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ONTARIO AI SNAPSHOT

The state of the province's AI ecosystem in 2021-22

Produced by Deloitte on behalf of the Vector Institute

When we published our first Ontario ecosystem snapshot in January 2021, we believed that the province was a global hotbed of AI research and talent, but lacked the data to back it up. Now in its third year, our annual snapshot demonstrates a steady year-over-year progression in key metrics, giving proof to our assumption: Ontario is a world-leading AI hub.

Rather than resting on our laurels, it is critical that we harness this momentum and open the door to the next phase of Canada's AI journey: the commercialization of AI-powered products and services and the ability to compete both in and outside of the country.

Ontario has already set these wheels in motion, and this bodes very well for the future of Ontario businesses and the innovation economy. As you will see throughout this report, Vector and its stakeholders—government, private sector, institutions—have a continued role to play in order to get there. Even amid economic uncertainties, our ecosystem is thriving.

Garth Gibson, President and CEO
Vector Institute

This report outlines why all Ontarians should be optimistic about the future of our province's AI economy, and how surging interest in AI is driving Canada to solidify its position as a world leader in this sector. With more than 22,000 jobs created—nearly a third of those paying more than $85,000 annually—AI is sparking new economic opportunities and having a wider positive impact on the lives of all Canadians. And this ecosystem is primed for growth, with more than $2.86 billion in VC investment into Ontario's AI ecosystem. As our country and the world at large face a moment of geopolitical and economic uncertainty, our AI economy offers a strong foundation for stability, resilience, and opportunity for all to thrive and do better. Building on the current momentum and our deep relationships with stakeholders and public institutions, it's clear that Ontario is on strong footing to be best-in-class.

Anthony Viel, Managing Partner and Chief Executive
Deloitte Canada

INTRODUCTION

The Vector Institute is an independent, not-for-profit corporation launched in 2017 with the generous support of the Government of Canada, the Province of Ontario, industry leaders from across the country, and AI trailblazers at the University of Toronto. The vision of the Vector Institute is to drive excellence and leadership in Canada's knowledge, creation, and use of AI to foster economic growth and improve the lives of Canadians. Today the Vector Institute is a pillar of Ontario's AI ecosystem, sitting at the heart of the Toronto–Waterloo innovation corridor.

We are committed to leading Ontario's efforts to build and sustain AI-based innovation, growth, and productivity in Canada by focusing on the transformative potential of deep learning and machine learning. Together with our AI partners across Canada, we work with Canadian industry and public institutions to ensure they have the people, skills, and resources to be best-in-class in the use of AI. We support the country's AI innovation clusters and help startups grow to become Canadian-based global leaders. And we also strive to attract the best global talent focused on research excellence; our researchers and academic partners form part of a vibrant community of innovative problem solvers working across disciplines on both curiosity-driven and applied research.

As part of our ongoing leadership in the AI space in Ontario, the Vector Institute publishes an annual Ontario AI snapshot in collaboration with Deloitte to report on the health of Ontario's AI ecosystem. This is our third report, covering the period from April 1, 2021 to March 31, 2022.

The Ontario AI Snapshot tracks 10 metrics covering areas such as AI job creation and retention, investment, application, and commercialization. These metrics serve as benchmarks for measuring the collective progress of governments, businesses, and institutions in further strengthening Ontario's AI ecosystem.

OVERVIEW

Ontario's AI ecosystem continued to strengthen in 2021-22, attracting new investment and new businesses, creating and retaining significantly more AI jobs, and developing new AI talent.

Ontario's AI ecosystem, along with AI hubs centred around the other two national AI institutes in Edmonton and Montreal, is making Canada a leading AI centre globally. Continued support from both the federal and provincial governments, the private sector, and partner institutions will keep both Ontario and Canada firmly among the world's leading AI centres. The federal government's announcement, in its Budget 2021, of another $443.8 million in funding over 10 years for the Pan-Canadian Artificial Intelligence Strategy (PCAIS) is an example of the ongoing support that will keep the province and country at the forefront of AI development.[1] As the Ontario and Canadian AI ecosystems continue to grow and the focus on commercialization intensifies, Canada's AI community—including its industry, government, and institutional partners—will accelerate economic growth and improve the lives of Canadians across the country.

The world has had to navigate a series of complex social, political, and economic challenges throughout much of 2022. The year has also been marked by concerns about a slowdown in the broader technology sector, with falling share prices, staff reductions, and more difficulty in raising VC funding. Our report suggests that AI companies have been bucking the trend: AI companies have continued to attract investment, create jobs, and support economic growth. It's important to acknowledge that our report reflects the state of Ontario's AI ecosystem from April 2021 to March 2022. Our next report will enable us to better understand how Ontario's AI ecosystem has fared during this tumultuous year.

However, we remain absolutely confident that continuing to invest in and support AI talent and technology during this period of uncertainty and slower economic growth will help Ontario's industries innovate, become more competitive and productive, compete and grow, and create new, well-paying jobs. The Vector Institute is proud to play its part in supporting both the facilitation of this economic growth and the talent production necessary to develop innovation.

KEY INSIGHTS

22,458
AI jobs created
including 7,547 jobs paying more than $85,000+/ year and held by highly qualified professionals
↗ **+210% YOY***

59,673
jobs retained

↗ **+334% YOY**

1,110
new AI Masters' enrolments

↗ **+17% YOY**

$2.86 billion
in VC investment into Ontario AI ecosystem

↗ **+206% YOY[2]**

1,007
new AI Masters' graduates

↗ **+55% YOY**

273
unique investors directly investing in Ontario AI companies
↗ **+29% YOY**

56%
have commercialized AI products/services

— **UNCHANGED[3]**

66
new AI-related patents filed

↗ **+61% YOY**

50
companies relocated to the Ontario AI ecosystem

↗ **+285% YOY**

$852 million to $2.75 billion
spent on Ontario AI R&D

↗ **+~37% YOY[4]**

22
new AI companies established in Ontario

↘ **-37% YOY**

51%
say AI is strategically important

— **UNCHANGED**

*Year-over-year percentage change compared to 2020-21 Ontario AI snapshot results

TALENT & JOB MARKET

Ontario sees massive jump in new AI jobs created

Ontario's AI ecosystem is generating new jobs at an astonishing pace. An estimated 22,458 AI jobs were created in Ontario in 2021-22—a 210% increase from the previous year. Another 59,673 AI jobs were retained in 2021-22, a 334% increase from the previous year.[5]

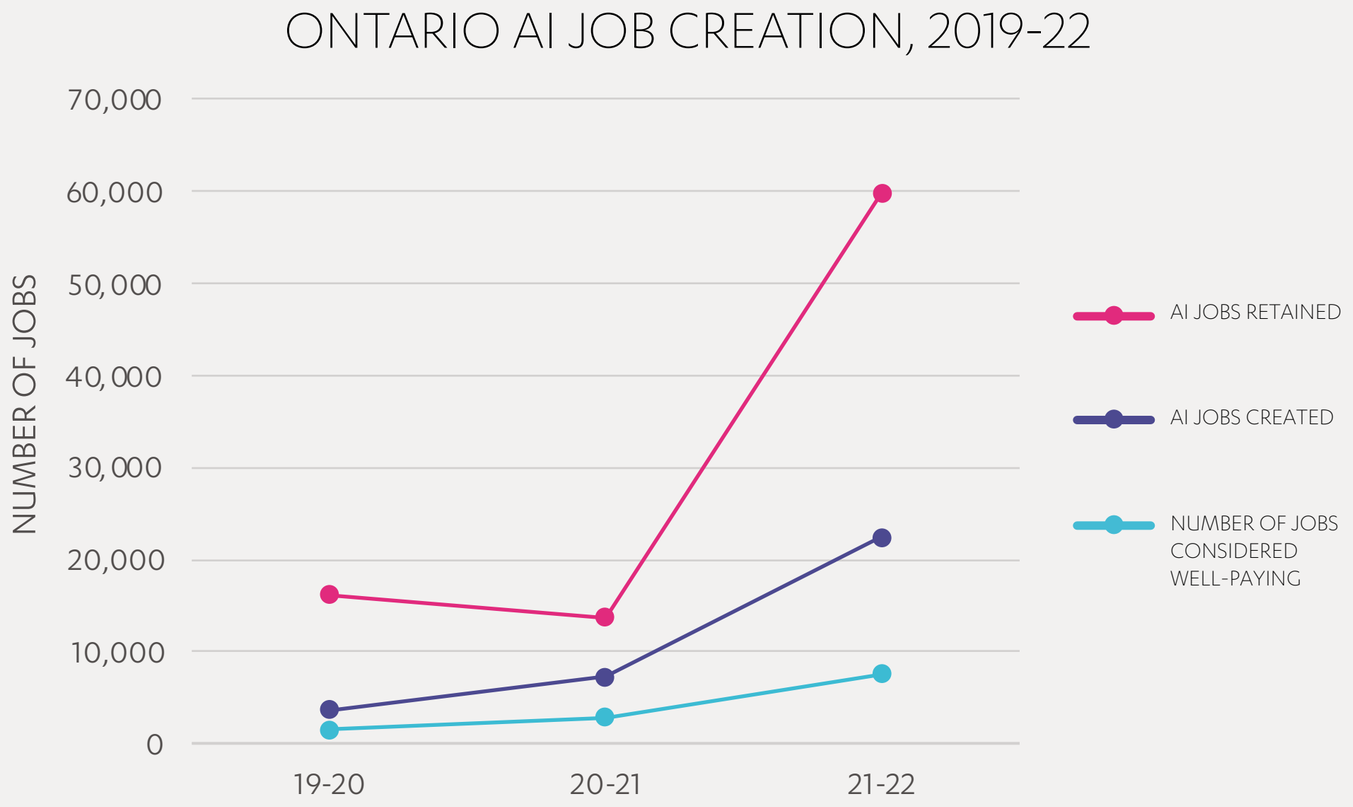
Approximately one in three of those new AI jobs are considered well-paying, which is defined as those jobs with salaries of $85,000 or more.[6] An estimated 7,547 new AI jobs were held by highly qualified professionals (HQPs) graduated from AI-related programs in 2021-22, a 158% increase from our 2020-21 snapshot.

Ontario's supply of AI talent rising steadily

There were 1,110 students enrolled in Vector-recognized AI programs in Ontario in 2021-22, a 17% increase from the previous year. In addition, 1,007 students graduated from AI master's programs, compared to 700 last year.

The steady rise in AI graduate numbers can be attributed to a couple of factors. First, the number of Vector-recognized AI programs rose in 2019-20, and the graduates tracked in this year's snapshot were from one- and two-year master's programs (i.e., no PhDs). Second, a cohort of students prevented from graduating in prior years due to Covid-related lockdowns instead graduated this year, along with current grads.

In addition, Vector's research community expanded by nearly a hundred people in 2021-22. Today, our community includes 714 individuals: 138 faculty, 51 postdoctoral fellows, 289 PhDs, 121 master's students, and 115 undergraduate students.



BUSINESS AND R&D INVESTMENTS

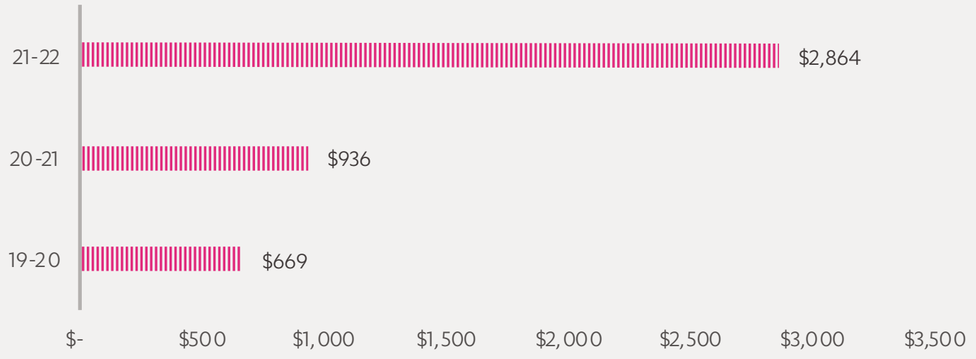
Investment into Ontario AI is increasing

$2.86 billion in venture capital investment flowed into Ontario's AI ecosystem in 2021-22, an increase of 206% over last year's $936 million.[7] This influx of venture capital is a likely driver of the significant growth in Ontario's AI talent demand.

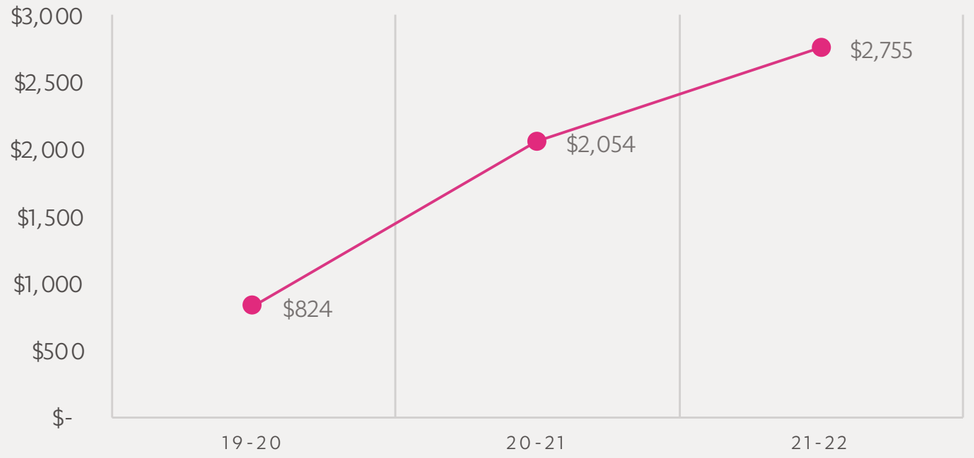
We also identified 273 unique corporate investors that made direct investments into Ontario-based AI companies in 2021-22, in the form of private investments or minority stakes. That's an increase of 29% over 2020-21.[8]

As well, 50 companies relocated their offices or operations into Ontario's AI ecosystem in 2021-22, compared to 13 in the previous year. However, we also found that these relocations don't bring a lot of new jobs to the province; their overall impact on Ontario's surging AI job numbers in 2021-22 was quite modest. In some cases, these relocating companies moved small teams to Ontario to focus on specific projects—establishing a foothold from which to grow in future. This suggests that job growth in the AI ecosystem was happening primarily in existing companies, rather than in companies moving from one place to another.

VC INVESTMENT IN ONTARIO AI COMPANIES 2019-22
($ MILLIONS)



AI R&D SPENDING AND EXTERNAL FUNDING IN ONTARIO 2019-22
($ MILLIONS)



Spending on AI R&D is also growing

Funding for Ontario AI research and development activity also rose in 2021-22. Between $852 million and $2.75 billion was spent on Ontario AI R&D in 2021-22.[9]

Sharp jump in AI-related patent filings

Like venture capital investments and integration of AI research into products and processes, patent filings are considered one of multiple leading indicators of AI commercialization activity. In 2021-22, Canadian AI researchers filed 66 new AI-related patents, an increase of 61% over last year.[10] However, it's likely that at least some of this increase is attributable to lockdown-related delays in last year's patent filings.

MARKET SIZE AND AI ADOPTION

AI plays critically important role, say Ontario business leaders

AI continues to be seen as an important asset by many Ontario businesses. Over half (51%) of Ontario business executives surveyed feel that AI plays a strategically important role in achieving their company's business objectives or that their company has implemented a formal AI strategy within all business units.

More than half (56%) of Ontario companies interested in AI already sell AI products or services or use AI to sell their core products and services. The other 44% of companies interested in AI plan to implement AI in some form within the next two years.

As well, a deeper dive into the results reveals that the number of Ontario companies selling AI products or services rose 44% in 2021-22.

Ontario remains fertile ground for new AI companies

An estimated 22 new AI companies were established in Ontario in 2021-22, a 37% decline from last year.[11] This drop might reflect the increasing difficulty of raising funding at a time of changing economic conditions; it may also be that investor interest in brand new, incubator-based startups was tempered this year as investment funding flowed into AI companies with high growth potential and established companies' own AI efforts instead.

"Ontario is home to some of the brightest minds in the tech sector, making our province a leading source of AI talent in North America. This is particularly true in Toronto, where we have one of the highest concentrations of AI start-ups in the world. Our government is proud to work with industry leaders like the Vector Institute to further grow the AI sector and ensure Ontario continues to be the best place for companies to invest and grow."

Vic Fedeli
Ontario's Minister of Economic Development, Job Creation and Trade

CONCLUSION

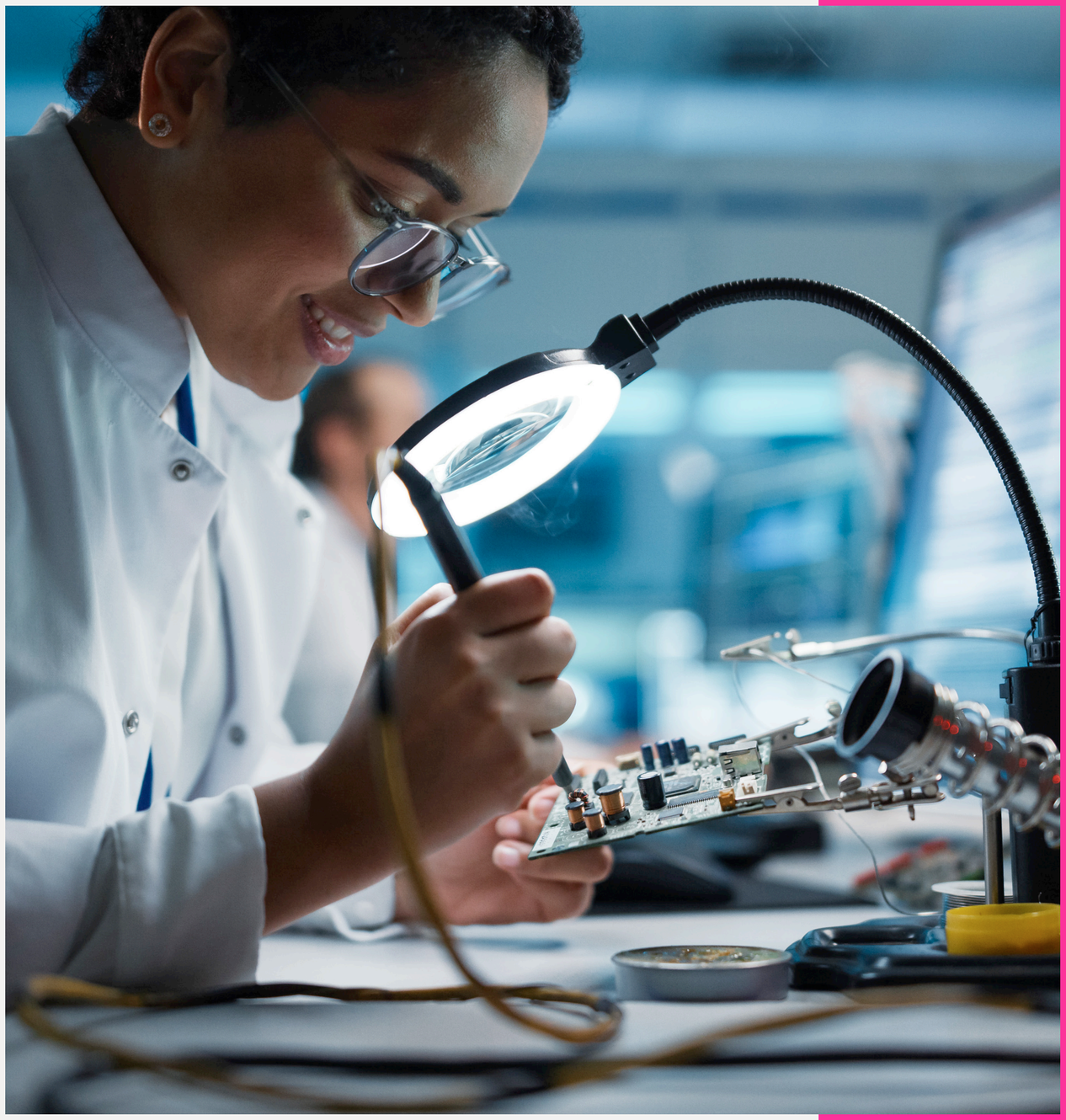
The data presented in our third Ontario AI snapshot suggests that the province is still making important progress in its efforts to build a thriving AI ecosystem—even as it emerges from the pandemic and faces both inflationary pressures and economic uncertainties.

The Vector Institute is confident that AI will play an increasingly important role in our economy and society. We are equally certain that ongoing collaboration and investment among Canadian businesses, the academic community, and public institutions will continue to enable Ontario's AI ecosystem to flourish and achieve future growth and success.

This year's research shows that Ontario's AI ecosystem attracted investment, created jobs, and generated talent through 2021 and into 2022. It's unlikely that the province's AI ecosystem will emerge completely unscathed from the technology sector's downturn this year, but there may prove to be an upside.

The downturn should drive interest in AI-related education, as people upskill to broaden their knowledge and marketability. This bodes well for Ontario's future, because significant opportunities remain for companies across the province, in every industry—including small and medium enterprises—to capitalize on AI's strategic potential, accelerate AI adoption, and unlock new paths to growth. And they're going to need skilled AI talent to do that.

As we look ahead, we encourage Ontario's AI community to strive to commercialize their innovations and bring them to market. We urge all Ontario companies, no matter their size or sector, to look for ways to harness the power of AI for their business. Finally, we exhort all of Ontario's AI ecosystem partners to continue to foster Canadians' trust in AI, by ensuring the use of AI remains fair, transparent, and equitable for all.



ENDNOTES

1. Vector Institute, "Federal Government Renews Pan-Canadian Strategy." https://vectorinstitute.ai/2021/05/03/federal-government-renews-pan-canadian-ai-strategy/. Retrieved Sept. 1, 2022.
2. The methodology used to calculate VC investment in Ontario AI was refined for our 2021-22 report. The new methodology was retroactively applied to last year's data to determine the year-over-year percentage change.
3. We have deemed the change in the AI commercialization metric between last year's report (57%) and this year's (56%) to be a matter of rounding and thus negligible.
4. The methodology used to calculate Ontario AI R&D spend was refined for our 2021-22 report. The new methodology was retroactively applied to last year's data to determine the year-over-year percentage change.
5. 21% of executives surveyed said they created between 1 and 15 AI jobs in 2021; 1% said they created between 25 and 299 AI jobs; 2% said they created between 300 and 1000 AI jobs. In terms of retention 33% of executives surveyed said they retained between 1 and 10 AI jobs in 2021; 4% said they retained between 25 and 100 jobs; 2% said they retained between 500 and 3,000 jobs. To estimate the total number of Ontario AI jobs created and retained, we used the midpoint of the ranges provided (i.e., 8, 25, and 650 jobs created; 6, 63, and 1,750 jobs retained) and multiplied this against the estimated 1,520 AI companies in Ontario.
6. In the 2019-20 and 2020-21 iterations of this report, new AI jobs were considered "well-paying" if they offered salaries of $70,000 or more.
7. We used the QUID market research database to estimate venture capital investments in Ontario-based companies made between April 1, 2021, and March 31, 2022. Search terms used: "Artificial Intelligence" OR "Machine Learning" OR "Data Science" OR "Natural Language Processing" OR "Image Recognition" OR "Computer Vision" OR "Deep Learning" OR "Analytics" OR "Health Informatics" OR "Big Data" OR "Quantitative Analytics" OR "Quantitative Computing" OR "AI" OR "ML" OR "DL" OR "NLP" OR "RL" OR "Reinforcement Learning." Search results were further refined manually. Venture capital investments also included incubators/accelerators, angel investors, and BDCs. The criterion for a venture capital investment was any investments into start-ups with high growth potential (or distressed companies) that would be traditionally too risky for private equity firms and banks to invest in. Due to refinements in our research methodology for calculating venture capital AI investments, we have retroactively recalculated last year's data with the updated methodology. Direct comparisons with previous years' published results are discouraged.
8. We used the QUID market research database to estimate the number of unique investors that made direct investments into Ontario-based AI companies—private investments or minority stakes—between April 1, 2021, and March 31, 2022. Search terms used: "Artificial Intelligence" OR "Machine Learning" OR "Data Science" OR "Natural Language Processing" OR "Image Recognition" OR "Computer Vision" OR "Deep Learning" OR "Analytics" OR "Health Informatics" OR "Big Data" OR "Quantitative Analytics" OR "Quantitative Computing" OR "AI" OR "ML" OR "DL" OR "NLP" OR "RL" OR "Reinforcement Learning."
9. We used survey data as well as QUID market research data to develop an informed estimate of Ontario AI R&D spending in 2021-22, both in terms of budgeted R&D spending and allocations of external funding towards AI research. Due to further refinements in our research methodology for calculating our high-end estimate for AI R&D spending, direct comparisons with previous years' results should be made with caution.
10. We used the Canadian Intellectual Property Office's website to query relevant AI-related patents filed by Canadian investors between April 1, 2021, and March 31, 2022. Search terms used: "artificial intelligence" OR "k-nearest neighbor classifiers" OR "support vector machines" OR "classification trees" OR "back propagation" OR "data science" OR "image recognition" OR "health informatics" OR "big data" OR "quantitative analytics" OR "artificial neural networks" OR "auto encoders" OR "naive bayes" OR "random forest" OR "generative adversarial network" OR "reinforcement learning" OR "natural language processing" OR "predictive analytics" OR "pattern identification" OR "pattern recognition" OR "natural language processing" OR "optical character recognition" OR "computer vision" OR "deep learning" OR "machine learning." To arrive at this year's figure, search results were scored and manually reviewed for AI relevancy.
11. We used the QUID market research database to first identify how many companies operating in AI-related fields were founded in Canada between January 1, 2021, and May 31, 2022. Search terms used: "Artificial intelligence" OR "Machine Learning" OR "Data Science" OR "Natural Language Processing" OR "Image Recognition" OR "Computer Vision" OR "Deep Learning" OR "Analytics" OR "Health Informatics" OR "Big Data" OR "Quantitative Analytics" OR "Quantitative Computing" OR "AI" OR "ML" OR "DL" OR "NLP" OR "RL" OR "reinforcement learning."

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METHODOLOGY

The Vector Institute, together with Deloitte, employed a combination of research and external databases to obtain the information used for this report.

Modus Research was engaged to conduct a survey of 151 business executives and senior managers in enterprises and universities operating in Ontario; the survey was carried out between May 26 and June 21, 2022. Participants and organizations were screened for their relevance to this survey from an established executive business panel developed by Modus Research in partnership with Deloitte.

All survey participants come from organizations that were either AI developers, offered AI services, used AI to drive their services, or have plans to implement AI into their business within the next two years.

Additional market research was conducted using government patents databases and QUID, a company/industry research portal. Finally, some results were interpolated using data from the Vector Institute's Research Operations & Academic Partnerships team.

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