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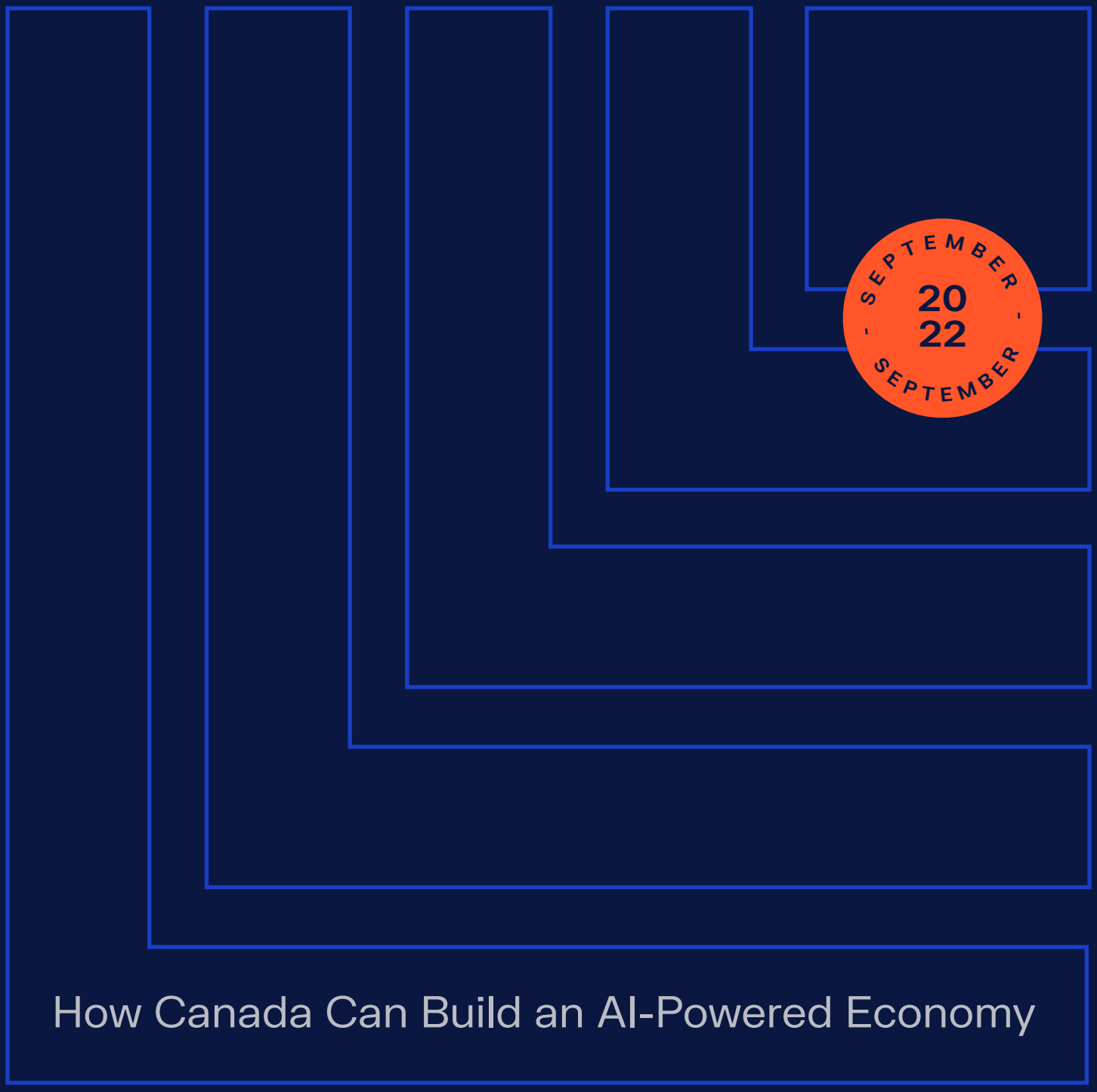

How Canada Can Build an AI-Powered Economy

AI at Scale

SCALE|AI

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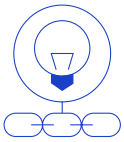

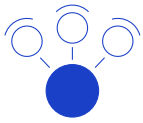

Introduction

Over the recent decades, Canada has played a significant role in the advancement of AI research and has gained global recognition as a leader in the field. Translating those achievements into wide-spread economic wealth for Canadians requires an interconnected network of different entities working together to create market-ready AI-based products and services, in other words a mature AI innovation ecosystem.

The objectives of this report are threefold. The first goal is to analyze the current state of AI research and industry adoption in Canada and to contrast it with the situation in peer countries.

Secondly, the report aims to identify levers for policy makers, businesses, investors and other ecosystem members to lift Canada's AI ecosystem to the next level. One the one hand, we aim to provide policy makers with an up-to-date fact base on the state of AI in Canada. Analyzing the development of AI in Canada over time will reveal where to focus our limited resources and what policy levers will be most impactful to drive value for Canadians. On the other hand, we also see this report as a call-to-action for business leaders in Canada. We need Canadian businesses to step up their game, particularly regarding wide-spread AI diffusion. This report will provide business leaders with insights where some of toughest challenges lie and how to tackle them.

Lastly, we also hope that this report will trigger a constructive debate among ecosystem members on how to accelerate the deployment of AI across industries to drive massive productivity gains for companies of all sizes. We encourage all ecosystem members to dive into our report, share it with their network and engage in a constructive dialogue on our findings and recommendations. We will be publishing regular updates of this report to track Canada's program and welcome feedback from all parties that may inform future editions of this report.

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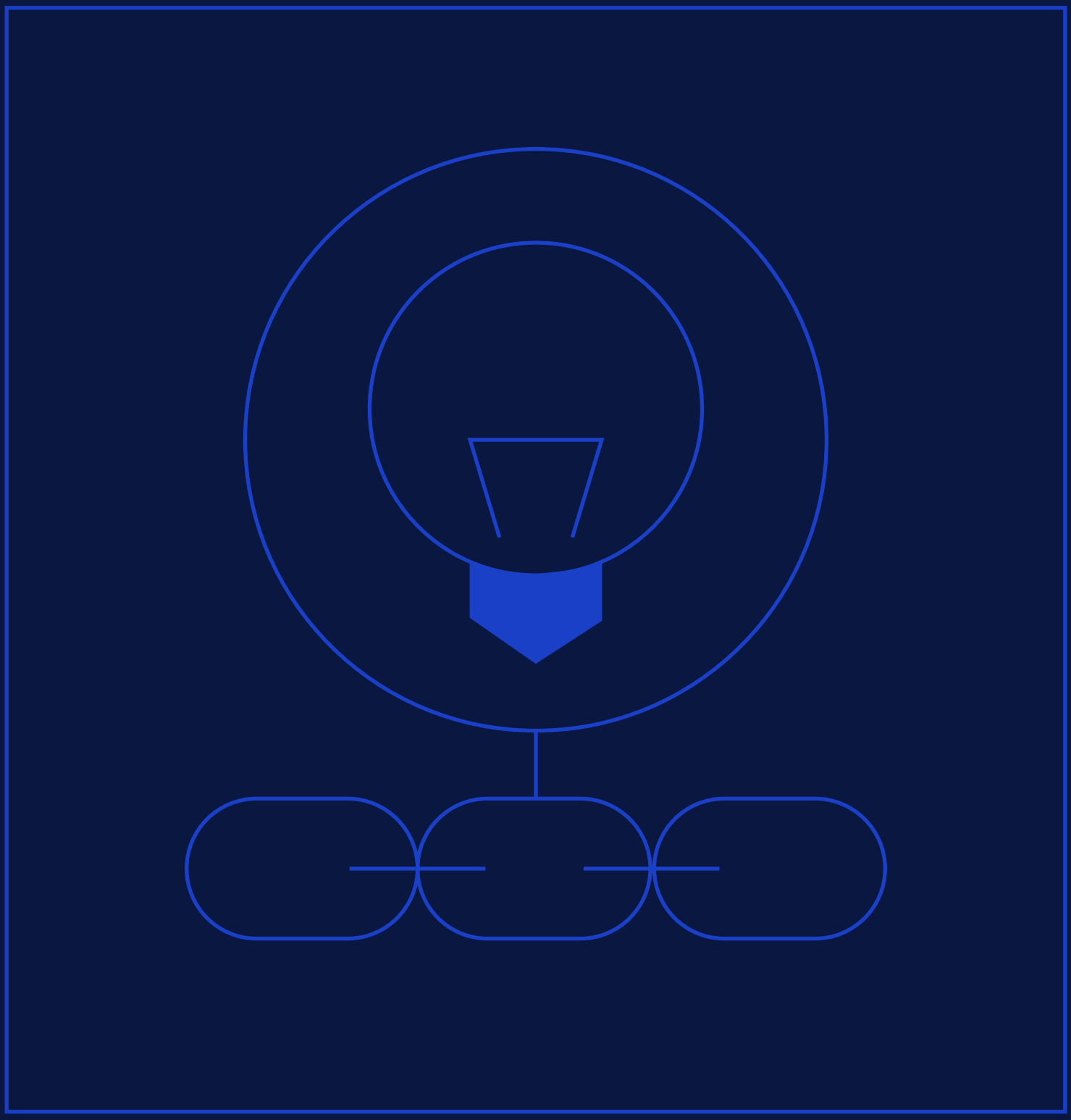


The AI Innovation Value Chain

The AI Innovation Value Chain

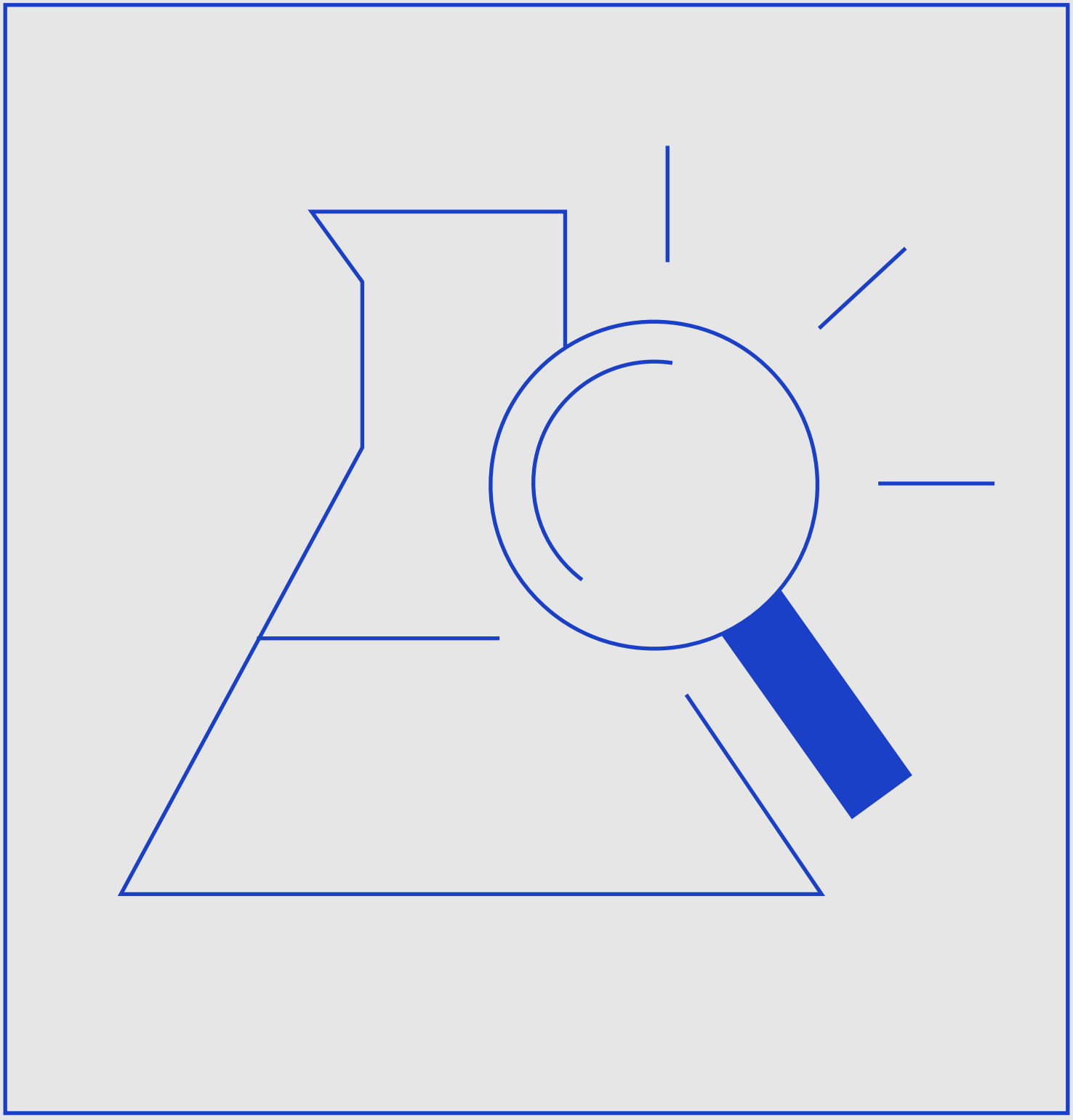
Analyzing the state of AI in Canada is a daunting task given the number of players and interdependencies that are involved in driving innovations and making them usable for businesses to benefit the broader economy and society. For this report, we are leveraging the Innovation Value Chain approach, which breaks up the innovation process in three phases: idea generation, conversion/early adoption and diffusion.[1] Based on Scale AI's work over the last several years at the heart of the AI ecosystem, we further tailored this approach to address the specificities of the Canadian AI landscape. The objective of our value chain framework is to make a very complex system manageable to analyze and draw actionable conclusions. Like every framework, it is a simplified view of the innovation process, which is hardly linear, but often shaped by feedback loops and serendipity.

The first element of our value chain is focused on Research & Development. This entails researchers working at universities, in specialized applied research centres or in corporate R&D labs to generate new knowledge and approaches in the field of Artificial Intelligence. To measure Canada's performance in this area, we analyzed both the input and output side of R&D. On the input side, we looked at R&D financing (public & private R&D budgets) as well as the quantity (breadth) and quality (depth, i.e. representation among top publishers) of AI researchers, and in particular applied researchers. On the output side, we analyzed Canada's publication of scientific papers and patent filings versus peers over time.

The second link in our chain is focused on Early Adoption, which is about converting AI research into novel products and services. This step includes AI Service & Solution Providers (AI SSPs), often start-ups and SMEs, creating new commercial products and services, as well as adopting companies that implement AI pilots in-house. We started by analyzing Canada's AI start-up ecosystem at a high-level, comparing the overall number of AI start-ups in Canada as well as birth and attrition rates over time compared to peer countries. We then dug deeper into the drivers behind Canada's AI start-up performance by analyzing the network of incubators and accelerators, access to venture capital and institutions facilitating access to local and global industry demand. Access to talent also plays a role, but while applied research talent (data scientists, ML engineers) still matters, entrepreneurial talent (founders, product managers, etc.) is equally if not more important in this stage. On the adoption side, we leveraged publicly available data to understand how Canadian companies are faring on implementing AI pilots in-house or by collaborating with external providers. This time as well, we strove to identify the underlying drivers of AI adoption, which includes both structural factors (i.e. those based on the nature of the Canadian economy) as well as firm-specific factors (i.e. those that pertain to the specific choices made by a company).

The last element in our framework is about AI Diffusion, meaning businesses scaling proven AI solutions across their organization and industry to reap the full potential of AI. While AI pilots can often be implemented even with smaller, disparate data sets, deploying AI at scale requires a critical level of digital maturity and data infrastructure to succeed. Most companies reaching this stage have built their own internal AI capabilities, and gained access to sufficient technical AI talent, which has been a persisting pain point in Canada. Key enablers for diffusion are investment in infrastructure, continuous executive sponsorship and the right organizational culture as scaling AI, which by definition, need larger investments and longer time commitment than running a pilot.

1. Harvard Business Review (2007): The Innovation Value Chain.



R&D: Canada as an AI R&D Powerhouse

R&D: Canada as an AI R&D Powerhouse

Overview

Over the last decade, Canada has established itself as an AI R&D powerhouse. Pioneering Government programs and reliable public funding allowed Canada to develop leading AI institutions, contributing to the attraction of top research talent from abroad and the accumulation of a critical mass of AI researchers.

As a result, Canada is now strongly represented among the global AI research elite. Even more important for the commercialization of AI innovations, Canada also has the second highest number of industry-affiliated AI researchers, driven by our strong applied research centres and numerous corporate R&D centres.

So far, however, these strengths have translated into limited Canadian-owned IP. We believe that underutilized partnerships between Canadian industry and academia is one main driver for this. Two examples illustrate this point. Firstly, most corporate R&D labs/centres in Canada were actually created as partnerships with foreign companies and only very few Canadian firms have set up R&D labs/centres with academia so far. Secondly, Canadian firms only invest less than 1% of GDP in R&D (incl. AI), significantly less than their OECD counterparts.

Pioneering Government Strategy & Reliable Public Funding

Canada was the first country to define and implement a national AI strategy in 2017. Led by the Canadian Institute for Advanced Research (CIFAR), Canada's national AI strategy prioritized educating, recruiting and retaining researchers working at the leading edge of AI, and providing strong support for top-notch applied research centres.

Shortly after, Scale AI was established jointly by industry and academia in response to the Innovation Supercluster Initiative (now known as the Global Innovation Cluster Initiative) led by Innovation, Science and Economic Development (ISED) Canada. As Canada's AI Global Innovation Cluster, Scale AI identifies cross-sector collaborative projects and provides funding and expert guidance to start-ups, SMEs and large industry players. Other federal programs, such as the 2017 Canada Research Chairs Program, further helped to attract top research talent from abroad and managed to create a critical mass of research expertise. Those national initiatives were supported and multiplied by Provincial Governments.[1]

However, while Canada was one of the early movers with regards to dedicated public policy support for AI R&D, other countries have now caught up and partially surpassed Canada in terms of public funding. For instance, the US, Germany and France have all launched their own national AI strategies and committed more funding than Canada, both in absolute terms and on a per capita basis. While it is difficult to obtain an exhaustive view of all AI government funding across countries, our analysis suggests that in 2021 non-military AI funding was ~USD1.3B in the US, ~USD800M in Germany, ~USD360M in France and ~USD110M in Canada.[2]

Strong International R&D Partnerships

The strong Government support for AI R&D in Canada has attracted an increasing number of international firms to set up AI-specific R&D labs and centres in Toronto, Vancouver, Montreal and Waterloo.[3] On the one hand, those R&D centres have facilitated international research partnerships (80% of Canadian AI research publications from 2015-19 were the result of international collaboration, vs. 51% in the US over the same period[4]). On the other hand, those R&D centres contribute to the brain drain of Canadian AI talent. For instance, US firms that set up R&D centres in Canada (including Meta (Facebook), Google, IBM, and Microsoft) keep ~70% of AI implementation staff in the US, often using their R&D labs in Canada as recruiting pools.[5]

1. University of Toronto: Canada's AI Ecosystem.
2. Stanford University: Artificial Intelligence Index Report 2021; Strategie Künstliche Intelligenz der Bundesregierung Fortschreibung 2020.
3. JFGagne - Global AI Talent Report 2020.
4. JFGagne - Global AI Talent Report 2020.
5. CSET (2021): Mapping U.S. Multinationals' Global AI R&D Activity. Included companies for staff are Amazon, Apple, Meta (Facebook), Google, IBM, and Microsoft.

Canada is Producing High Quality AI Research

As a result of targeted public policy support and investments from foreign firms, Canada is now well positioned within the global AI research elite. This is illustrated by the number of papers accepted at two of the leading global AI conferences, the International Conference on Machine Learning (ICML) and the Neural Information Processing Systems Conference (NeurIPS). While ranking 4th on the total number of accepted AI publications, Canada ranks 2nd in terms of per capita publications with a growth rate only outpaced by China.[6]

With regards to the absolute number of AI researchers, Canada is still somewhat lagging behind peers in absolute terms, but already ranks second in per capita terms, growing faster than any of its peers.[7] Further, Canada has the second highest number of industry-affiliated AI researchers, driven by its strong applied research centres.[8]

Canada ranking 4th (up from 5th YoY) on total number of top AI publications and 2nd per capita with a strong growth rate

Papers at top conferences[A]	Totals 2020 (per 1M ppl)	CAGR vs 2019 (Rank 2019)
	1,678 (5)	+33% (1)
	281 (<1)	+52% (2)
	161 (2)	+28% (3)
	115 (3)	+43% (5)
	103 (2)	+9% (4)
	92 (1)	+42% (6)

Canada lagging peers in number of researchers, but catching up quickly due to a fastest growth rate among peers

AI Authors on arXiv[B]	Totals 2020 (per 1M ppl)	CAGR 2017-2020
	26,818 (81)	+56%
	6,401 (5)	+65%
	2,974 (44)	+52%
	2,775 (41)	+44%
	2,660 (32)	+68%
	2,201 (58)	+73%

A. Full paper equivalents at the International Conference on Machine Learning (ICML 2020) and Neural Information Processing Systems (NeurIPS 2020); CAGR 2019-2020 (Gleb Chuvpilo)
B. Based on the AI/ML (cs.AI, cs.LG and stat.ML) repositories on arXiv. ArXiv is where researchers pre-publish their papers (i.e. prior to peer review for acceptance to a publication or conference 2) and is perhaps the closest thing there is to a census of AI research. It also gives a much broader view of AI growth by including papers on applied methods. CAGR 2017-2020 (JFGagne - Global AI Talent Report 2020).

Canada is well-represented among global top publishers (depth) and also catching up rapidly on overall number of AI researchers (breadth).

Almost Half of AI Patents are Owned by Foreign Firms

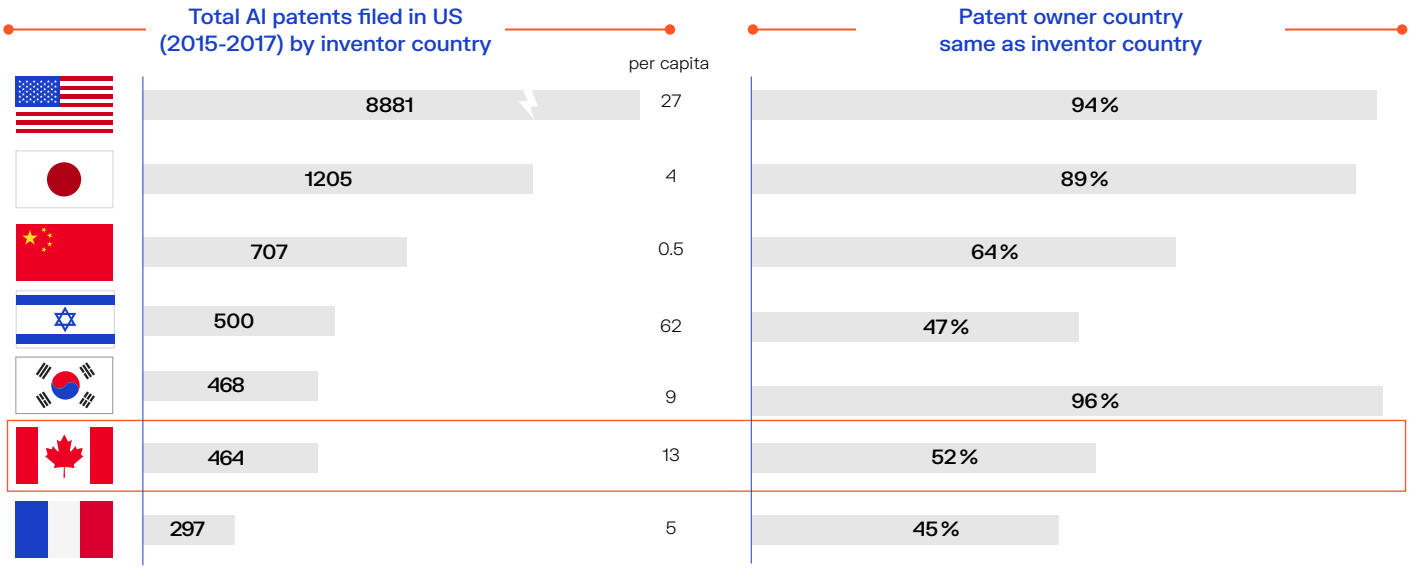
When it comes to R&D outputs, patents are not a strong quantitative indicator of AI R&D activity for several reasons, including that the uncertainty surrounding patentability of AI and software in the US following recent US Supreme Court decisions tends to discourage filing, as well as a marked preference in AI for other IP measures such as trade secrets and open source. Nevertheless, the ready availability of patent data makes it a useful qualitative indicator of trends.

While US inventors have an unsurprising lead in total AI patent filings, filings based on the work of Canadian inventors is on the rise, putting Canada in the top three inventor nations on a per capita basis.[9]

6. Gleb Chuvpilo (2020): Who's Ahead in AI Research in 2020? Insights from the International Conference on Machine Learning (ICML 2020).
7. JFGagne - Global AI Talent Report 2020. Based on the AI/ML (cs.AI, cs.LG and stat.ML) repositories on arXiv.
8. JFGagne - Global AI Talent Report 2020. Data represents researchers affiliated with industry or who research professionally in the private sector, mostly based on LinkedIn data.
9. Based on data from UK Intellectual Property Office: Artificial Intelligence, A worldwide overview of AI patents and patenting by the UK AI sector (2019); dataset at

US inventors lead for total AI patents, but Canadians are 3rd on a per capita basis

Canadian companies own just over half of AI patents invented by Canadians



Source: A re-analysis of data from UK Intellectual Property Office: Artificial Intelligence, A worldwide overview of AI patents and patenting by the UK AI sector (2019); dataset at https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/808699/AI-raw-data.csv/preview.

Canadian inventors are inventing - but foreign firms are patenting.

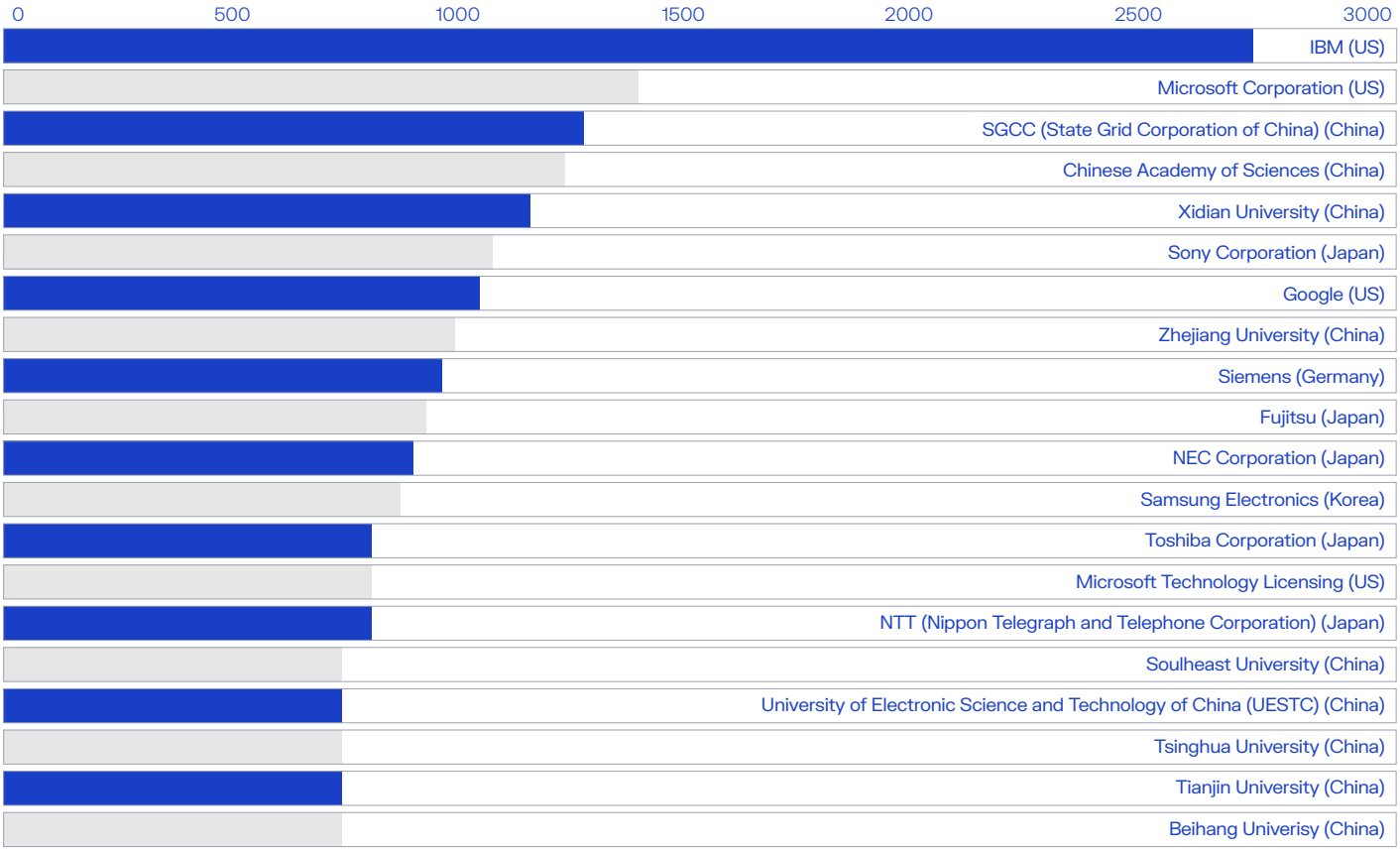
However, almost half of those patents were filed by the foreign-based employers of those Canadian inventors. Foreign-ownership of Canadian-invented patents is significant, although the data shows that this is by no means a uniquely Canadian problem. Indeed foreign ownership of AI patents seems to be the rule, outside of the US, Japan, China and Korea. However, focusing on Canada, when we look at AI patents filed globally between 1998 and 2017, no Canadian company is found among the top 20 applicants.[10] Scale AI's interactions with its ecosystem has also gathered testimonies and observations concluding that a significant amount of the AI IP generated in Canada is owned by foreign firms.

Foreign direct investment (FDI) in the Canadian AI ecosystem, and the relatively higher propensity for firms from the US, China, Japan and Korea to patent their AI outputs, are contributing factors to high foreign ownership of AI patents. While FDI does have beneficial and widely-recognized effects on growing portions of Canadian ecosystems, it is clear that FDI alone will not help Canada meet its objectives to develop a fully-functioning AI ecosystem.

https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/808699/AI-raw-data.csv/preview

10. UK Intellectual Property Office: Artificial Intelligence, A worldwide overview of AI patents and patenting by the UK AI sector (2019).

Top applicants by total number of AI patents, 1998-2017[A]



A. UK Intellectual Property Office: Artificial Intelligence, A worldwide overview of AI patents and patenting by the UK AI sector.

No Canadian company among top 20 AI patent applicants between 1998-2017.

Recent investments by various levels of government in Canada, including those made through Scale AI, have been aimed at this deficiency in Canadian IP ownership by incentivizing Canadian firms, small and large, to build their AI IP portfolios. While it is still too early for data to show whether these recent government investments are bearing fruit, it is nevertheless imperative for Canada to keep a strong focus on this issue of growing domestic ownership of AI IP.

However, IP plays only a supporting role in business - IP can help make good companies great, but cannot by itself make any company succeed - and therefore the present IP landscape is only a symptom of the underlying issues. Focusing only on IP growth will not sustainably bear fruit for Canada. A larger perspective is required.

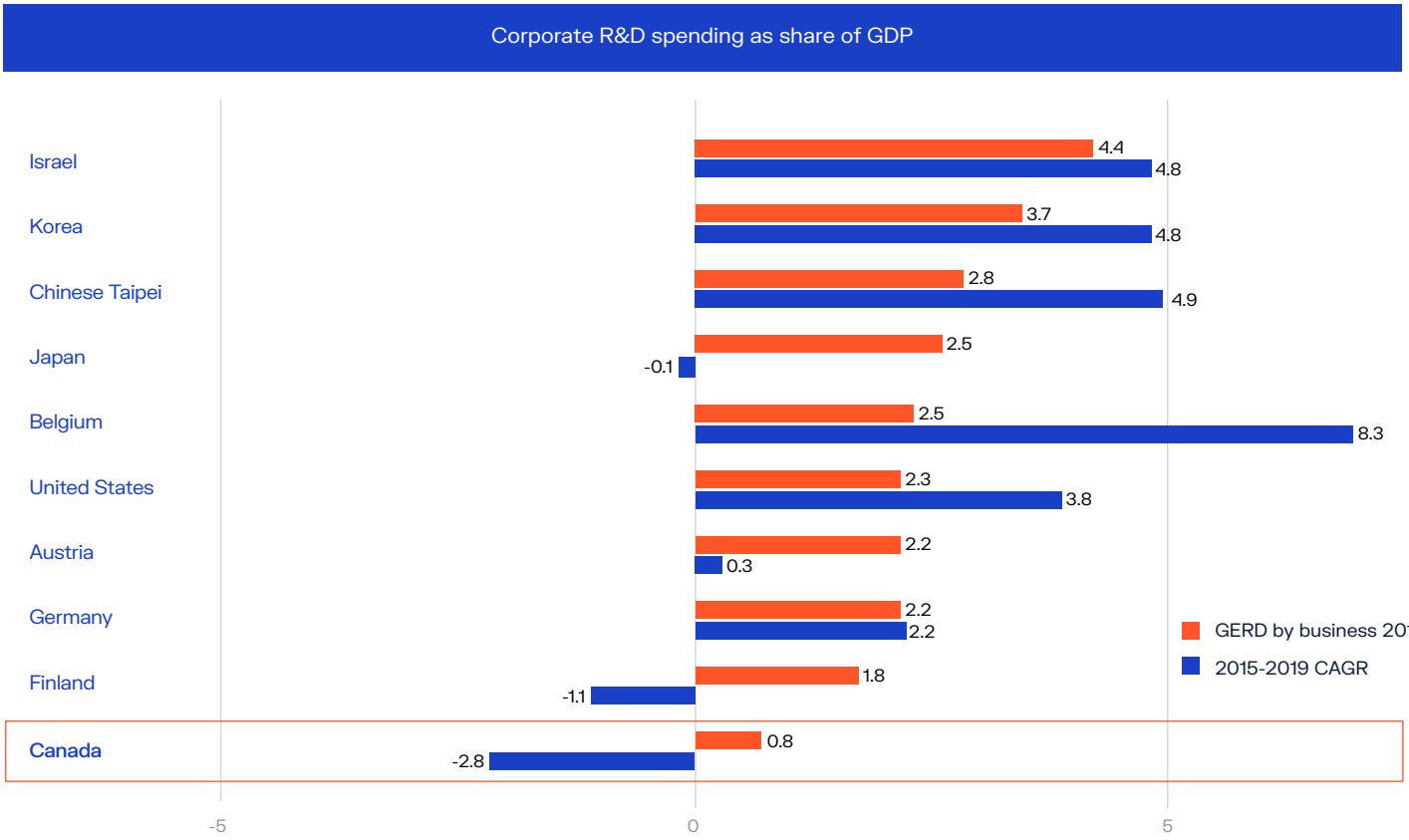
The Need for Canadian AI Leaders

One important reason for the relatively low percentage of domestic ownership of AI IP can be traced to the low number of Canadian-based companies that have established AI-specific R&D centres or relationships in Canada. In the last 10 years, at least 45 foreign-based companies have set up such AI R&D centres in Canada (including Microsoft, Google, Uber, Thomson Reuters, Samsung, IBM, Amazon, Intel, NVIDIA, LG Electronics, General Motors and others), yet in the same period only 2 Canadian-based companies (RBC and TD) have similarly established AI R&D centres in Canada.

This lack of Canadian industry-based AI R&D is reflective of two broader patterns in the Canadian corporate sector. Compared to peer countries, Canadian firms invest less than 1% of GDP in overall R&D, including AI. Even more alarming, that share has been declining by ~3% every year since 2015, widening the gap vs. peers.[11]

11. OECD: Gross domestic expenditure on R&D by sector of performance and type of R&D (https://stats.oecd.org/Index.aspx?DataSetCode=GERD_TORD#).

Further, from our interactions with hundreds of organizations in the ecosystem, we observed that for many Canadian companies it is still not common to collaborate with academic institutions to access top research talent and jointly drive innovation.

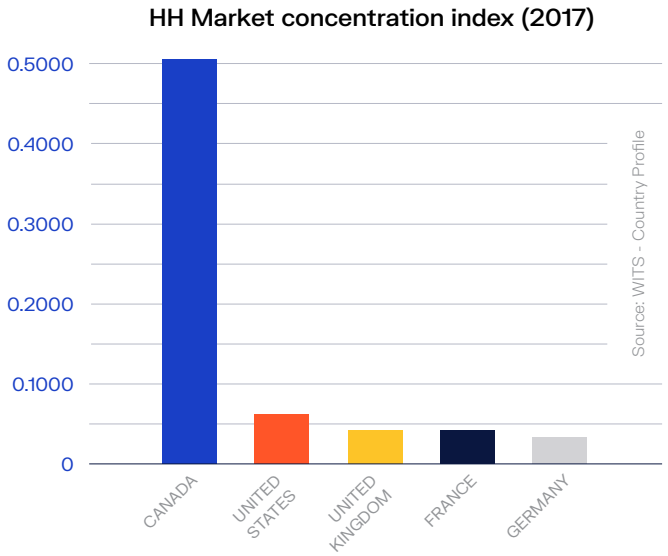


Source: OECD: Gross domestic expenditure on R&D by sector of performance and type of R&D (https://stats.oecd.org/Index.aspx?DataSetCode=GERD_TORD#)
A. GERD: Gross expenditure on R&D.

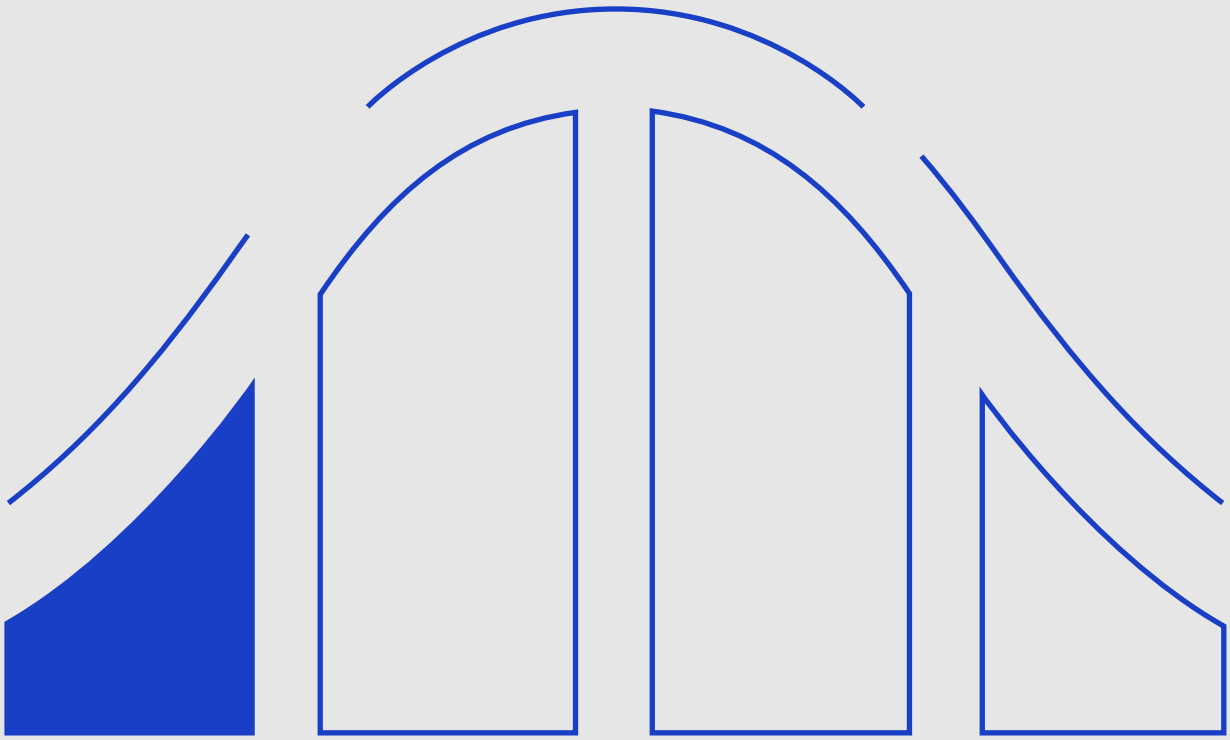
Canadian corporate R&D represents only 0.8% of GDP (#23), with an annual decline of 3% since 2015, widening the gap vs. leaders.

These challenges are further exacerbated by structural barriers that hamper innovation among Canadian companies. These include strong market concentration on certain sectors lowering competitive pressure to prioritize innovation budgets, as illustrated by the Hirschman-Herfindahl market concentration index, which was 10x higher in 2017 in Canada (0.51) compared to the US, UK, Germany and France (between 0.04-0.06).[12] Further barriers include a comparatively higher risk-averse corporate culture and lacking investments in digital infrastructure and systems, which are analyzed in more detail in the third section of this report.

While some of these factors are not specific to AI, it will be imperative to address them in a holistic way in order to support the emergence of Canadian-based AI leaders and to foster the growth of a robust AI ecosystem in Canada.



12. Worldbank: HH Market concentration index By Country 1988-2019.



Early Adoption:
Canadian Firms Slowly Catching Up

Early adoption: Canadian Firms Slowly Catching Up

Overview

The Early Adoption step of the innovation value chain includes new AI products and services developed either by AI Service & Solution Providers (AI SSPs), often start-ups and SMEs, and/or by companies that implement AI pilots in-house.

Canada has created a strong launchpad for AI start-ups, based on a dense network of R&D institutions (see previous section), incubators and accelerators, and favorable immigration policies that attract founders of start-ups. However, we are struggling with scaling up start-ups as they face several challenges to survive and grow in Canada. The main ones are: a lack of sufficient talent supply to enable growth and a lack of domestic demand from industry adopters.

Canadian firms have been catching up on early adoption over the last three years as we are seeing a steady increase in the share of businesses that have experimented at least once with AI, but we are trailing behind our peers. That being said, our global peers have higher shares of early adopters which has further implications: falling behind in early adoption results in lagging diffusion as well (as early adoption is a necessary condition for the latter). In most of our peer countries, a large share of successful early adopters have already entered the diffusion phase and have become seasoned AI adopters. AI, by nature, relies heavily on reiterations and feedback loops. While we are stalling the launch of AI initiatives, our global competitors implement algorithms that keep getting better with time. Since foreign companies are getting more skilled in AI, they launch more advanced AI solutions, reinforcing and widening the productivity gap.

Strong Start-up Birth Rate Fostered by Dense Support System

Canada now has an extensive network of over 30 business accelerators and incubators (BAIs) supporting AI start-ups, providing them with hands-on advice, mentorship, market insights and subject matter expertise, along with marketing opportunities, networking and critical connections to capital, talent, and customers. BAIs aim to empower the next generation of global leaders in AI technologies, providing support during the early stages of start-up growth and development.

The fundamental needs of AI start-ups are no different than those of traditional start-ups. “Access to financing, often identified as the main obstacle to the growth of a start-up, is generally what motivates the founding team to seek support.”[1] However, the added complexities linked to the development of AI technologies require BAIs to provide a new kind of support, mostly relating to data access and technical expertise.

Main BAI programs adjusted their offering to integrate additional resources focused on AI, like hiring a dedicated program lead, venture manager, or Entrepreneurs in Residence, onboarding new subject matter experts, signing strategic partnerships with AI research centers to provide expertise and consulting to ventures or integrating AI-specific content and workshops to their curriculum. The best BAIs also adjusted their target beneficiaries to emphasize their focus on AI ventures by offering dedicated AI cohorts or by ensuring minimum quotas for AI start-ups.

Presently, most of Canada’s BAIs are hosted by academic institutions offering a generalist, curriculum-based structure, where public funding is driving the start-up journey. Support is provided through strong academic courses and entrepreneurship theories, but with limited exposure and connection to markets. Only a few BAIs are associated with corporate ventures or venture capital funds that tend to use more specialized structures and provide more business-focused, applied, and practical curriculum, focused on go-to-market and commercialization opportunities.

In Canada, support is offered through a myriad of programs with certain redundancies and gaps. Redundancies are illustrated in the start-up recruitment and selection process, influenced by performance metrics favoring the same start-ups. Resources are heavily concentrated in similar growth stages (validation and efficiency), with limited help available from the ecosystem for the ideation and discovery as well as the growth stages of ventures. “In most regional start-up ecosystems, *coopetition* tends to be the preferred model. *Coopetition* is defined here as the fact

1. Mouvement des Accélérateurs d’Innovation du Québec, Incursion dans l’écosystème start-up des régions du Québec, p.10.

that collaborative and competitive dynamics coexist, especially when the time comes to pool skills and resources." [2] There is no structured coordination across BAIs to cover the entire spectrum of start-up growth stages.

VC funding is another crucial factor for start-up creation. VC funding for AI start-ups in Canada has improved steadily over the last couple of years, placing us fourth in terms of AI VC per capita, behind US, UK & Israel and growing steadily.[3] However, even if CVCA is signaling a growth in the number of investable Canadian start-ups and a maturing VC economy[4], there are still significant challenges for AI start-ups to raise capital at the pre-seed and seed stages in Canada.

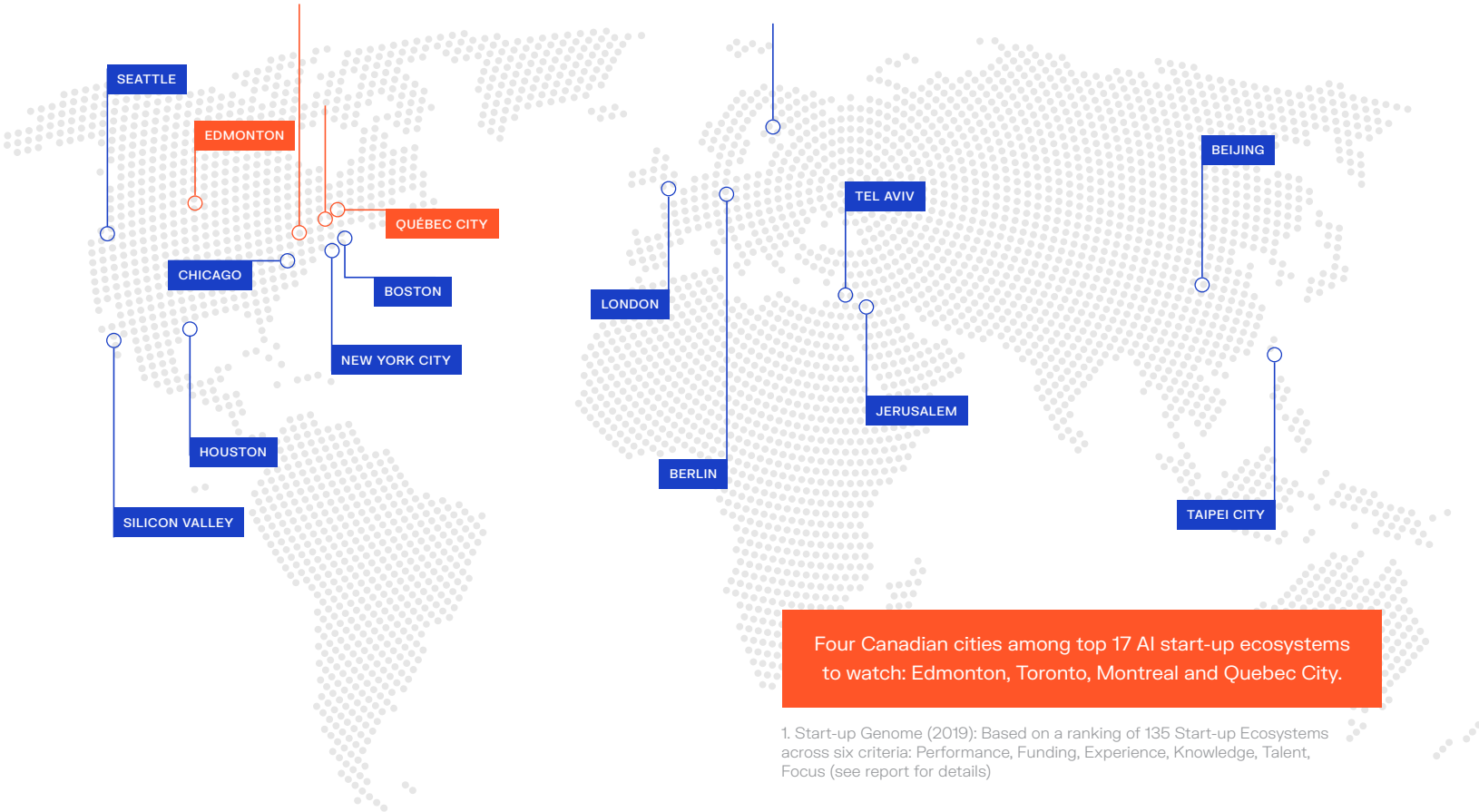
While there are still major challenges, immigration policies in various provinces have acted as a catalyst for attracting AI talent. Over 1,100 Canadian employers, including many start-ups, leveraged the Government's Global Talent Stream fast-track since its inception in 2017 to attract 24,000 highly qualified workers to Canada.[5]

As a result of these factors, four Canadian areas (Toronto-Waterloo, Montreal, Edmonton, and Quebec City) now rank among the top 17 AI ecosystems to watch.[6] These four ecosystems are the main drivers behind Canada's strong AI start-up birth rate, positioning Canada ahead of its peer countries in the number of AI start-ups per capita.

Apart from US & Israel, Canada ahead of peers in percapita AI VC, growing steadily

AI VC 2020 ($M)[1]	Totals (per 1M ppl)	CAGR 2017-2020
	45,000 (136)	(+32%)
	20,000 (22)	(-6%)[3]
	2,629 (39)	(+29%)
	2,400 (266)	(+51%)
	1,500 (18)	(+55%)
	1,380 (36)	(+24%)

1. OECD AI Policy Observatory



Four Canadian cities among top 17 AI start-up ecosystems to watch: Edmonton, Toronto, Montreal and Quebec City.

1. Start-up Genome (2019): Based on a ranking of 135 Start-up Ecosystems across six criteria: Performance, Funding, Experience, Knowledge, Talent, Focus (see report for details)

2. Mouvement des Accélérateurs d'Innovation du Québec, Incursion dans l'écosystème startup des régions du Québec, p.11
3. OECD AI Policy Observatory. Note: Negative CAGR in China driven by massive increase between 2014-2016 peaking in 2016.
4. Canadian Venture Capital Market Overview 2021 Year in Review.
5. Radical Ventures: 2021 Primer - Canada's AI Research Ecosystem.
6. Start-up Genome: The Global Start-up Ecosystem Report 2019 & 2021.

While AI start-up birth rate has been strong in Canada, those start-ups struggle to scale as they face several challenges to survive and grow. One illustration of that is the low number of AI unicorns in Canada compared to peer countries. The primary factors hampering scale-up are a lack of sufficient talent supply and domestic demand from industry adopters. These are the factors we will analyze in the following section.

Canadian punching above its weight regarding # of AI start-ups, but China & UK growing faster

# of AI start-ups[A]	Totals (per 1M ppl)	CAGR 2018-20[B]
	2,000 (6)	(+13%)
	1,189 (<1)	(+46%)
	800 (86)	(+26%)
	660 (17)	(+15%)
	364 (5)	(+22%)
	275 (3)	N.A.

Only few manage to scale in Canada, US with fewer AI start-ups per capita but more AI unicorns

# of AI unicorns 2021[1]	Totals (per 1M ppl)
	33 (0.09)
	18 (0.01)
	4 (0.44)
	4 (0.06)
	3 (0.08)
	0 (-)

A. Statista: Number of artificial intelligence (AI) start-ups worldwide in 2018, by country; HBR: Is China Emerging as the Global Leader in AI?, University of Toronto: Canada's AI Ecosystem; KI-Start-ups in Deutschland im Überblick; Onn Shehory (2020): Israel: (AI) Start-up Nation? Israeli Artificial Intelligence Start-ups and Their Ecosystem.
B. CB Insights: The Complete List Of Unicorn Companies. Note: CAGR for Israel based on 2014-2018 period.

AI start-up birth rate has been strong in recent years but only few manage to scale significantly.

Weak Domestic Demand and Talent Shortages Stifle Adoption

Early adoption hinges on the ability of start-ups to provide AI solutions and the willingness of the market to integrate such solutions. As previously mentioned, though we have a strong start-up birth rate, Canadian AI start-ups encounter challenges in scaling. Start-ups and scale-ups are hampered by a lack of demand for AI solutions and services from Canadian businesses and difficulties in competing with large technology companies for AI talent. This is a reinforcing cycle, as the less demand there is, the harder it is to attract talent (both at the start up and at the adopter levels, as talent is needed to integrate the solutions developed).

Lack of local demand starts with a lack of awareness among corporate executives. Many business executives in Canada still believe AI is "just not applicable" to their industry.[7] Only 5% of Canadian Executives believe that AI is critically important for their business at this time and 27% believe that it will be critically important in two years from now, significantly less than executives in peer countries.[8]

Moreover, even amongst the executives who are aware of the importance of AI, 68% of early adopters reported low to modest familiarity in selecting AI technologies and technology suppliers.[9]

7. Deloitte (2019): Canada's AI imperative - Start, scale, succeed.
8. Deloitte (2018): State of AI in the Enterprise survey.
9. Deloitte: Canada's AI imperative- From predictions to prosperity.

% of respondents	Execs believing AI critically important now[A]
	14%
	14%
	11%
	6%
	5%
	4%

% of respondents	Execs believing AI critically important in 2y[A]
	45%
	42%
	42%
	38%
	32%
	27%

Low industry demand is the main driver of start-up attrition, driven by Canada's executives underestimating AI's current and future importance.

A. Deloitte (2018): State of AI in the Enterprise survey.

The second barrier for adoption is the high level of competition for the available talent in data science and engineering. Though this is a global issue, it is exacerbated in Canada, given the fast growth in demand for AI talent since 2016 (3rd highest amongst peers). The hiring difficulties faced by Canadian start-ups and businesses stems from the significant pull from large, US based companies, who outcompete domestic firms in terms of compensation and attractivity. Canada thus has a significant retention problem when it comes to AI talent; while it manages to attract an increasing number of AI R&D talent at the student level, it is often unable to keep that talent at the professional level, supplying other countries instead.[10]

Supply shortage is a global issue, but exacerbated in Canada

% of respondents	Execs seeing AI skill gap in their firms (2019)[A]
	51%
	57%
	68%
	72%
	72%
	73%

3rd fastest growth in demand for AI talent since 2016

Indexed vs. 2016 baseline	Growth in AI job postings (2016-20)[B]
	3.5x
	2.8x
	2.7x
	2.4x
	2.3x
	2.2x

But Canada unable to retain its AI talent, supplying peers instead

St. Dev. from global avg.	Chances of talent staying in that country (2014-19)[C]
	+0.53
	+0.41
	+0.31
	+0,30
	+0.24
	-0.11 (#19)

A. Deloitte (2019): Future in the balance? How countries are pursuing an AI advantage - B. JFGagne - Global AI Talent Report 2020 - C. JFGagne - Global AI Talent Report 2020

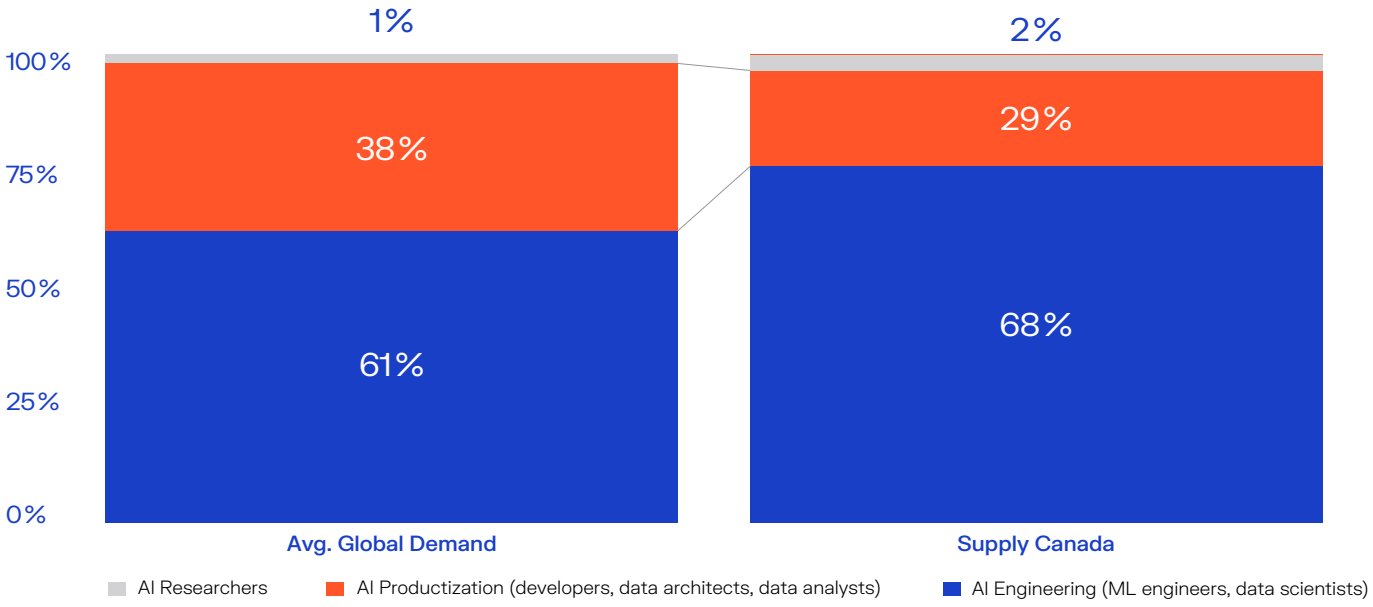
Talent shortage exacerbated in Canada by rapidly increasing demand and low retention, further driving start-up attrition.

10. JF Gagne - Global AI Talent Report 2020.

The low retention (ranking 19th globally) is at least partially driven by lower salaries and lower awareness of employer brands (most tech giants being located in the US).[11] As an example, salaries for AI talent in the US and Israel are estimated to be ~33% higher than in Canada (after accounting for taxes, social contributions and cost of living).[12] A study by Universum in 2021 revealed that 50% of most attractive employers for IT talent are US brands, 30% are German, French or British, but none are Canadian employers. [13] As a result, Canada's supply of AI talent has actually shrunk by ~18% over the last three years and placing us third last among 30 peer countries.[14]

Further, the perception of AI maturity in Canada by AI practitioners is lowest in our peer country group, which might contribute to the supply shortage as professionals prefer to seek jobs where they perceive they will have better professional opportunities. Data scientists, ML engineers, operational research specialists are attracted to companies where they will be able to build new solutions, tackling challenging problems, if they perceive the Canadian market as not providing such opportunities, they are likely to relocate to countries that are perceived to push forward the AI agenda (e.g., US, Israel, France, etc.). This has a reinforcing effect; the less we are perceived as AI mature, the more challenging it becomes to attract professional talent, which leads to less AI adoption and reinforces the perception of lack of opportunities.

The supply shortage issue is further exacerbated as Canada's talent supply mix is also out of line with demand. This is especially noteworthy because deploying solutions requires data engineers vs. researchers and scientists. AI engineers show the biggest supply shortage, whereas researchers are overrepresented in the supply pool compared to peer countries. This illustrates Canada's strong performance in attracting and providing opportunities for researchers in academia. However, Canadian companies do not leverage this research pool sufficiently as mentioned before (e.g., by creating partnerships with corporations), and instead are fighting over the small pool of AI practitioners in the market.[12]



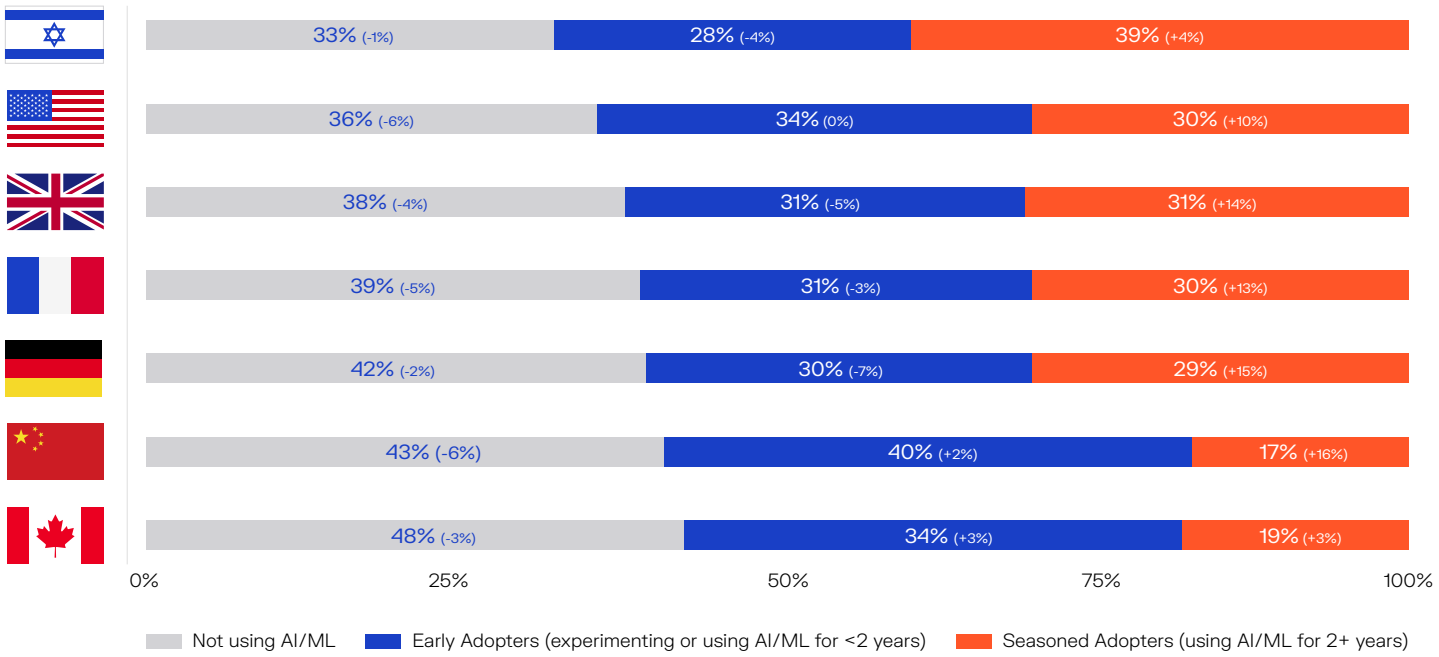
Source: JFGagne: Global AI Talent Report 2020. Based on self-representation data from social media.

Canada not only has a supply volume issue, but also a mix issue:
AI engineers are underrepresented and AI researchers are overrepresented.

Canadian businesses lag behind on AI adoption and diffusion, with almost half of our companies not making use of AI/ ML solutions. Our adoption starting point is behind our peers who are already making strides into diffusion. Many early adopters in other countries are maturing, becoming seasoned adopters, hence not being counted as early adopters anymore.[15]

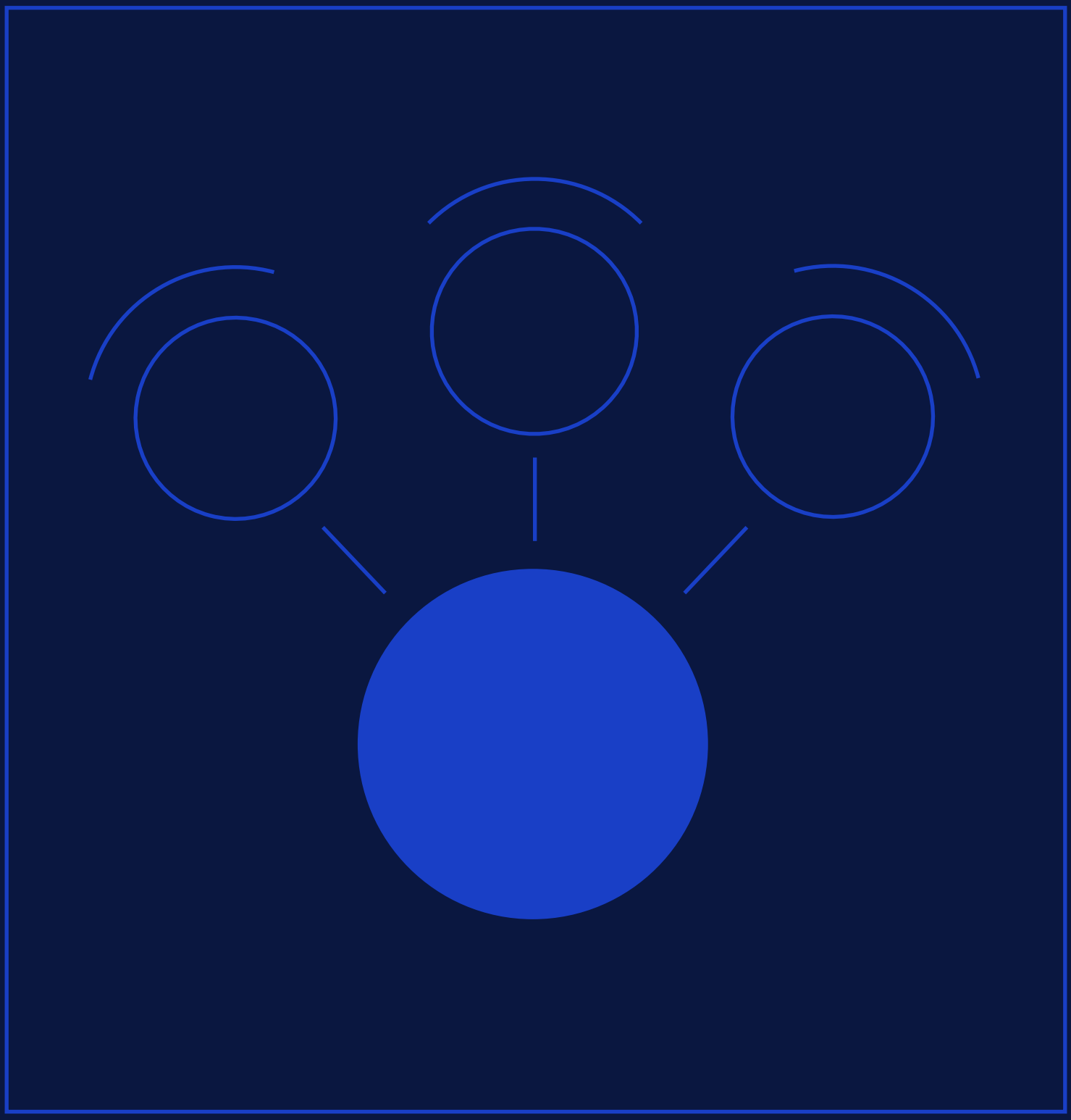
11. JF Gagne: 2019 Canadian AI Ecosystem.
12. Kaggle ML & Data Science Survey on Machine Learning Adoption. Data based on employee surveys.
13. Universum: World's Most Attractive Employers 2021.
14. JF Gagne: Global AI Talent Report 2020.
15. Kaggle ML & Data Science Survey on Machine Learning Adoption. Data based on employee surveys.

Company AI/ML adoption rates (Data for 2020, CAGR vs. 2018)[A]



A. Kaggle ML & Data Science Survey on Machine Learning Adoption. Data based on employee survey

Canadian catching up on early adoption while many companies in peer countries are already seasoned adopters entering diffusion.



Diffusion:
Canada’s Achilles’ Heel

Diffusion: Canada's Achilles' Heel

Overview

Strength in research and start-ups will not be sufficient to sustain Canada's global leadership. To reach this goal, we need large scale business adoption and consumer acceptance for AI. Diffusion is the largest issue that Canada is facing in the race for AI dominance.

In a survey conducted by Kaggle, only 19% of surveyed employees of companies reported to perceive their company as a "seasoned" AI adopter (i.e., using AI/ ML for 2+ years)[1] while 48% indicated that they were not using AI (see previous section).[2]

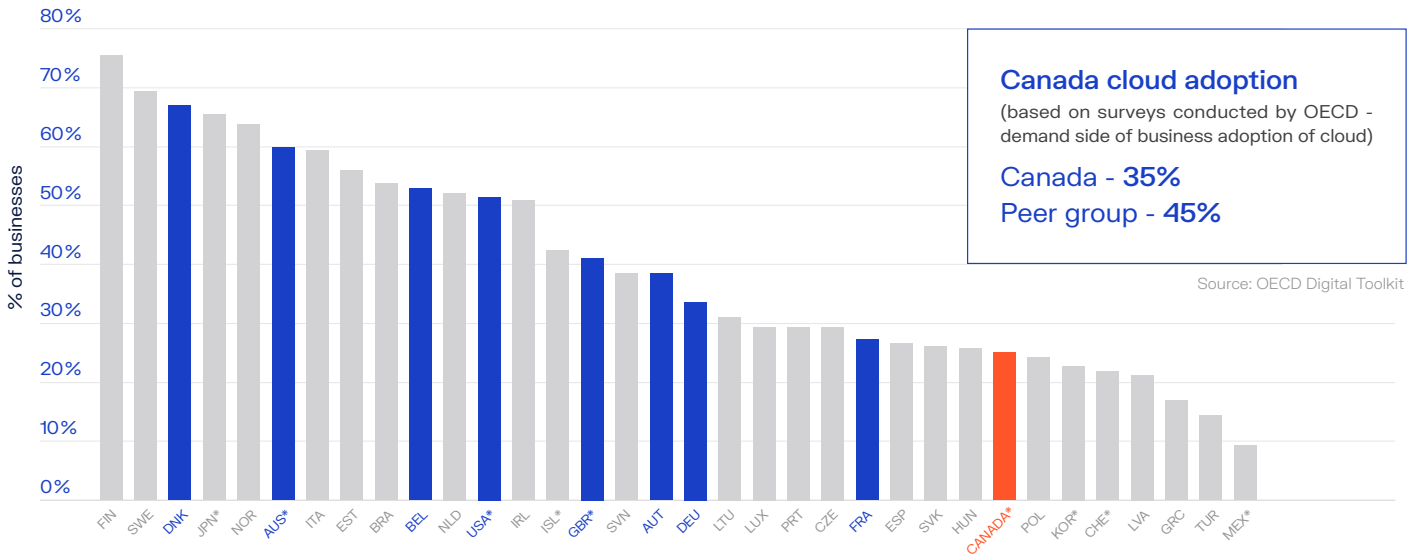
Diffusion is Canada's weakest link of the AI innovation but is the key to the long-term survival and development of a strong AI industry. Our assessment of the main obstacles for diffusion in Canada, based on publicly available literature and data, identified: low investment in systems, slower cultural shift to embrace AI technology and talent upskilling as the most important ones.

Low Investments in Digital Infrastructure

Data collection, storage and processing are foundational necessities for AI diffusion. Moreover, making the available data usable is key. Some companies struggle to move away from legacy systems and invest in infrastructure, tools, and software to collect, process, and derive insights from data, while others invest in tools that do not communicate, collecting as much data as possible but not making it usable or accessible.

New infrastructure requires human resource adjustments and transition time, perceived as disruptive to the ongoing business. Companies need the right systems to enable AI diffusion and currently Canadian companies are falling behind peers in terms of digital infrastructure investments. Adapting current systems to facilitate AI adoption entails focusing on three pillars: IT Spent, System Integration and Data Management.

Though this is a global issue (according to a McKinsey study, only 15%[3] surveyed companies believe they have the right infrastructure for implementing AI technology), Canadian companies invest less than peer OECD countries (35% of companies invest in the cloud in Canada vs. global peers investing 45%)[4], partly contributing to our lower diffusion rates.



1. Kaggle ML & Data Science Survey on Machine Learning Adoption. Data based on employee survey.
2. Universum: World's Most Attractive Employers 2021.
3. Source: McKinsey Report, AI adoption advances, but foundational barriers remain.
4. OECD Digital Toolkit.

AI needs good, usable data which relies on systems that capture it and integrate it well. Integration is a global issue prevalent in Canada as well as our global peers. In a report issued by Databricks, 37% of businesses indicated there are too many technologies that do not integrate, while 51% of businesses identified data silos as one of the main reasons for low AI adoption. 55% of executives said the data they get for analysis is often out-of-date or stale by the time it gets to them, resulting in inability to derive insights (precursor for implementing any AI solutions).[5]

Integration issues arise when too many tools are acquired which do not communicate with each other, limiting the potential to employ data from multiple sources within an organization. Patchy acquisition of tech leads to interoperability issues, as procurement is not integrated with a larger IT strategy. Companies are not currently equipped to select the right technologies for enabling the AI layer. Less than half (45 percent) of companies surveyed by Deloitte indicated they have a high level of skill around integrating AI technology into their existing IT environment.[6] That results in data scientists creating "shadow" IT environments, building custom models from scratch, and preparing data differently for each model. While that might work for AI early adoption, it challenges diffusion (as diffusion relies on system wide adoptions).

This indicates that in addition to increasing their spend, Canadian companies must steer these investments towards systems that promote data integration and enable interoperability across business units and with external partners. Leveraging the right systems will help us gain a competitive advantage vs. our peers who encounter similar challenges currently.

Another infrastructure component is data management. Companies need clear policies/accountability to manage data intra-organizationally and with external parties. This issue is pervasive on a global arena, and Canadian organizations encounter similar challenges. While there is widespread recognition of the need to implement data management policies, only 21% of global companies surveyed by PwC had a Chief Data Officer.[7] Further, even when the position is created, average tenure for CDOs is 1 vs. ~4.6 years for CIOs as excitement dissipates and CDOs take a back seat to business as usual.[8] Data governance hinges on the existence of data culture (the ability of employees to embrace the use of data in decision making). 72% of HBR surveyed executives report that they have yet to forge a data culture (53% state that they are not yet treating data as a business asset).[9]

Slow Culture Shifts Impede Diffusion

Transitioning from pilot projects to diffusion throughout any organization often requires reaching corporate departments that are historically less familiar with new technologies. While it is well-understood that an organization's culture is driven by top leadership, Canadian companies suffer from a lack of clear executive sponsorship championing the organization-wide changes necessary for wide diffusion of AI. To effect change, executive leadership needs to communicate the importance and imminence of AI adoption in order to stay competitive and relevant on both the local and global scale.

LEADERSHIP ENDORSEMENT:

While there is a global gap in executive endorsement and understanding, Canada is behind its peers in terms of sponsoring and incorporating AI initiatives as part of core company strategy. Only 27% of CEOs surveyed by Deloitte (in a sample representing companies across industry and sizes) designed an AI long-term strategy. This laggard position of our CEO endorsement vs. peers, stems from the lack of perceiving the urgency and importance of developing an AI strategy to be competitive in local and global markets.[10]

The uncertain ROI of AI spendings makes it harder for leadership to prioritize them in budgets. ROIs are hard to capture in advance due to the experimental, non-linear nature of such initiatives and though there are immediate benefits, most take time to be generated as models are developed, implemented, and refined. Finally, trust, understanding and accountability for the recommendations generated by algorithms are ambiguous (some leaders being excited about employing AI, others reluctant to take accountability for decisions made by machines).

5. Databricks - 2018 Trend Report AI Adoption.
6. Deloitte Thriving in the Era of Pervasive AI.
7. PWC CDO Survey.
8. Korn Ferry Age and Tenure of C-Suite.
9. HBR: Companies Are Failing in Their Efforts to Become Data-Driven.
10. Data for 2019 (Deloitte: Future in the balance? How countries are pursuing an AI advantage); Seasoned AI adopters are the most-experienced AI early adopters, at the leading edge of AI adoption maturity. They have undertaken a large number of AI production deployments and report they've developed a high level of AI expertise—in selecting AI technologies and su pliers, identifying use cases, building, and managing AI solutions, integrating AI into their IT environment and business processes, and hiring and managing AI technical staff.

In addition, when it comes to leadership understanding, worldwide, 92% of executives are concerned about the negative impact of data and analytics on corporate reputation while 62% of executives surveyed in the 2018 KPMG Global CEO Survey, believe that primary responsibility for the recommendation and decision making stemming from algorithms stays with technical teams (thus removing responsibility and the need to understand AI from decision making).[11]

per 1M ppl	% with companywide AI strategy[A]	% see critical importance of AI in 2+yrs[A]	% investing 10%+ YoY in AI[A]
	46	43	44
	41	45	60
	37	43	54
	28	38	52
	27	27	42
	26	32	54

A. Data for 2019 (Deloitte: Future in the balance? How countries are pursuing an AI advantage); Seasoned AI adopters are most experienced AI early adopters, at the leading edge of AI adoption maturity. They have undertaken a large number of AI production deployments and report they've developed a high level of AI expertise—in selecting AI technologies and suppliers, identifying use cases, building and managing AI solutions, integrating AI into their IT environment and business processes, and hiring and managing AI technical staff

Leadership sponsorship: Canadian executives lag behind in designing AI strategies as they underestimate urgency.

Fewer Canadian companies have an AI strategy vs. peers. Further, Canada has a strong nucleus of companies that have invested in AI and continue to invest (small share, rest less inclined) given that 27% of companies with an AI strategy also see the critical importance of AI. In comparison, our peers have a higher number of companies acknowledging the importance of AI vs. developing strategy (e.g., in Germany, though only 26% of companies developed an AI strategy, 32% acknowledge its importance).

EMPLOYEE BUY-IN:

Understanding the value of AI at all levels (leadership and employees) is fundamental to adoption and diffusion. Canadian companies have a harder time getting buy-in from their employees given Canada's low trust index and level of understanding of AI. A study from Deloitte found that only 4% of Canadians felt confident about explaining what AI is and how it works, 86% believe they currently don't use AI and 50% don't think they will within the next 5 years. A third of Canadians think they'll never use AI-powered tools or devices in their work lives.[12]

These numbers are surprising, since most Canadians already actively use AI-fueled solutions on a daily basis and 76% of the population own a smartphone.[13]

4% of Canadians felt confident about explaining what AI is and how it works.[A]

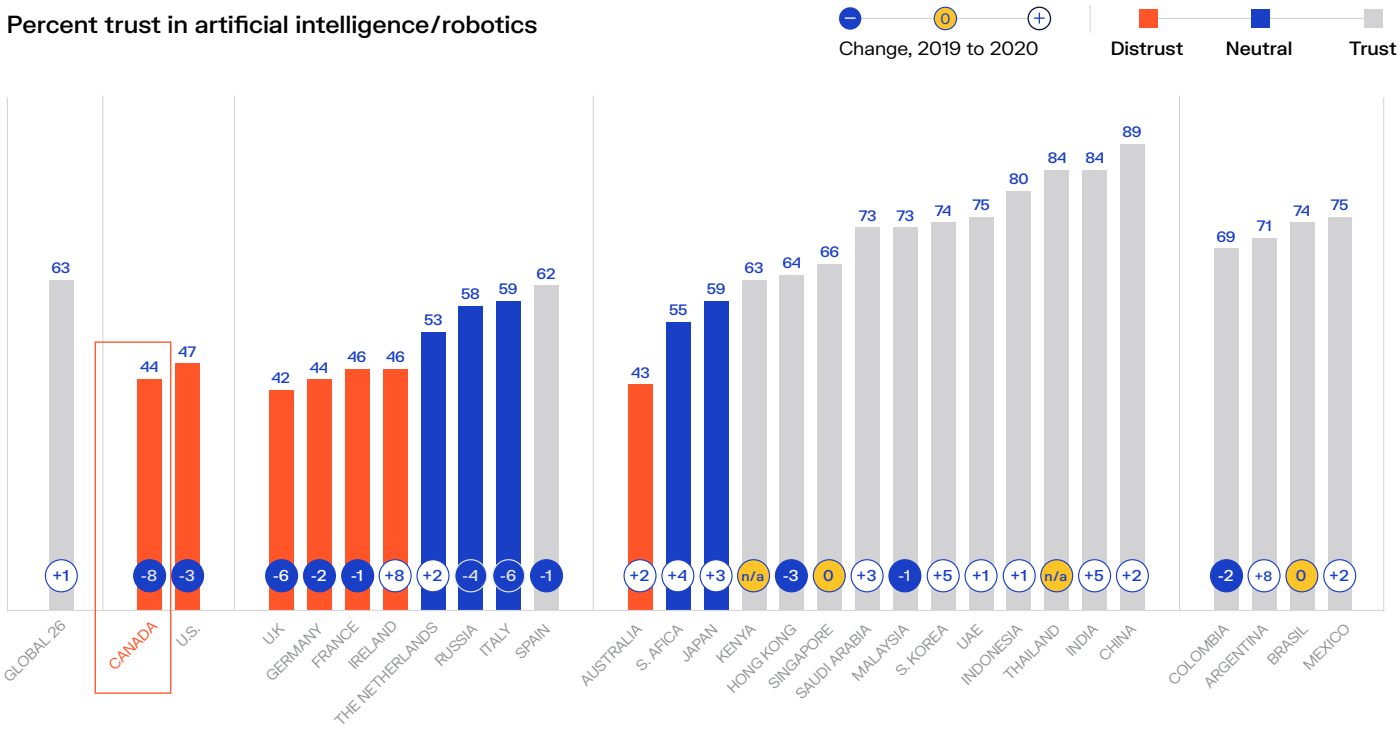
86% of Canadians believe they currently don't use AI and 50% don't think they will within the next 5 years.[A]

1/3 of Canadians think they'll never use AI-powered tools or devices in their work lives (76% of Canadians own a smartphone).[A]

A. Canada's AI imperative - Overcoming risks, building trust.

11. KPMG Global CEO Survey 2018.
12. Canada's AI imperative - Overcoming risks, building trust by Deloitte.
13. Canada's AI imperative - Overcoming risks, building trust by Deloitte.

Percent trust in artificial intelligence/robotics



44% Of surveyed Canadians trust AI, placing Canada on the third lowest place in the Global Trust Index (25th out of 26 according to the Edelman Trust Barometer).[A]

-8% Canada wide population trust has decreased YoY. (which is ultimately the workforce responsible for adopting AI solutions). The intangibility of AI may be contributing to a sense of confusion and distrust.

Source: 2020 Edelman Trust Barometer
A. 3 Barriers to AI Adoption by Gartner (https://www.gartner.com/smarterwithgartner/3-barriers-to-ai-adoption).

Often, employees feel current system works well enough, worry their job may be automated, and they do not understand or trust the true benefits of AI in their daily role.[3]

The lack of understanding and mistrust affects leadership as well (with a likely corresponding impact on their willingness to develop an AI strategy). While the lack of understanding is a global phenomenon and not specific to Canada, Canada is quite low compared to other geographies.

In contrast to Global leadership stance, US CEOs are pioneers, being very supportive of AI dissemination in their companies, with 87% of the ones surveyed by EY in 2020, actively investing in AI and 82% being optimistic about the AI solutions implemented.[14]

Shortage of Talent & Upskilling

As companies move along their AI journey and become more seasoned adopters, most of them start relying less on external AI service providers and building up permanent internal AI teams instead. When they turn to the Canadian talent market to hire AI resources, they face the same issues of talent shortage and supply mix as described in the early adoption chapter.

The supply-demand mismatch of skills is pertinent. On one hand, there is a severe shortage of ML developers (equally germane to early adoption). On another hand, the sustained lower adoption/diffusion in Canada, resulted in fewer opportunities for ML engineers, redirecting local and global talent to other countries and non-Canadian companies with local presence. Canadian companies must fully engage in leveraging the diffusion levers to catch up and establish itself as an attractive market for local and global talent. To foster AI diffusion, companies need to build up internal AI teams

14. EY US CEO Surveys.

that include different profiles (more engineers, fewer data scientists) which is tougher for Canada given the breakdown of workforce (see JF Gagne Global Talent report graph in the Early Adoption section). Those that manage to scale their AI initiatives will enter a virtuous cycle in which their deployed AI initiatives help them attract new talent, which helps deploy additional AI solutions.

In addition to new talent attraction and retention, upskilling existing employees is a key lever for AI diffusion. In contrast to hiring external talent, companies are more in control of upskilling their existing workforce and can leverage their employee's knowledge of the company's internal culture, systems, and processes to develop and integrate new solutions effectively. However, data literacy & digital skills of the current Canadian workforce are trailing versus those of our global peers. General digital skills are necessary to enable diffusion and make continuous use of new technology throughout an organization upon deployment whereas specific data science and development skills are necessary to develop and support new AI solutions.

Canadian companies are behind peers in investing in upskilling existing talent. Though Canada is faring well on the "digital skills index" (ice. ability to use digital tools in daily activities), Canadian firms are lagging behind OECD peers in terms of continuous skill development as less than 20% of Canadian organizations[15] have invested in upskilling in the last 12 months (2018 OECD data).

Canadian companies with lowest rate of training developers to create new AI solutions and IT staff to deploy AI solutions

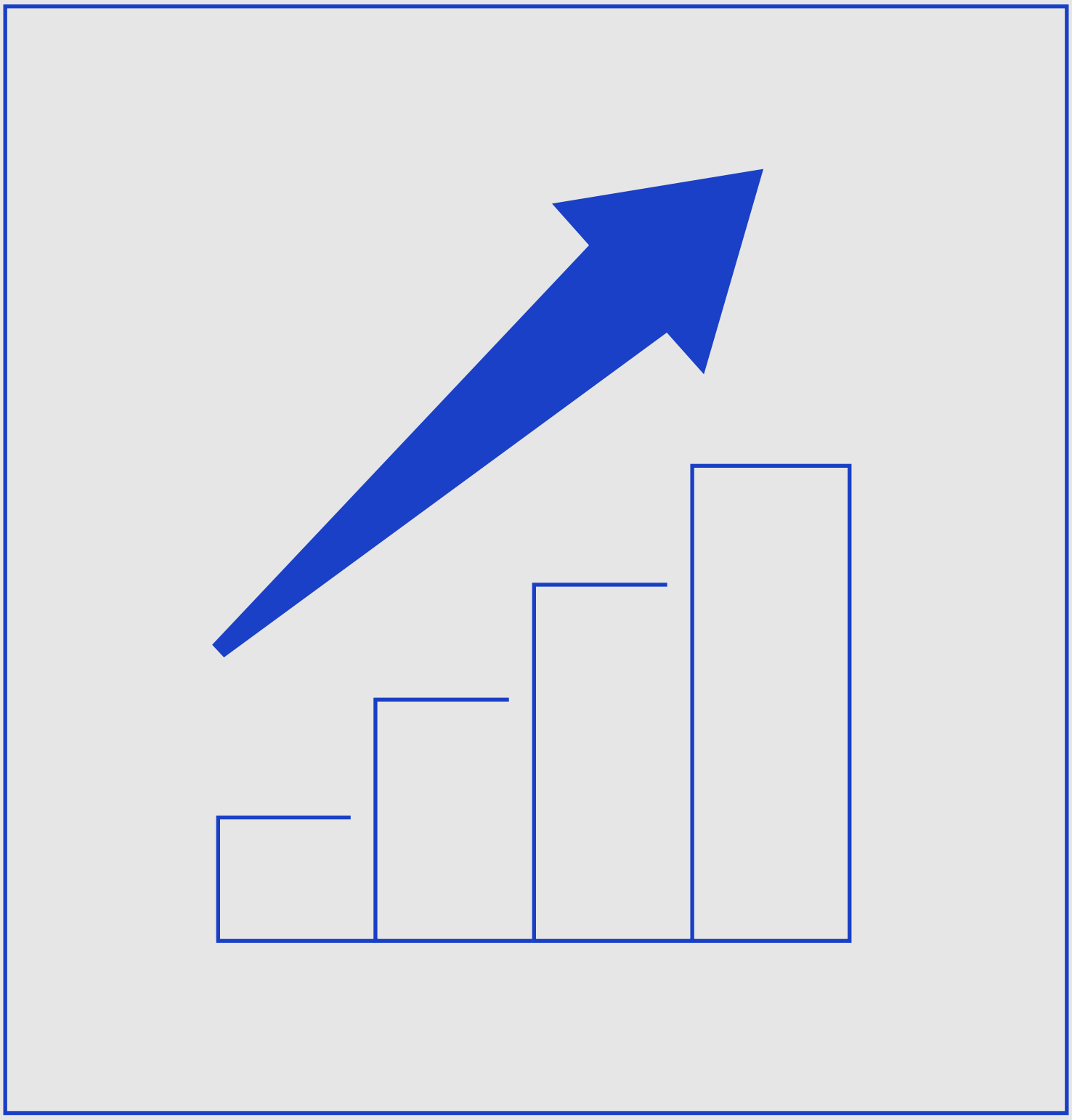
per 1M ppl	% employees who use AI in their jobs[A]	% of developers who create new AI solutions[A]	% of IT staff who deploy AI solutions[A]
	63	64	64
	57	54	61
	54	67	60
	57	52	60
	57	59	58
	52	45	51

A. Data for 2019 (Deloitte: Future in the balance? How countries are pursuing an AI advantage); Seasoned AI adopters are most experienced AI early adopters, at the leading edge of AI adoption maturity. They have undertaken a large number of AI production deployments and report they've developed a high level of AI expertise—in selecting AI technologies and suppliers, identifying use cases, building and managing AI solutions, integrating AI into their IT environment and business processes, and hiring and managing AI technical staff - 2. OECD Data on ICT training investment

Talent: Canadian companies are less likely to upskill AI & non-technical employees.

Potential reasons for lower investments in upskilling can be attributed to Canadian companies not recognizing immediate needs to upskill. Anecdotal evidence also points to businesses encountering challenges in navigating skills/training to invest in, given the plethora of courses available. Further, given the aforementioned lack of comprehensive AI strategies, companies face difficulties integrating a training plan that will facilitate such a strategy.

15. OECD Data on ICT training investment.



The Future: From R&D Powerhouse to an AI-fueled Economy

The Future: From R&D Powerhouse to an AI-fueled Economy

In this final chapter, we are bringing together our findings and providing our view on what the future might hold for Canada's AI ecosystem. To this end, we defined four archetypes representing a country's strength of its supply of and demand for AI talent, products, and services. Our intent is not to make exact predictions, but instead, to identify various pathways that our AI ecosystem could end up on, pending on the interventions we will take.

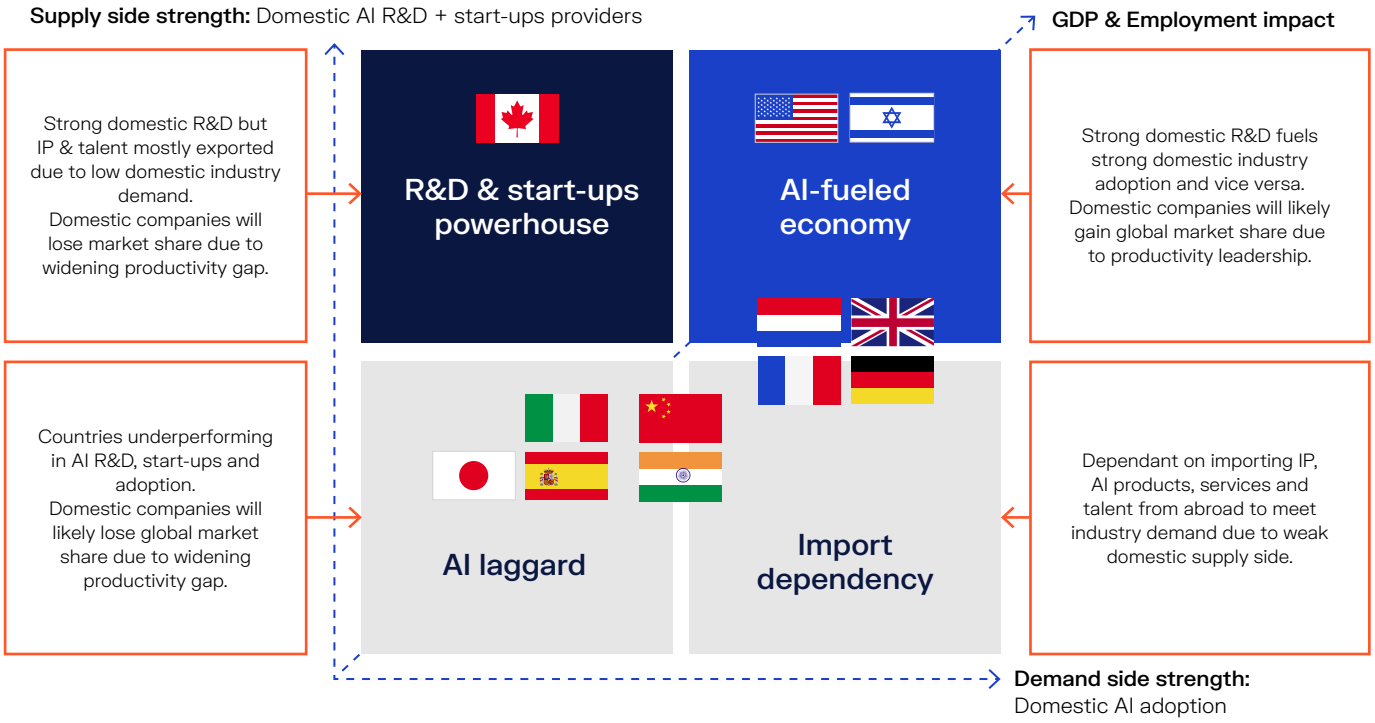
Ultimately, we propose a set of actions that we believe will allow Canada to reap the most economic and societal benefits from AI. Though this is not meant to be an exhaustive list of recommendations, our hope is to trigger discussions and actions across our ecosystem to shape the future trajectory of AI in our country.

For our assessment, we considered two major dimensions:

1. The supply side of AI: A strong AI ecosystem hinges on the availability of knowledge, talent, IP, products, and services, which derive from domestic R&D activities, a large pool of available talent and a vibrant start-up scene.
2. The demand side of AI: Demand is essential for building adoption and diffusion (companies investing in projects, partnering with start-ups, hiring talent). These industry firms will leverage AI to drive productivity gains, grow international market share and create highly qualified jobs for Canada. A lack of adoption will stifle start-up growth, push talent to leave for abroad and ultimately endanger the competitiveness of Canadian industry.

The Four AI Archetypes

Taking into account the two dimensions described above, four archetypes emerge to help us grasp the current and future positioning of Canada's AI ecosystem and that of its peers.



Please note: Representative data only available for the following countries:
Canada, China, France, Germany, India, Israel, Italy, Japan, Netherlands, Spain, United Kingdom, United States. Hence, the ranking is a relative comparison among those countries only.

AI Laggards

Starting in the bottom left corner of graphic X below, we refer to AI laggards as countries that are currently underperforming across the innovation value chain including R&D, start-up activity and industry adoption. This is often driven by limited investments in R&D, talent attraction and retention as well as weak support for and development of the demand side. These countries will not benefit from easy access to advanced AI tech and face the risk of losing productivity potentially widening the productivity gap with countries in other archetypes. Based on our analysis, countries such as India, Spain, Japan, and Italy would currently qualify in this category.

Import Dependencies

Import dependency characterizes countries that underperform on the R&D and start-up side hence are dependent on importing expertise, IP, talent, products, and services from abroad to meet their strong industry demand for AI solutions (both early adoption and diffusion). While we don't see any country that falls directly into this quadrant, countries with a strong and modern industrial base but not yet fully grown supply side such as the Netherlands, UK, Germany, France, are on the border for import dependency.

R&D & Start-up Powerhouses

Countries that we classified as "R&D and Start-up powerhouses" have strong academic and research institutions, attract top research talent, and facilitate transfer from academia to commercial applications, thus facilitating nascency of start-ups. IP and talent are mostly exported given the lower domestic industry demand, which in the long run may result in domestic companies losing global market share due to widening productivity gaps. Canada currently falls in this category.

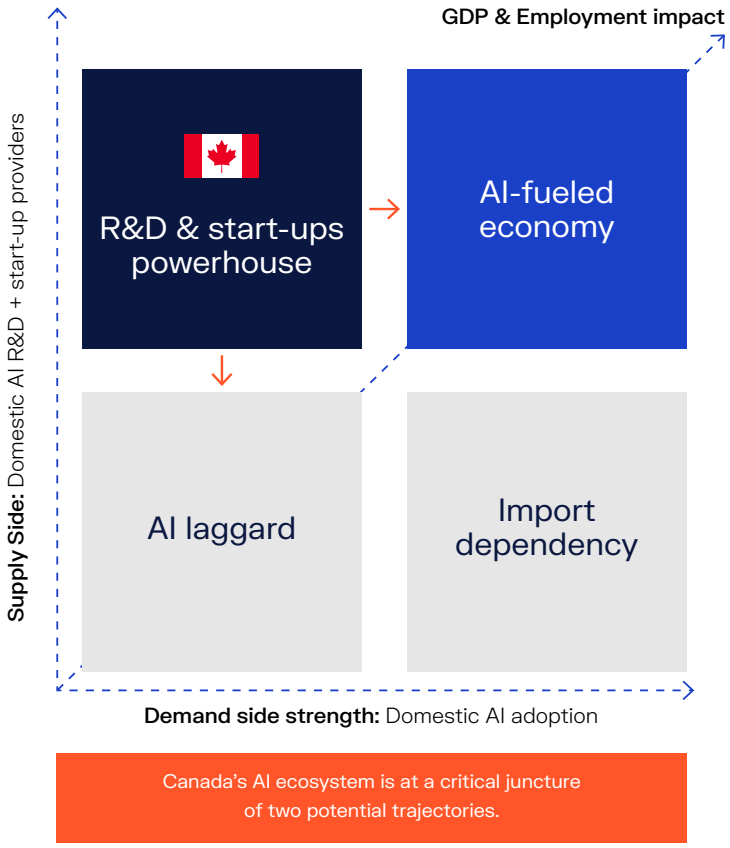
AI-Fueled Economy

Finally, we use the term "AI-fueled economy" to describe countries that outperform both on the supply side and on industry demand for AI. These countries are best positioned to reap the full benefits of AI in terms of GDP and employment growth. Domestic companies in such countries will likely gain global market share due to productivity leadership. Currently, the US and Israel are good examples of this category.

Canada's Future Positioning: AI Laggard or AI-Fueled Economy?

As mentioned, Canada is currently an AI R&D & start-up powerhouse, placing us in the upper left quadrant, with a firm position in supply side leadership. However, we currently face the risk of losing this position due to lagging domestic adoption, leading talent, and start-ups to leave for more attractive markets. Long term, this would likely result in the regression to an AI laggard, losing our competitive edge and suffering from lower productivity.

A more ambitious pathway would bring us to an AI-fueled economy which requires effort across the entire value chain. This target state entails preserving our supply side leadership while building a stronger demand side. If done well, it will lead to the creation of a virtuous cycle where talent gravitates towards existing talent (similar to Silicon Valley): strong demand creates local opportunities and helps retain talent that comes to Canada to study and attracts professional talent from abroad given the number and quality of AI opportunities they create, fueling supply side growth and vice versa. Being an AI-fueled economy can result in massive productivity gains across sectors by making advanced solutions widely available for Canadian businesses, which in turn fosters economic growth and international competitiveness.



The depth and breadth of researchers will allow access to expertise that a vibrant local start-up scene can leverage to create products for global commercialization. The proliferation of service and solutions providers (more start-up birth and higher survival rates) will lead to more competition of AI products, will foster innovation, employment and affordability for adopters and consumers.

A strong AI sector growth will attract and retain highly qualified personnel in other technology areas (other than AI), a cross- pollination process that will enable the growth of other highly innovative sectors (e.g., quantum computing, blockchain). Further, moving down the experience curve in AI will drive ROI of AI investments - triggering more investments and higher tax revenue from profits and wage.

How Does Canada Get There?

Interventions from various stakeholders will be necessary to move Canada to an AI-fueled economy.

Academia and research

Canada's strength in quality and quantity of top researchers places us ahead of our global peers and should be continuously developed. Our academic centres should continue attracting students from around the world, while retaining graduate and fellow students. In addition to maintaining momentum in existing research, universities should proactively reach out to corporations and foster collaborations with local industry players. To strategically create an AI-fueled economy, we need to focus on bringing research from universities into industry and creating applied AI labs with local rather than international companies. Doing so will create interesting opportunities for grad students and enable Canadian firms to leverage those labs as hiring pools, similar to how international firms are already exploiting their Canadian AI labs. Furthermore, given the mentioned mismatch between the supply and demand of talent (specifically the need for deployment and implementation ML expertise in addition to data science), there is a role for academia to play in developing technical practical profiles akin to trade specialties, trained to tackle deployment issues (e.g., developing the curricula for data technician profiles).

Start-ups

As start-ups evolve, we must create better conditions for the scale-up phase within the lifecycle. As they grow, start-ups should balance the mix between technical and entrepreneurial talent and apply creativity in maintaining employees engaged (some start-ups we consulted mentioned that what made the difference were the type of complex problems they asked their employees to solve and providing freedom of researching their areas of interest). Further, start-ups should create partnerships with local academia early on to allow their employees to continuously learn and reach out to researchers to gain advice on the technical approaches/methodologies chosen. Close relationships with academic institutions are also an effective way to hire talent before it gets poached by larger international firms, for instance by partnering with coop programs (e.g., Data Science and Artificial Intelligence Coop at the University of Waterloo) or offering them internships early on in their academic education.

As we move towards AI maturity, we would like to see more start-ups developing productizable solutions rather than focusing on recurring consulting contracts. While consulting engagements are a great way to develop solutions and start journeys, companies should use them as avenues to develop products. If consulting engagements cannot be converted to SaaS solutions, companies should systematically invest in industrializing their services to leverage the newly developed IP for subsequent projects.

Moving to asset-based models will allow companies to scale more effectively and to build products that can be used as tools that companies can integrate into their systems. Start-ups should ultimately provide their customers with solutions that leverage AI to solve business problems, not merely provide AI solutions. Based on interviews and discussions with start-ups we noted that they have a keen focus on leveraging ecosystem resources effectively (e.g., talent, government support), which should be continued as additional support becomes available in the ecosystem.

Industry Players

Businesses are the main force behind creation of local demand through adoption and diffusion. Industry players are critical to facilitate the move to an AI fueled economy as they can incentivize transition from research to market solutions, support start-ups to grow, drive demand and move to more sophisticated requirements for solutions. Their active participation can generate productivity gains and offer Canada a competitive edge vs. global peers.

While academia should proactively reach out to create partnerships with businesses, companies need to equivalently leverage collaborations with academia as a platform for innovation and early talent attraction (facilitating talent acquisition vs. traditional job postings). We would like to see the share of AI R&D labs between academia and domestic firms grow from less than 5% currently (only 3 labs with domestic firms vs. 45 R&D labs with foreign firms) to more than 25%, allowing CAN firms to build up strong IP portfolios.

Across the organization, from executives to customer facing personnel, a wave of education is necessary on the value of AI and how it can transform organizations. By realizing the potential of AI and understanding its applicability, employees will be more willing to engage in shaping solutions and upgrading the type of work that they engage in (moving from repetitive execution to thinking through how insights from AI solutions can be applied). Further, companies need to support the upskilling of both technical and non-technical personnel. While the technical team needs the skills to build the tools, the wider organization needs to use them effectively.

In addition to investing in education, companies need to take a strategic approach when investing in IT. Technology cannot be a mere budget line that can be cut based on cyclicality, instead companies should strive to set up the right data infrastructure. That will ultimately allow them to be competitive both on a local and global level.

Larger enterprises should foster partnerships with smaller organizations (who can provide solutions) as they are nimbler and can develop products and services, unencumbered by larger systems. Larger entities need to understand that AI is novel and cannot be applied in silo, instead it requires working with partners to develop, apply and continuously improve models.

As previously mentioned, AI journeys are fueled by sustained investments in technology and people and are dynamic in nature. To navigate it successfully, companies must adopt a mindset of experimentation, iterate, and integrate feedback in shaping solutions. AI is dynamic, it cannot be implemented once and forgotten, it needs constant feeding of data, developing and understanding. Companies have a skillset to maintain post-deployment.

Federal and Provincial Governments

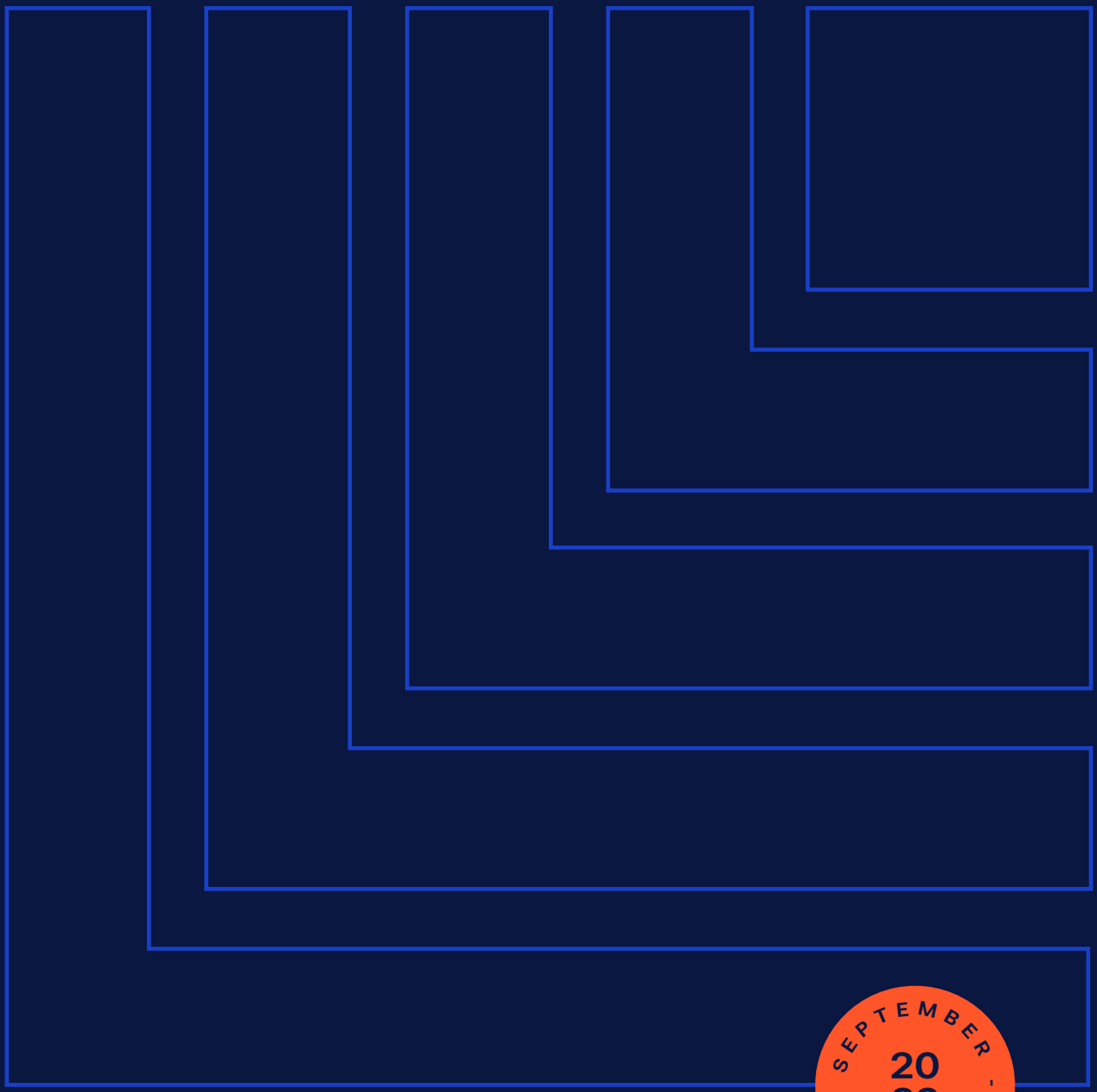
Canadian firms' investment in R&D has been decreasing and currently sits at less than 1% of GDP, compared to 4% among global leaders. Given the high uncertainty of AI investments, corporate investment in AI is probably significantly lower. We need to turn around this development to secure future economic prosperity in Canada. Federal and provincial governments have experimented with innovative policy instruments to leverage public capital to stimulate private sector investments, for instance through co-financing AI commercialization projects and creating cluster effects between academia and industry. Based on our interactions, these efforts have been met with very positive feedback from the ecosystem members. While those instruments likely must be further developed, they seem to provide effective levers to incentivize private sector spending in specific areas and should be continued. Similarly, the government should continue using those tools to trigger investments in large-scale workforce development to ensure the future employability of Canadians.

As an independent arbiter, the government should evolve the regulatory framework for AI. We have heard on numerous occasions from the ecosystem that various players (large and small organizations) believe the government should create a policy framework for facilitating data sharing. Data availability, visibility and sharing is a foundation to move forward the AI agenda across the industry and currently companies are struggling to access, integrate and share data across departments and organizations.

Investors

The role of investors should evolve from providing funds to creating better commercial connections that will multiply potential funding opportunities.

Angels and venture capital should support the productization of AI start-ups by providing patient capital (i.e., with a lesser focus of immediate revenue generation). Private equity investors have the prime position with access to leadership of various portfolio companies. They can leverage those relationships to influence adoption of solutions, support executives as they ramp up in their AI journey and integrate AI in their strategies. Similarly institutional investors can exercise influence, through their board memberships, to accelerate the adoption of AI. The above relies on investors getting educated on the value of AI and understanding the competitive advantage that it can bring to various industries.



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