML. Opportunities for developing leadership are highlighted through a review of Calgary’s analytics community, including addressing digital talent skills gaps, maturing data governance practices and culture and developing a collaborative environment wherein technology companies can thrive.

TERMS AND DEFINITIONS

Artificial Intelligence (AI): The ability of a machine to perform cognitive functions associated with human minds, such as perceiving, reasoning, learning and problem solving.²

Big Data: A term to describe a large volume of data – structured and unstructured – that inundates businesses daily. It can be analyzed for insights that lead to better decision-making and strategic business moves.³

Data Analytics: The strategies and technologies used to gather business intelligence on the historical, current, predictive and prescriptive views of business operations to enable informed business decisions.

Digital-tech: Occupations and activities that typically contribute to the development and output of computer hardware or software (e.g. software companies or technology architects).⁴

High-tech: Occupations and activities that require advanced, intrinsic use of digital-tech but do not primarily create a digital output.⁵

Internet of Things (IoT): Technology that interconnects the internet of computing devices embedded in objects. Includes anything from smartphones to kitchen appliances and heart monitors.

Industrial Internet of Things (IIoT): Extension and use of the internet of things (IoT) in industrial sectors and applications. The IIoT encompasses industrial applications, including robotics, medical devices, and software-defined production processes.⁶

Machine Learning (ML): A major approach used to realize AI that, rather than being explicitly programmed, detects patterns and improves itself with new data and experiences.⁷

² McKinsey & Company, AI Looks North: Bridging Canada’s Corporate Artificial Intelligence Map. (2018)

³ SAS, Big Data: What it is and why it matters, https://www.sas.com/en_ca/insights/big-data/what-is-big-data.html

⁴ Brookfield Institute, Who Are Canada’s Tech Workers? (2019)

⁵ Brookfield Institute, Who Are Canada’s Tech Workers? (2019)

⁶ TrendMicro, Digital Information Security Software. (May 2020)

⁷ McKinsey & Company, AI Looks North: Bridging Canada’s Corporate Artificial Intelligence Map. (2018)

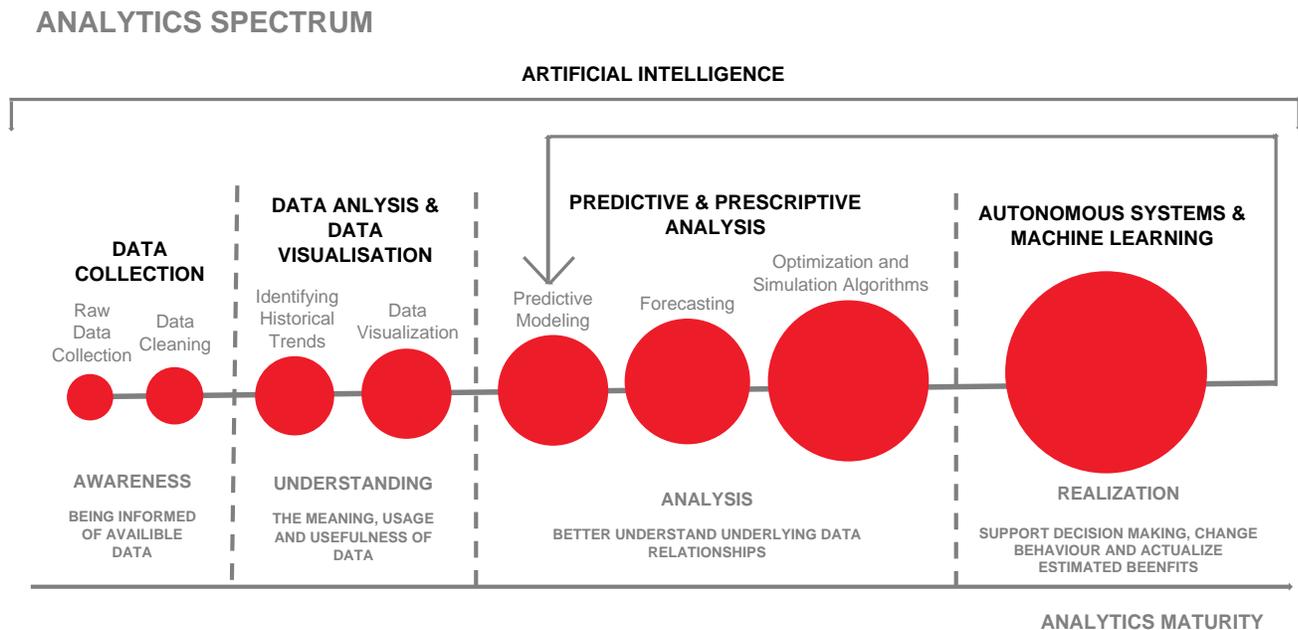
DEFINING THE ANALYTICS SPECTRUM

Enterprises rely heavily on technology to gather data on historical, current, predictive and prescriptive information. Recent developments in AI, such as machine learning, allow these enterprises to retrieve previously unimaginable amounts of data, which in turn allows for more accurate and useful insights.

The process focuses on five main stages within a spectrum:

- Data collection and data cleaning
- Descriptive data analytics and data visualization
- Forecasting and prescription of actionable steps
- Autonomous systems and machine learning
- Artificial intelligence and decision-making

Below is a spectrum highlighting the components of data analytics:



DATA COLLECTION

Data helps companies understand their business and industry. Gathering more data translates to greater reporting accuracy, especially in the application of machine learning initiatives and Industrial Internet of Things (IIoT) devices. Historically, companies have compiled data sets for individual undertakings and have often fallen short of coordinating data gathering across multiple projects.

Calgary AI, ML and data analytics companies empower clients with better decision-making abilities by enabling real-time communication of information across large distances and multiple sites. By continuing to push the envelope, Calgary companies are finding innovative ways to scale data across networks of projects.

DATA ANALYSIS AND DATA VISUALIZATION

Data analysis and data visualization

Data analysis is the inspection and curation of collected data. Through this process, quantitative variables are processed to produce information and identify trends.

Calgary companies excel at leveraging emerging technologies to provide more extensive data analysis.

Calgary companies have found success in the application of artificial intelligence, big data, and IoT in subsets of energy, cleantech and healthcare. These companies have the capability to develop rich, useful dashboards which allow clients access to analyze both historic and real-time metrics.



Envio Systems is a Calgary-based building management company that collects live and historic data across several supply-based metrics to reduce excess energy usage. Utilizing a fully integrated Internet of Things (IoT) that incorporates new and already networked equipment, their program can capture information from a variety of systems and buildings. All this can be accessed through a secure cloud system that enables real-time operations to produce energy savings of up to 70%.



In industries where field work can drive company costs up significantly, [Spira Data Corp's](#) Operations Resource Platform (ORP) digitally links areas of management, field operations, supply chain, and scheduling to increase profits. Efficiencies are created by sharing real-time information between the field and office.

PREDICTIVE AND PRESCRIPTIVE ANALYSIS

Whereas data analysis deals with historical data, the prediction and prescription aspect of data analytics deals with the application of findings to affect measurable change.

Calgary companies are advancing their work in predictive and prescriptive analysis using actionable data and a feedback system that tracks the outcome produced by an action taken.

With the collected raw data, patterns can be devised, forecasting future events and prescribing an action, allowing decision-makers to act on information quickly.

AUTONOMOUS SYSTEMS AND MACHINE LEARNING

Machine learning provides measures of automated and continuous advances in data analytics capabilities. These autonomous learning systems drastically increase the efficiency and scale at which data can be gathered and processed.



CMO4HIRE
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One of the biggest problems that marketers face is understanding their digital KPI metrics, forecasting their go-to-market strategy and then tracking actuals against that forecast to see if they are on track.

Calgary-based CMO4Hire has 1Tracker and 1Forecast software that incorporates predictive analytics algorithms to help optimize marketing and sales results.

By connecting live data sources from a variety of marketing tools and platforms, DBMMS.io can predict whether or not you will make your forecast by the end of the year. More importantly, it will show you what to focus on to improve results.



THE GLOBAL LANDSCAPE FOR DATA ANALYTICS

Worldwide revenues for big data and business analytics solutions was forecast to reach \$189.1 billion US in 2018 with double-digit annual growth through 2022.⁸ The strong relationship between AI and analytics is not lost on international business leaders. A 2018 study conducted by SAS, Accenture, Intel and Forbes Insights found 79 per cent of companies, having experienced success in deploying AI-technologies, report analytics have a “major” role in AI.⁹

Data analytics and data-related jobs are on a growth trajectory in the European Union. Between 2014 and 2016, the value of the data economy – which includes the direct, indirect and induced effects of exchanged data products and services – grew from €257 billion to nearly €300 billion.¹⁰ The European data industry, which employed approximately 6.1 million people in 2016, is heavily concentrated in professional services, wholesale and retail, manufacturing and information and communication. It is projected that a data-skills gap in the EU28¹¹ will grow to almost 770,000 unfilled positions by 2020. Such a wide gap would potentially act as a deterrent to continued growth for the region’s data industry.

In the United States, the number of people employed as data professionals is expected to increase to 2.7 million by 2020.¹² The American data industry is heavily concentrated in banking, process manufacturing, discrete manufacturing, the federal government and professional services.¹³ Significant investment in data analytics began in 2012 with the Big Data Research and Development Initiative – a \$2 million US investment.¹⁴ From 2013 to 2015, the relative weight of the data market on overall Information and Communication Technology (ICT) spending increased from 9.8 to 12.3 per cent. In the United States, some deterrents to development in the data space will be the expensive hiring costs, the necessity for new training programs and high risk to future productivity.

⁸ IDC, IDC Forecasts Revenues for Big Data and Business Analytics Solutions Will Reach \$189.1 Billion This Year with Double-Digit Annual Growth Through 2022.

<https://www.businesswire.com/news/home/20190404005662/en/IDC-Forecasts-Revenues-Big-Data-Business-Analytics>. (April 4, 2019)

⁹ SAS, Accenture Applied Intelligence and Intel with Forbes Insights, AI Momentum, Maturity & Models for Success. (2018)

¹⁰ IDC and Open Evidence, The European Data Market Study: Final Report. (February 1, 2017)

<http://datalandscape.eu/study-reports/european-data-market-study-final-report>

¹¹ Member States of the European Union

¹² Forbes, IBM Predicts Demand for Data Scientists Will Soar 28% By 2020. (May 13, 2017)

<https://www.forbes.com/sites/louiscolombus/2017/05/13/ibm-predicts-demand-for-data-scientists-will-soar-28-by-2020/#3c3c793e7e3b>

¹³ TechBullion, Latest Trends, Growth Drivers and Developments in USA Big Data Market. (January 7, 2017)

<https://www.techbullion.com/growth-drivers-trends-and-developments-in-usa-big-data-market/>

¹⁴ SecurityWeek, Obama Administration Places \$200 Million Bet on Big Data. (March 29, 2012)

<https://www.securityweek.com/obama-administration-places-200-million-bet-big-data>

While the EU and the U.S. are large players in data analytics, countries such as China, Japan and Brazil are also making headway in research, development and application of data tools. Big data has allowed the Chinese economy to shift to more advanced industries such as business IT in the wake of slowing growth and the loss of their manufacturing cost advantage to countries such as Vietnam and Cambodia. In 2015, the ICT sector provided nine per cent of China's GDP¹⁵, a number that is steadily increasing.

Brazil accounts for 46.7 per cent of Latin America's big data and analytics market, which is projected to reach \$8.5 billion US by 2023.¹⁶ Companies in Brazil are using technological advances in analytics to monitor air pollution, support its oil and gas sector and manage telecommunications.

The rise of big data and analytics is one of the most significant technology trends in Canada over the past several years. International Data Corporation (IDC) Canada estimated market size for Canadian IoT as \$6.5 billion in 2018.¹⁷ EMC Corporation expects Canada's Big Data market to grow by 40 per cent per year through 2020.¹⁸ There is significant demand among Canadian government organizations and private sector enterprises for AI, data analytics and machine learning solutions. Opportunities exist in areas such as IoT analytics, cognitive computing, wearable technology, health care analytics and enhancing customer experience.

Globally, the greatest progress in data analytics has been viewed in location-based services and in retail, where there are lags in progress in construction, the public sector and healthcare.

¹⁵ EU-Japan Centre for Industrial Cooperation, Digital Economy in Japan And the EU - An Assessment of The Common Challenges and The Collaboration Potential. (March 2015) <https://www.eu-japan.eu/publications/digital-economy-japan-and-eu-assessment-common-challenges-and-collaboration-potential>

¹⁶ PR Newswire, Brazil and Mexico Stand as Front-runners in the Latin American Big Data Market, says Frost & Sullivan. (April 23, 2018) <https://www.prnewswire.com/in/news-releases/brazil-and-mexico-stand-as-front-runners-in-the-latin-american-big-data-market-says-frost--sullivan-680542631.html> (Accessed May 29, 2019)

¹⁷ IDC, Canadian ICT 2015-2019 Forecast.

¹⁸ Invest in Canada: Big data and analytics in Canada. (2016) https://www.international.gc.ca/investors-investisseurs/assets/pdfs/download/Niche_Sector-Big_Data.pdf

CALGARY COMPANIES AT WORK

In Calgary, energy is more than just powering our communities. It is also embedded in the community spirit and entrepreneurial values of our city. The city's energy, coupled with its business infrastructure, is the reason companies choose to locate here and why Calgary has the highest concentration of headquarters in Canada.

With machine learning and artificial intelligence, Calgary companies are gaining momentum in digital transformation initiatives.

Significant advances in technology and the use of artificial intelligence will impact all industries over the next decade. Calgary companies continue to gain an edge in the digital economy.

Calgary is home to 55 per cent of Alberta's private tech companies.¹⁹ Businesses invest heavily in the technologies of the future, reiterating their value in the digital economy. Strong investment growth into digital transformation is forecasted across all sectors in Calgary, ranging between 16 and 23 per cent from 2019 to 2022.²⁰ Alberta software companies, which include analytics services, comprise the largest share of technological deal flow at 40 per cent, followed by energy and cleantech at 21 per cent and life sciences at 13 per cent.²¹

In energy, AI has been employed to improve safety through virtual monitoring, increased productivity through real-time optimization and refining management practices through predictive quality analytics.²² The life sciences sector has used AI to create outcome-based drug pricing models, utilize real-world evidence and create IoT data records.²³ Financial



It's said that Artificial Intelligence today is like the internet in the '90s. The technical capability is here, the products that will revolutionize industries (mostly) aren't here yet. AltaML partners with industry to create those products. With a large team of data scientists, machine learning developers, and product managers, their team guides partners from conceptualization through MVP. Co-investing in these products ensures aligned interests. Some of AltaML's current partners include PCL, AimCo, Boehringer Ingelheim, DynaLIFE and dozens more.

¹⁹ The Company Story: Page 16; Alberta Tech Deal Flow Study. (2018)

²⁰ IDC Canada DX Spending Statements, IDC & Calgary Economic Development Analysis. (2019)

²¹ Executive Summary: Page 1; Alberta Tech Deal Flow Study. (2018)

²² IDC Energy Insights: Agile Energy, IDC. (2019) <https://www.idc-dxusecases.com/wp-content/uploads/2019/03/EI-Agile-Energy.pdf>

²³ IDC Health Insights: Knowledge-Based Medicine, IDC. (2019) <https://www.idc-dxusecases.com/wp-content/uploads/2019/03/HI-Knowledge-Based-Medicine.pdf>

service providers have adopted AI in functions such as improving insights, automating business operations and cybersecurity threat detection.²⁴

Since digital-tech and innovation are a vital component to Calgary's growth and diversification strategy, Calgary Economic Development gathered a private sector perspective on the strengths of data analytics in Calgary. High-level research and management individuals were interviewed within leading Calgary companies that are active in the area. An obvious finding from the interviews was that Calgary companies love data.

Through innovative AI software and creative services, Calgary's data analytics companies are transforming data into intelligence and solutions.

The use of analytics for big data assessment is becoming more pervasive. To meet the demands of today's evolving marketplace, Calgary continues to grow with hyper-talented people who utilize innovative and entrepreneurial thinking. Calgary has a growing supply of start-ups and entrepreneurs in the data analytics ecosystem. With a mindset that fosters value-driven, industry-applicable innovation, Calgary's data analytics sector is proving that entrepreneurial thinking can be taught and will solve economic, cultural and social challenges.



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Vivametrica, a Calgary-based Predictive Health Analytics company, partnered with SCOR Global Life to create a wearable device-based method of predicting health and mortality, without the need for blood or fluid samples, doctor visits or extensive questionnaires.



CANADA'S DATA ANALYTICS SOLUTIONS ARE INDUSTRY-SPECIFIC.

Calgary is broadening the analytics landscape, building AI technologies that include data mining, descriptive analytics, data visualization, business performance management, text analytics, predictive analytics and prescriptive analytics models across a diverse group of industries.

²⁴ IDC Financial Insights: Connected Banking, IDC. (2019) <https://www.idc-dxusecases.com/wp-content/uploads/2019/03/FI-Connected-Banking.pdf>

Being a well-established energy city, Calgary has obvious advantages in business intelligence systems related to the energy industry. Several data-based decision-making companies including [Ambyint](#), [BDO IT Solutions](#), [Bow River Solutions](#), [Cadeon](#), [Core Data](#), [Dakota Analytics](#), [HiFi Engineering](#), [Braintoy](#), [IBM](#), [Simplicity Business Intelligence](#), [Tugboat Logic](#), [Veerum](#), [Verdazo](#) and [White Whale Analytics](#) are providing world class solutions and services to clients in the energy space.

IBM's Natural Resources Solution Centre is based in Calgary and delivers support to energy companies looking to adopt the innovative IBM Watson tool, which uses AI and ML-based technology to improve the efficiency of producers and help them make smarter decisions. Companies adopting this technology as part of the IBM-led innovation consortium are expected to reduce drilling costs, improve forecasting methods, reduce energy consumption and improve employee safety.

Having adopted these processes early, Calgary technology companies are leaders in using AI for data analysis within the energy industry. Local technology companies are using data analytic processes, machine learning and artificial intelligence to seek out solutions in other industries including marketing, construction, agriculture, transportation, insurance, retail, aerospace and digital media.

DATA IS POWER

Calgary companies know that the first step to good decision-making is efficiently organizing information through superior data visualization and human-to-computer interaction.

Calgary companies such as, [Matterhorn](#), [Verzado](#) and [Cadeon](#) have created powerful data visualization tools for all levels of business, across industries, that enable their clients to get maximum value from their data analytics dashboards. These companies have advanced knowledge in programming computers to process and analyze large amounts of natural language data.

[Chata](#) builds AutoQL, an API-first, AI-driven solution that allows anyone to interface with their business data directly, just by asking questions in their own words. AutoQL can be embedded into any SaaS product or enterprise software system to provide data on demand to users of all skill levels, including non-technical individuals.

[PataBid](#) serves the construction industry by using natural language processing to collect and analyze tender documents across all industries in Canada with a focus on predicting cost and success rates.

[Braitoy](#) is a Calgary technology startup that offers an easy-to-use AI platform that lets end users solve practical problems for their businesses. Their technology makes it possible for anyone, even those with no coding skills, to start using AI without the risk, cost and complications that come with AI development.

[White Whale](#) is a data technology company building AI analytics solutions that empowers businesses to make sound, data-driven decisions. White Whale envisions a future where people of all skill levels use AI to explore, question and understand their data. Their flagship solution, DeepSea, is used in several industries including energy, health and wellness, aviation, defense and professional sports.

STELLARALGO

StellarAlgo's leading SaaS data analytics solution helps businesses quickly and cost-effectively organize, analyze and leverage the data they need to make successful business decisions.

One example of their innovative technology in action is their work with the Portland Trail Blazers. StellarAlgo helped them get a +10 per cent renewal rate increase for season ticket holders and a +2,700 per cent ROI.

In health care, predictive tools are most useful when their knowledge can be transferred into action. Calgary companies are leading internationally when it comes to harnessing the power of historical and real-time data for personal health outcomes. One example is Imagia.com which brings together healthcare expertise and advanced artificial intelligence technology, applying machine learning to structured data sets to create scalable solutions that improve patient outcome.

As well-established Calgary companies continue to form collaborative clusters, Calgary's expertise in data collection, data analysis and data visualization continues to grow. One example is the success of the Calgary Artificial Intelligence Meetup which includes over 3,100 members.²⁵

²⁵ Calgary Artificial Intelligence Meetup. <https://www.meetup.com/meetup-group-wmHrkGoA/members/> (Accessed May 22, 2020)

GROWTH AREAS AND NEXT STEPS

TALENT

The ability for talent to effectively utilize and capture the full potential of AI will be vital to organizations' abilities to achieve their strategic and operational objectives.

GROWTH AREAS: EVIDENT TALENT GAPS

The economic strategy: *Calgary in the New Economy*, identifies talent as a strategic area of focus to position Calgary as Canada's destination for skilled workers.

Companies in the analytics space are looking for top talent who know data and have coding skills, but also who understand business problems and communicate well. With increased knowledge around digital transformation, Calgary's highly developed workforce is well-positioned to harness the full potential of machine learning and AI.

"One of the key passions that I personally try to pass on to people, especially young people in school, is to gain programming skills, no matter what discipline they are in. Ultimately, the key to the success in high-tech sector is the right people who understand the subject matter in detail and have enough programming/algorithm skills to put that historical knowledge to work predicting the future."

Stephen King
CEO and Co-founder at [CMO4HIRE](#)

Brookfield Institute's 2019 study, *Who Are Canada's Tech Workers?* reported Calgary has the highest workforce concentration of high-tech talent in Canada. It also has one of the lowest concentrations of digital-tech talent, or talent with the knowledge needed to generate hardware and software solutions consistent with the current data analytics landscape.²⁶

It is imperative for Calgary to build a critical mass of experts in all fields aligned with AI, including stack development, mathematics, machine learning, engineering, economics, data science, software development and information technology. Ensuring digitally fluency across disciplines such as marketing and sales will enable Calgary's AI companies to increase target market horizons and remain globally relevant.

²⁶ Who Are Canada's Tech Workers, Brookfield Institute. (January 2019) <https://brookfieldinstitute.ca/report/who-are-canadas-tech-workers/>

NEXT STEP: INCREASE TRAINING EFFORTS

Leading AI firms understand the value of talent with deep domain knowledge and how that translates into successful data science. The next step to enhancing Calgary's global competitiveness is reliant on the integration of tech skills into existing capabilities. This means attracting outside talent and building the skills of existing students and workers. One example is the Energy to Digital Growth Education and Upskilling ([EDGE UP](#)) program led by Calgary Economic Development and a consortium of partners. In 2018, Calgary Economic Development engaged with the Information and Communications Technology Council (ICTC) to develop a talent roadmap and skills inventory. The talent roadmap helped identify current and future skills needed to support energy sector competitiveness. This roadmap paved the way for EDGE UP. Through this program, highly-skilled energy sector professionals who have been displaced mid-career can gain access to tech training in Calgary through an almost \$1.5 million investment to EDGE UP from the [Future Skills Centre](#).

Ongoing investments in this area include a commitment from government to help post-secondary institutions scale their technical programs. There are a variety of ongoing public and private-sector efforts to develop digital and AI capabilities in non-traditional candidates and help transition workers from other sectors to tech.

"Alberta is already a leader in Artificial Intelligence, businesses in Calgary are well positioned to benefit. As demand for these skills increase it's critical we continue to develop people with the right training and practical knowledge of how to apply AI in industry."

Lucas Sheer
Managing Director, [AltaML Inc.](#)

Calgary's post-secondary institutions are working hard to groom future talent amid a changing labour landscape. These efforts are bolstered by the Government of Alberta's [Talent Advisory Council on Technology](#). The council brings together leaders of industry, post-secondary institutions, students, and government to provide guidance and advice on strategies, investments and outcomes on tech-related training programs. Most recently, Government of Alberta Budget 2020 includes more than \$200 million for innovation²⁷, research and commercialization, including \$34 million for artificial intelligence²⁸ over three years.

The University of Calgary (UCalgary) already excels in several AI-related fields, ranked second nationally by the Academic Ranking of World Universities for citation impact of publications in medical technology, economics, energy science, engineering and chemical engineering.²⁹ UCalgary is also implementing programs at the undergraduate and graduate

²⁷ [Budget 2020: Fiscal Plan](#), pp31-32, Government of Alberta

²⁸ [Budget 2019: Fiscal Plan](#), p9, Government of Alberta

²⁹ University of Calgary, UCalgary top 5 nationally in ARWU Shanghai Subject Rankings. (July 12, 2019) <https://ucalgary.ca/news/ucalgary-top-5-nationally-arwu-shanghai-subject-rankings>

levels to help prepare and re-train talent. As of March 2020, UCalgary is offering a minor³⁰ in data science.³¹ In addition, UCalgary is offering a new master's program in software development³² and a graduate program in wearable technology.³³

The Southern Alberta Institute of Technology (SAIT) has broadened the scope of its curriculum and created more opportunities for students to interact with emerging technology. Students can develop expertise in unmanned systems through a rigorous curriculum that revolves around communication, navigation, mapping and data collection. Students also have opportunities to delve into clean technology development and research. The Centre for Innovative Information Technology Solutions (CIITS) at SAIT has scaled its radio frequency identification (RFID) research to include a wide variety of electronics and information-technology projects. In December of 2019, SAIT received a \$30 million donation to establish a new school that will provide the latest in digital education, allowing maximum change through technology, making SAIT a leader in digital transformation and education.³⁴

Mount Royal University (MRU) offers an information systems curriculum for students to explore programming, systems analysis, and systems design. Bow Valley College (BVC) has partnered with Adobe's Analytics Academic Initiative to deliver a diploma in digital design. In 2019 Bow Valley College became the first institution in Canada to partner with the IBM Skills Academy to offer courses on data analytics and other IT careers.

Canadian education company [Lighthouse Labs](#) has opened a satellite location at The Edison, a leading coworking space in Calgary, to provide a range of programs on web and front-end software development. Lighthouse Labs provides participants with a practical curriculum of in-demand development languages with onsite mentoring, peer-to-peer learning experiences, personalized career coaching and access to real-time online assistance. As well, the [Alberta Machine Intelligence Institute \(Amii\)](#) has begun to offer a [Machine Learning](#)

³⁰ This minor is a joint program between the math and computer science departments. At the graduate level, the University will be offering a certificate and a diploma in data science. The diploma can be completed in 8 months by a full-time student. The program initially accepted 25 students but is expected to grow to 75 students over the next few years. As well, students can now pursue a certificate in information security.

³¹ University of Calgary, UCalgary launches new graduate-level certificate and diploma programs in data science and analytics, University of Calgary. (April 27, 2018) <https://www.ucalgary.ca/news/ucalgary-launches-new-graduate-level-certificate-and-diploma-programs-data-science-and-analytics>

³² University of Calgary, University of Calgary launches new master's program in software engineering. (August 17, 2018) <https://www.ucalgary.ca/mediacentre/files/mediacentre/nr-techtalentmaster-final.pdf>

³³ University of Calgary, UCalgary launches program specializing in wearable technology. (August 29, 2018) <https://www.ucalgary.ca/utoday/issue/2018-08-16/university-calgary-launches-new-masters-program-software-engineering> (Accessed April 2019) (Note: Invalid link. No valid replacement link provided by UCalgary. (May 2020)

³⁴ Southern Alberta Institute of Technology, \$30 million gift to SAIT sets new course for the future. (December 3, 2019). <https://www.sait.ca/about-sait/media-centre/news-and-events/news/donor-stories/2019-12-3-bissett-announcement>

[Foundations](#) course in Calgary through the University of Alberta's faculty of extension in order to educate professionals on the applications of high-tech innovations to business.

Non-profit initiatives are also starting up to support Calgary's tech ecosystem. The recently launched [EvolvU](#) educational program offers participants the opportunity to learn more about software development, design and entrepreneurial thinking, user experience, product management, technical skills, sales and business management. The not-for-profit program aims to help address the tech talent skills gap in our fast-growing digital economy, and help professionals pivot to employment in tech. It is supported by Calgary Economic Development, Rainforest Alberta and the Hunter Family Foundation.

New initiatives are repositioning Calgary's talent base to align with in-demand skills. As problems faced by industry become increasingly rooted in the digital domain, post-secondary institutions must continue working to re-skill an already technical, energy-trained talent base to be capable of addressing these evolving challenges. Similarly, post-secondary institutions need to scale and realign their talent development programs to stay ahead of technological evolution. Furthermore, government partners need to support the efforts of post-secondary institutions to keep momentum going.

In December 2018, Calgary Economic Development collaborated with ICTC to launch a web platform that helps Calgarians transition towards digital-tech and in-demand roles within the region. This platform, [Calgary Upskill](#), showcases the skills gap between current professional occupations that are experiencing high levels of unemployment (such as petroleum engineers and geoscientists), and in demand occupations such as software developers. In many cases, the average high-tech worker has about half the necessary skills to transition into digital-tech roles. The platform provides users with an inventory of educational programs in the Calgary region and helps fill the remaining skills gap from local educational institutions.

To secure strong candidates in our evolving digital landscape, Calgary Economic Development continues to work on attracting and retaining top tech talent from other regions globally.

Other efforts that can be made to transition and attract workers to the tech sector in Calgary include:³⁵

- Promoting flexibility between the transitioning job seeker and employer
- Investing in on-the-job skills upgrading that is aligned with marketplace trends
- Identifying crosswalks between the skills of displaced workers and in-demand occupations
- Making technological innovation just as important as other core subjects in elementary, middle and high school

³⁵ ICTC, Mapping Calgary's Digital Future: Tech Employment Opportunities for Displaced Workers, Information and Communications Technology Council (ICTC). (January 2019)

With enhanced collaboration in industry, post-secondary institutions and government, Calgary has the potential to produce top tier talent at a scale needed to launch Calgary's tech ecosystem to the forefront.

FINANCING

GROWTH AREAS: INVESTMENT CLIMATE | NEXT STEP: MEET NEEDS OF STARTUPS

Calgary has high investment potential, with both private and public financing. With the rapidly changing technology landscape, there continues to be tremendous opportunities for investment in emerging, local technology companies.

Calgary's established investment community has been active in building and supporting energy ventures but is less familiar with the risk profiles and business models of high-tech startups. As Calgary's investment landscape evolves, having local investors learn to work with high-tech opportunities is part of building capacity in a globally-competitive innovation ecosystem. As the ecosystem matures, the community will foster a cycle of entrepreneurship at scale, increasing access to capital, and improving the competitive robustness of developing products and ventures.

"Investors need to realize that digital commercialization takes time and patience, and more money than most people are used to spend on marketing in Calgary."

Melvin Newman
President/CTO at [Patabid](#)

SCALING

GROWTH AREAS: MARKET PENETRATION | NEXT STEP: SUPPORT PILOT PROJECTS

Generally, small businesses move at a faster pace than large businesses. For this reason, the critical stage for any startup is the period between ideation and market penetration. The challenge for startups lies in that they must act fast to assess the product market fit due to time and financial constraints that prevent continually testing products in the marketplace.

Many established companies are cautious of integrating new technologies into their business strategies due to uncertainties in the rigorosity of product testing, the frequency of new developments in analytics techniques and the potential to disrupt everyday business activities. While challenges to technology adoption are not unique to Calgary companies, continuous collaboration between local technology developers and users can help build the community's resiliency and the potential strength of these relationships may even become a competitive advantage for the ecosystem.

To better tackle the challenge of market penetration, large or established companies should work with startups to streamline due diligence processes and support pilot projects. Startups need the opportunity to better convey how their technological advancements make a business more competitive. Beyond that, in this rapidly-advancing landscape, it would benefit businesses to be willing to integrate novel technologies. Under a transparent partnership, young companies can build credibility, collect feedback from users to refine their offering, and build referral networks, all the while helping established companies streamline their activities and become more successful.

Calgary-based accelerators, incubators, and organizations offer programs and services that encourage growth.

- [Startup Calgary](#) is a support organization helping entrepreneurs launch startups. Startup Calgary guides and supports tech entrepreneurs on their entrepreneurial journey, pointing them to what they need, when they need it. They offer a variety of events and programs to support entrepreneurs taking their potential ventures through ideation and conception stages. Startup Calgary also provides an excellent collection of resources for services, funding sources, mentors and connections for entrepreneurs and startups.
- [Platform Calgary](#) accelerates the impact of innovation-driven ventures by providing access to space, programs, mentorship and the capital to help at each stage of business. In partnership with the Calgary Parking Authority, Platform Calgary is developing a joint space for innovators called the Platform Innovation Centre in East Village. The \$80 million-dollar project will be a multi-use space for learners, projects, makers, and the community, and is slated to open in Fall 2020.
- The [Calgary Innovation Coalition \(CIC\)](#) is a group of organizations supporting innovation-driven entrepreneurs, startups, and enterprises to create a stronger entrepreneurial ecosystem in Calgary.

- The IBM and District Ventures [Calgary Innovation Space](#) was launched in 2017 and is an example of a large corporation partnering with a local enterprise to support entrepreneurs. The space offers support to growth-stage companies and the use of new technologies such as IBM Cloud and IBM Watson.

INTELLECTUAL PROPERTY OWNERSHIP

GROWTH AREAS: IP GREY SPACE | NEXT STEP: REWORK STATUS QUO

Legal barriers and grey areas are a key problem for startups trying to go-to-market and attract investors. For companies established from university research activity, most Canadian institutions follow the inventor-owned intellectual property (IP) policy. This policy states that although inventors own their IP, the university takes a financial stake in all future revenues. Startups and post-secondary institutions that collaborate with each other on ground-breaking projects tend to experience issues with ownership of intellectual property.

Valuing early-stage startups is often challenging when seeking early rounds of capital. From the startup perspective, the university's financial stake in the venture can be detrimental to their valuation. From the post-secondary perspective, there is a need to be compensated for the use of institutional infrastructure, systems and talent in the development of technologies.

Should post-secondary institutions take equity or a stake in royalty? Should society be allowed free access to university research, or should only individual companies be allowed access? These questions might create contentious answers and may lead to an impasse in reform efforts.

For startups developing their IP with the use of data from more established companies, problems may also arise over the ownership of the final product, especially when written documentation does not exist from an early stage. While multinational companies can afford the litigators and insurance policies to navigate uncertainties in agreements, startups and universities are the players who benefit the most from increased clarity in IP law. The mission to refine IP law suitable to high-tech environments is global, and Canada can look to the EU, Japan and Singapore for examples of legal systems and precedents related to AI and ML-related innovations.³⁶

COLLABORATION

GROWTH AREAS: OPEN LABS | NEXT STEP: LONG-TERM COMMITMENTS

Capturing the full value of data analytics requires significant collaboration between various players through different segments of the value chain. While startups and academic institutions may be developing new technologies to analyze and use big data, established companies are typically holders and owners of big datasets from which innovative analytics are hoping to derive new value.

³⁶ Lexology, "Artificial Intelligence and the Patent Landscape – Views from the USPTO AI: Intellectual Property Policy Considerations Conference." (2019) <https://www.lexology.com/library/detail.aspx?q=aba12d63-f0aa-417a-88f6-a84a687a8afd>

While industry and academia have worked to reduce silos over the last five years, Calgary's support systems for developing predictive analytics are fragmented with many knowledge gaps. Many enterprises are still early in developing their own capabilities for using big data across their organizations. The degree to which decision-makers throughout Calgary's ecosystem – in academic institutions, private enterprises, community, and government agencies – already embrace the opportunity of big data analytics is significant. Concepts of real-time processing, machine learning algorithms, and artificial intelligence are normal in current business conversations – the challenge is at what pace can Calgary's ecosystem turn these ideas into realities at scale in industry and community.

Calgary's academic institutions and industry share a symbiotic relationship. Research work in universities is taken up by industry and turned into products and services, while industry looks to academia to train graduates whose skillsets are aligned with industry requirements.

When talking to digital-tech companies, there is general interest in establishing a relationship with academia and government in the form of an "open-lab" cluster. Under this structure, post-secondary institutions, regional government, and industry partners collaborate to establish a network of shared infrastructure and undertake joint strategic projects. This ecosystem bridges the gap between research and implementation, provides practical experience for students and increases the pace at which companies can develop cutting edge technologies.

How does Germany make it work? Regional governments connect universities to German companies, tapping into university resources to pay university students' wages at 20 per cent below market rates. This promotes high-tech industry growth through long-term information exchange, short-term personnel exchange and adequate supply of labour and social engagement.³⁷

Comparative networks loosely exist in Canada. The extent of collaboration between industry and post-secondary institutions is hampered in part by the financing Canadian companies bring to the table. Typically, Canadian companies will outsource short-term research projects to graduate students who they pay between 60 to 70 per cent below market rates.³⁸ This proves to be a difficult framework for collaboration as post-secondary institutions cannot legally compete with industry consultancies and they need two to four years of funding before they can afford to bring on graduate students.

Calgary has seen large investments in the physical infrastructure supporting digital-tech activities. Co-working spaces such as Assembly, The Edison, Work Nicer, Infusion, The Commons, and WeWork are rapidly expanding, bringing with them a communal work culture conducive to collaboration. While collaborative physical spaces are important for

³⁷ Fraunhofer Institute for Systems and Innovation Research, The changing role of universities in the German research system: engagement in regional networks, clusters and beyond. (2010)
<http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.723.6911&rep=rep1&type=pdf>

³⁸ University of Calgary, Based on interviews with Computer Science Department.

anchoring an innovation ecosystem, programming and infrastructure that enables knowledge exchange and capacity-building are also critical to nurturing the growth and maturity of the community. The opening of the Platform Calgary facility will offer integrated work space and programming and advocacy for innovation-driven companies. Continued and deep collaboration between all involved in the digital-tech ecosystem is necessary to help all participants achieve their respective potential efficiently and effectively.

Greater alignment of efforts and resources are needed within Calgary's digital-tech ecosystem to achieve and maintain global competitiveness. Greater strategic collaboration should help reduce red tape, increase infrastructure investment, and improve talent development and retention. A regional "open-lab" cluster may be one model to explore but will require local companies, governments, and universities to all increase investments of capital and talent through multi-year commitments to support collaborative initiatives at a greater scale.

TOWARDS INCREASED COLLABORATION

Nurturing an open digital-tech ecosystem in Calgary will mean coordination across the private and public sectors, as well as knowledge transfer related to leadership, best practices, research, support and training.

A strategic approach in developing the AI space would require identifying existing areas of strength in the community that can be harnessed to create impactful collaborations. To promote entrepreneurial culture, one example could be for Calgary companies to pair with enterprise efforts of driving Silicon Valley companies, taking on joint initiatives that develop collaborative mindsets.

A recent Accenture study finds that IT professionals in Silicon Valley are twice as likely to participate in open-source projects than those in other jurisdictions.³⁹ Corporate innovation challenges could be one model to foster the development of these cultural characteristics. The same Accenture study identified that Silicon Valley professionals were highly active in peer networks and that organizations tended to encourage transfers of talent within their companies. These traits are already well established in Calgary's energy sector and are a part of Calgary's business cultural ethos. Calgary can adopt some of these practices for our local digital-tech sector.

1. Addressing the skills shortage

Calgary has identified a shortage of analytical talent, or data experts which range from data engineers to big data architects to data scientists. Local technology companies have experienced difficulty attracting and retaining these professionals. Through creating and scaling a well-networked data community, Calgary can become a showcase of [world](#) class expertise which will attract further talent.

³⁹ [Accenture, Outlook: California Dreaming. \(2014\)](#)

2. Accessible super computing power

Current state-of-the-art analytics algorithms require significant computation power, especially for large datasets. Computing resources that can be widely accessible and utilized by high school students and advanced experts, would be an excellent leap forward for the Calgary community.

3. Data sharing, standards, methodology, and governance

The involvement of multiple tools, software and datasets imparts complexity into the work of digital-tech companies. The initial ambiguity of social impacts related to using digital-tech products adds further challenges for decision-making. The needs to comprehensively explore considerations of “should” in contrast to the ambitiously of pushing boundaries of “could”. Appropriate governance of data, supported by robust management and operational policies and processes, will be critical to ensuring the needed balance of security and personal privacy with sufficient access to data.

Clear legal and governance requirements for data security, personal privacy, and intellectual property are needed to provide guidance for quick-moving organizations working in a quickly-evolving technological space. In addition to formal governance measures, developing local cultures that align with responsible data usage among businesses, tech developers, and IT professionals will provide a stronger foundation for trust that enables more robust sharing of data, tools, and methodologies.

4. Accelerating collaboration

There is opportunity to strengthen relationships and collaboration between Calgary’s investors, post-secondary institutions, technical institutes, technology accelerators and government to develop a coordinated network that supports ventures from ideation to commercialization.

A thriving digital-tech ecosystem can be built on the local base of technical industries that are rich with data – this can help nurture entrepreneurial mindsets in Calgarians, create safe opportunities for failure and learning, and provide stronger anchors for retaining talent.

THE OPPORTUNITY FOR CALGARY

How should Calgary in the global tech space be branded?

Calgary is branding itself in the global technology space through an open, collaborative environment, supporting a culture of innovation with continued investment in global success.

Calgary already exhibits positive factors when it comes to high-tech growth. According to a 2019 IDC Canada forecast, nearly \$7.5 billion will be spent by Calgary businesses on digital transformation between 2019 to 2022. This averages to a compound annual growth rate of 20 per cent.⁴⁰ Of these sectors, the top three investors will be energy (\$1.9 billion), creative industries (\$1 billion) and life sciences (\$627 million).⁴¹

While the Calgary region has a demonstrated record of local companies successfully growing into mature organizations, more support is needed for startups to maintain a thriving pipeline of upcoming ventures. Calgary is also currently home to 62 per cent of Alberta's technology startups, 55 per cent of private tech companies, and 50 per cent of the province's funders.⁴² Between 2016 and 2018, the number of early stage startups in Calgary decreased by 12 per cent while there was an equivalent increase (12 per cent) in companies maturing to later stages of development.⁴³

The data analytics landscape in Calgary has developed remarkably and new advances in technology are paving the way for more breakthroughs. To remain competitive, Calgary needs to create a supportive ecosystem that can enable and nurture fast-paced growth and collaboration in the digital-tech community. This includes helping develop tech-talent to address current and future potential skills gaps, maturing network capabilities related to data governance and management, and fostering evolutions in local culture that enable a data-driven community. Truly collaborative ecosystems that accelerate the development of AI innovations tear down silos and strengthen working relationships within and across organizations. It's time to help Calgary's ecosystem embrace every member as a valuable contributor who drives success.

⁴⁰ IDC Canada and Calgary Economic Development, DX Spending Statements. (2019)

⁴¹ IDC Canada and Calgary Economic Development, DX Spending Statements. (2019)

⁴² Alberta Enterprise Corporation, 2018 Alberta Technology Deal Flow Study. (2019)

⁴³ Alberta Enterprise Corporation, 2018 Alberta Technology Deal Flow Study. (2019)

We wish to thank the following companies for their valuable insight into Calgary’s data analytics landscape. These interviews informed the findings and insights for this paper.

[Amii](#)

[Routeique](#)

[Altus Group](#)

[PataBid](#)

[chata.ai](#)

[SAIT](#)

[CMO4Hire](#)

[SAS](#)

[Cybera](#)

[Sidekick](#)

[Dr. Bob Hayes](#)

[StellarAlgo](#)

[Dr. Alexander Whalley](#)

[University of Calgary](#)

[Drew Gillson, AI Meetup](#)

[Validere](#)

[Envio Systems](#)

[Vivametrica](#)

[EZ Robot](#)

[White Whale Analytics](#)

[Robots & Pencils](#)

[Zeel GIS Solutions](#)