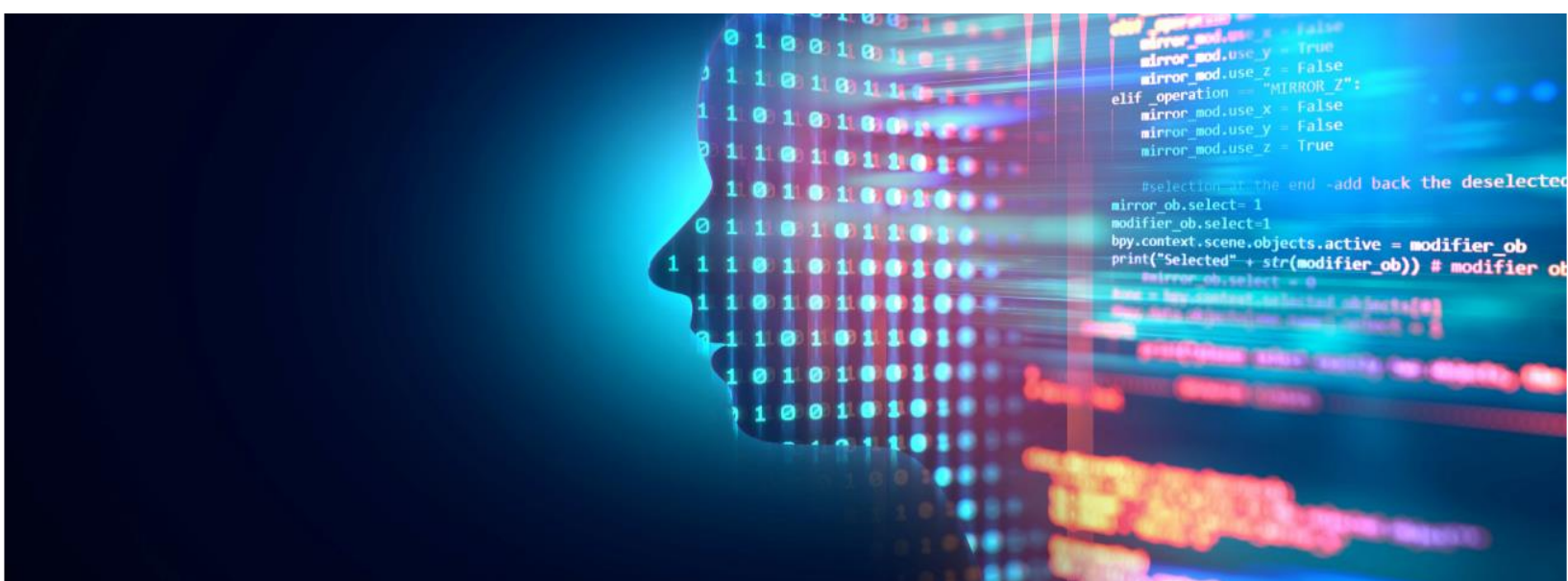


On The Edge of Tomorrow: Canada's AI Augmented Workforce



Study Scope

*(*The findings of this report have not been adjusted for the impact of COVID-19*)*

This report explores the current state of artificial Intelligence (AI) technology development, identifies Canada's greatest strengths in AI innovation, its regional development hubs, and discusses the implications of AI in the Canadian labour market.

On the Edge of Tomorrow: Canada's AI-Augmented Workforce also describes

- Occupations most likely to be augmented by AI
- Correlation of AI augmentation to wages
- International trends in AI
- Role of venture capital and corporate investment in AI
- AI in strategic sectors of the economy

Study Context

AI is a transformative technology with the potential to fundamentally alter Canada's labour market and business operations by generating new efficiencies, identifying hidden patterns, and automating tasks.

Prior to the 2008 global recession, AI existed more as a concept rather than a tool for many SMEs. Following this downturn, many businesses around the world began the acceleration of automation and

the application of AI to real-life challenges. As AI began to develop roots in the economy, increased network connectivity, the availability, affordability of sensors, the advent of big data, and the exponential growth of computational power supported its growth.

According to PwC study, AI adoption and implementation will add 10% in GDP across all industries by 2030.

The disruptive potential of AI requires responsible deployment. Canada is currently seen as a global leader in pathways for advancing ethical or responsible AI.

General Study Findings

ICTC's AI Labour Augmentation Model anticipates that many lower-wage jobs, such as customer-service representatives or entry-level administrative roles can be augmented by AI.

However, numerous high-wage occupations are equally at risk of being augmented by AI. These include auditors, financial analysts, and healthcare information management practitioners.

It is imperative these occupations are supported by training options that teach new competencies that lead to value-added work with better compensation. An effective strategy of upskilling and, in some cases, retraining will be needed to help Canadians prepare for a future where AI is no longer a "nice to have" but an essential component of the economy and society.

Key Concepts: General versus Narrow AI

- Artificial General Intelligence refers to the notion that a machine can eventually learn and mimic the human brain, i.e., the ability of a machine to perform any task that a human can. Some AI experts believe that this level of capability is inevitable given exponential developments in the field. Others believe Generalized AI will never be reached, given that human intelligence is multidimensional and that the human brain is impossible to model.
- Artificial Narrow Intelligence refers to what is possible with today's AI technology. It is highly limited to predefined functions. It does not include self-awareness or genuine intelligence. Narrow AI relies on vast amounts of data, predictive analytics, and machine learning to develop algorithms to solve problems and enable self-driving cars, recommender engines at Amazon or Netflix, facial recognition, etc.

Key Findings: AI in Canada

Canada is frequently identified among the global leaders in AI-related research.

In 2017, Canada was among the first countries to announce the development and framing of a national strategy for AI.

In 2018, a study by Element AI ranked Canada third in the world for the concentration of AI researchers, surpassing traditional leaders such as France and Germany.

A survey of global AI companies found that Canada has the highest proportion of AI ethics committees.

Canada has three regional AI hubs:

Montreal

Montreal is a global leader for AI research, with notable strengths in the area of Deep Learning. SCALE.AI is the body behind Canada's AI innovation supercluster based in Montreal.

- The Montreal Institute for Learning Algorithms (MILA) is comprised of over 300 researchers and doctoral students in AI-related fields. MILA works on deep learning, deep nets, computer vision, neural networks, etc.
- Examples of AI supercluster work includes Local Line, a food wholesaler working to reduce transportation costs for farmers and generate efficiencies through AI.
- IVADO Labs advances AI technologies from academia to commercialized products.
- Facebook's AI Research lab in Montreal produces fundamental research in national security, media, and medical imaging.
- Samsung's AI Centre focuses on research into machine learning, language understanding, and the next generation of semi-conductor development.

Toronto

Toronto is another world-class centre of expertise for AI, backed by academic institutions such as the University of Toronto (U of T).

- U of T programs include Computer Science with a Minor in AI engineering, a number of AI certificates, a Master's of Management Analytics, and Canada's first engineering undergraduate program in machine intelligence.
- Real estate consultancy CBRE identified Toronto as the fastest-growing tech market in North America, with the highest concentration of AI startups in the world.
- Vector Institute, Uber AI Labs, Nvidia's AI Research Lab, etc. are part of the city's AI ecosystem.

Edmonton

Edmonton is also considered a top Canadian AI research centre, specifically in machine learning.

- The Alberta Machine Intelligence Institute (AMII) is home to some of the world's most recognized experts in machine intelligence.
- In 2018, the city was ranked third globally for AI and Machine Learning Research.
- The University of Alberta is a top producer of academic papers on machine learning.
- A portion of AMII's government funding is dedicated to commercializing Alberta AI technologies.
- The Reinforcement Learning and Artificial Intelligence (RLAI) Lab and the expanded Google DeepMind research office is in Edmonton.

Venture Capital and Corporate Investments

Growing corporate investments and acquisitions in the Canadian AI suggests a maturing ecosystem.

In 2018, venture capital funding for Canadian AI businesses increased by approximately 50% from the previous year, with companies raising \$418 million (USD).

AI and the Labour Market

Indeed.com reports that demand for machine learning engineers, data scientists, and computational linguists have doubled in the last three years. AI job postings overall rose by 29% from 2018 to 2019.

Talent Demand

- Research by Paysa shows 35% of all AI positions require a PhD, with another 26% requiring a Master's degree.
- AI specialists such as machine learning engineers or deep learning engineers are currently in short supply in Canada and around the world.
- Wages for the most prestigious AI specialists in the US can range from \$300,000 to \$500,000/yr.
- Many AI companies hire top academics and professors on a part-time basis.

ICTC's AI Labour Augmentation Model

The AI Labour Augmentation Model ranks Canadian occupations by likelihood of AI augmentation.

Most Susceptible Occupations to AI Augmentation

(10 is most susceptible, 0 the least)

1. Accounting technicians and bookkeepers	10
2. Data entry clerks	9.8
3. Payroll administrators	9.7
4. Health information management occupations	9.6
5. Executive assistants	9.5
6. Court reporters, medical transcriptionists and related occupations	9.4
7. Administrative assistants	9.3
8. Medical administrative assistants	9.2
9. Financial auditors and accountants	9.1
10. Shippers and receivers	8.6

High-wage, high-skill roles susceptible to AI augmentation

1. Health information management occupations	9.6
2. Financial auditors and accountants	9.1
3. Database analysts and data administrators	8.3
4. Financial and investment analysts	8.0
5. Civil engineering technologists and technicians	8.1
6. Assessors, valuers and appraisers	8.1
7. Computer network technicians	7.6

AI Augmentation Resistant Roles

1. Psychologists	2.7
2. Registered nurses, registered psychiatric nurses	2.6
3. Paramedical occupations	2.1
4. Senior managers: financial, communications, business services	2.0
5. Dentists	1.9
6. Professional occupations in religion	1.8
7. Senior government managers and officials	1.7
8. School principals, administrators elementary/secondary education	1.4
9. Commissioned police officers	1.3
10. Legislators	0.2

AI in Strategic Sectors

AI is increasingly important to the following sectors of the economy.

- **Agri-foods and Food-tech:** A study from Goldman Sachs estimates that AI-powered precision farming could result in a 70% yield increase worldwide by 2050.
- **Health and Biotech:** Healthcare equipment and services, pharmaceuticals, biotechnology and life sciences are expected to benefit from AI's ability to process and analyze vast amounts of data to help scientists identify and synthesize new drugs, and other advances.
- **Clean resources:** AI is expected to improve extraction processes and advance carbon-neutral resource utilization.
- **Advanced manufacturing:** AI will help enhance productivity, boost output and generate efficiencies essential to remaining competitive in an increasingly connected global economy.

Ethics and Transparency

While it is tempting to place substantial trust in AI, it is not a neutral or unbiased intelligence built entirely on logic and facts. AI is ultimately a human construction that reflects human beliefs, biases, social norms, and values.

Beyond the privacy implications of AI's reliance on large-scale data collection and usage, AI developers are increasingly addressing concerns of sampling bias and other ethical issues by forming AI advisory committees to monitor and validate results.

- Facebook's Applied Machine Learning group works to remove spam from newsfeeds, search for fake accounts, and address content moderation concerns.
- The European Union is developing guidelines for ethical AI that are transparent, explainable, and can be understood by humans.