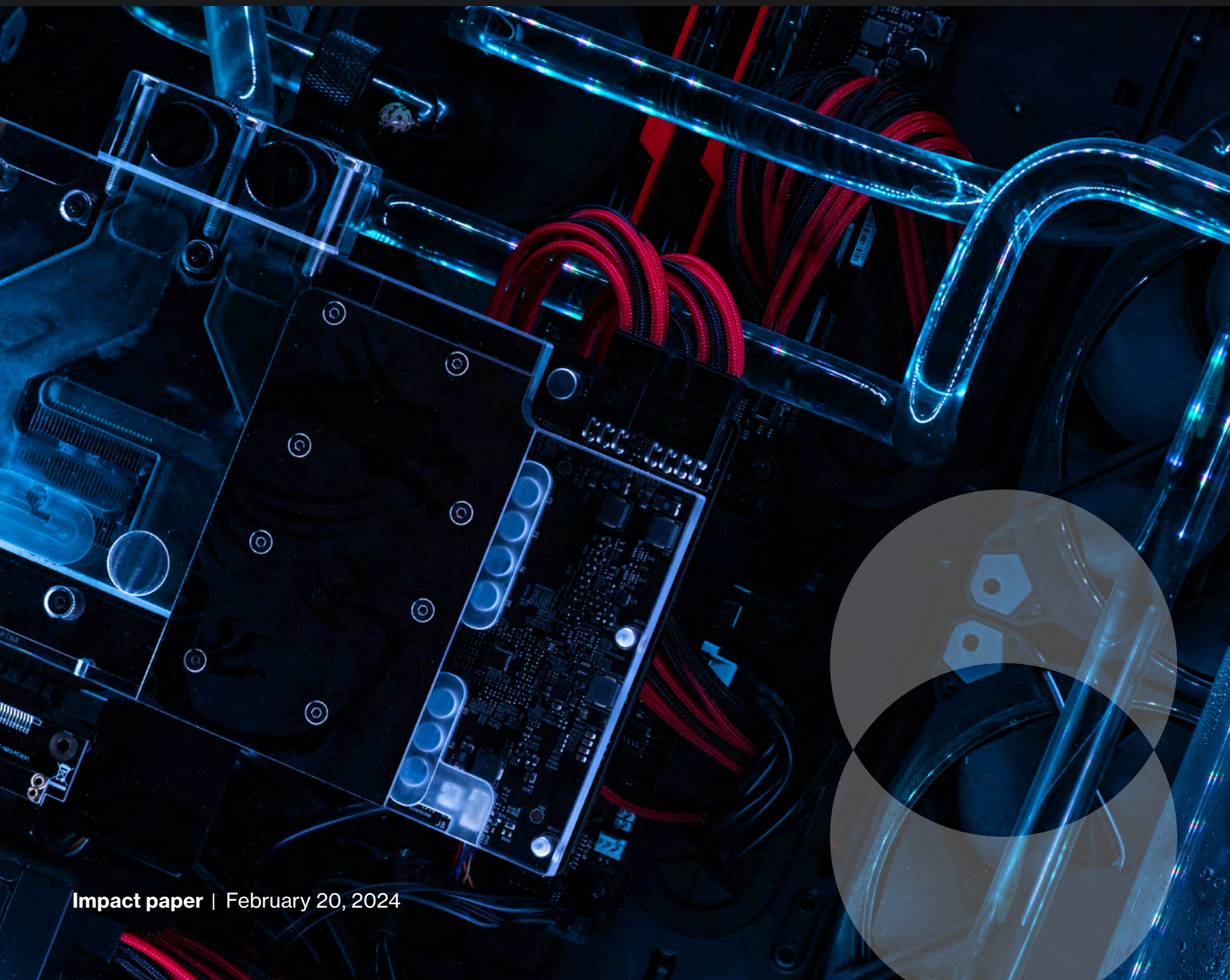**The Conference Board of Canada**

Real Talk

How Generative AI Could Close Canada's Productivity Gap and
Reshape the Workplace—Lessons From the Innovation Economy

Canadian Centre for the Innovation Economy

Canada has an innovation problem. We have a highly educated workforce and strong research capability, but consistently lack commercial success and innovation-based economic growth. This problem is known as Canada's innovation paradox, and it's the problem the Canadian Centre for the Innovation Economy is here to address.

The Canadian Centre for the Innovation Economy (CCIE) will drive national innovation performance by using data-driven insights to unpack the significant pain points to improve innovation in Canada.

CCIE aims to be the destination of choice for trusted, timely insights and policy recommendations on the innovation economy.

Our research reveals the ways Canada can enhance its productivity and global competitiveness through innovation. We focus on how we can accelerate technology adoption and the scaling up of Canadian businesses. Additionally, we analyze the implications of technological advancements on the future of work.

Our Research Centre is funded by multiple members—united in their mission for progress—who help support and inform the Centre's research agenda. We appreciate the support from our Funding Members. Their passion and understanding of the urgent need for progress helps propel us forward and allows us to conduct research that matters.

We welcome you to join us.

Contents

Key findings

- Generative artificial intelligence (AI) could add almost 2 per cent to Canada's GDP. Tech-heavy centres, such as Toronto, Waterloo, and Vancouver, stand to gain the most.

- The majority of start-ups we surveyed were already using generative AI (46 per cent) or were exploring it (38 per cent), and most said it had boosted productivity.

- Most businesses we surveyed (63 per cent) were not planning to reduce headcount as a result of deploying generative AI, but many are adjusting how they work and the skills they're hiring for.

- Our survey also revealed several barriers to generative AI adoption, including high costs, a lack of reliable training materials, concerns over data privacy and security, and uncertainty about how the technology will be regulated.

Recommendations

- **Invest in experimentation:** To take advantage of generative AI's potential, Canadian businesses need to break out of their historic pattern of under-investing in research and development.

- **Develop a national AI infrastructure strategy:** The federal government should devise a national strategy to support the development of supercomputing and data infrastructure. This strategy should include measures to bolster access to affordable computing power for researchers and small and medium-sized enterprises (SMEs).

- **De-risk adoption for SMEs:** The biggest employers are SMEs, but they might not have the resources to spend on adoption. Governments could de-risk adoption through financial incentives, while organizations that support SMEs should consider developing education and awareness programs and creating networks, clusters, toolkits, and best-practice guides to help speed up implementation.

- **Regulate smartly:** Federal regulations and guidelines that encourage employers to safely adopt generative AI without stifling innovation are needed. Corporations must engage in dialogue with the government around smart regulation for the safe adoption of generative AI in workplaces.

- **Upskill employees:** Although it's not yet clear how generative AI will alter the broader labour market, it seems the most valuable workers will be those who successfully use generative AI to augment their own output. Business leaders need to support employees along their learning journey and foster best practices.

- **Prep the next generation:** Canada's deep pools of AI talent are a major asset and need to be nurtured further. Education sectors need to help prepare students for the changing skill sets required by business and industry.
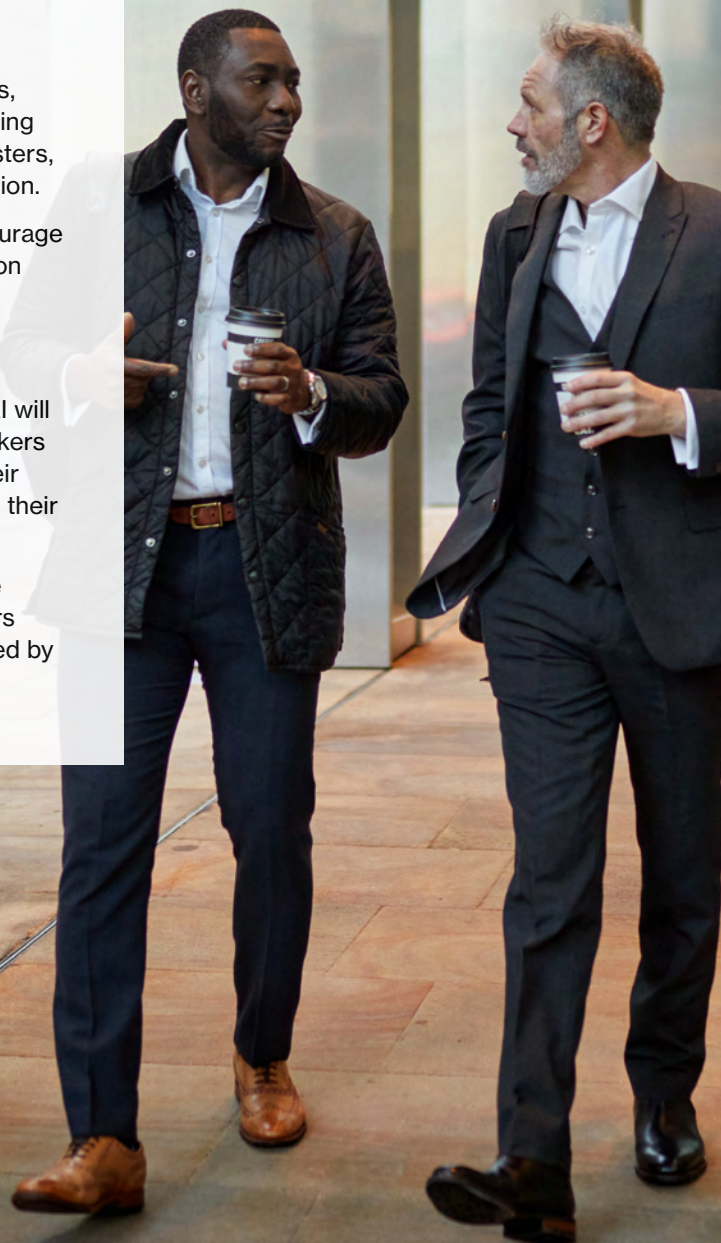
A uniquely Canadian opportunity

Generative artificial intelligence (AI) is upending work as we know it. Though these tools are still in their infancy, they can already summarize documents, analyze reams of data, forecast trends, and support code development.

Deployed correctly, generative AI will be transformative for parts of the Canadian economy and help reverse our decades-long decline in productivity. But Canadian businesses have been slower than their counterparts in the United States to adopt it.[1] To better understand the potential of this technology, we conducted a survey of 221 start-ups across Canada and 17 in-depth interviews with company founders and experts.

Canada is a leader in the discovery and creation of artificial intelligence. But the country is lagging in adopting the technology at the organizational level. Our findings suggest that governments, businesses, and machine-learning experts will need to work together to overcome barriers to adoption in the workplace and unlock the potential of generative AI for better economic performance.

Canada has the expertise. Now it needs to act. As Martin Bufi, a former senior technical advisor at MaRS, puts it, "It is definitely Canada's race to lose."

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1   KPMG, "Canadian Businesses Experimenting With ChatGPT."

The kick-start Canada needs?

After decades of development, 2023 was the breakout year for generative AI. In a matter of weeks, the technology burst out of the research lab and into the hands of anyone with an Internet connection. Suddenly, ChatGPT was writing emails, summarizing reports, and helping countless undergraduates formulate essays. Other tech companies raced to release their own versions, such as Google's Bard and Anthropic's Claude. Meanwhile, image generators such as DALL·E started turning out logos and other designs in minutes. When Microsoft made its AI assistant, Copilot, available to 150 million users of its enterprise Office suite worldwide, generative AI truly entered the mainstream.[2]

The rapid proliferation of these tools has huge implications for worker productivity. In a study of 453 college-educated professionals, MIT researchers found that those with access to ChatGPT completed a series of exercises—writing cover letters, composing emails, devising business plans—40 per cent faster than those who had no help from AI.[3] Several other studies have come to similar conclusions.

Mark Daley, Western University's chief AI officer—the first position of its kind in Canada—says that generative AI will fundamentally reshape how workers interact with computers. "Probably the most underappreciated, and kind of scary, opportunity is creativity," he says. "Five years ago, no one would have said a computer was creative." But generative AI can analyze data, form ideas based on it, and act as a sounding board for human users, a role once filled by human colleagues. "The best way to think about large language models"— the technology underpinning chatbots like GPT— "is that they are really enthusiastic but naive interns," he says. "Anything you can imagine getting an intern to do, now you have a machine that can do that—short of making coffee." (In fact, Daley says that he plans to staff his new office with "mostly robots and not human personnel.")

The productivity gap

Google estimates that generative AI will save the average Canadian worker 100 hours per year.[4] These gains will be welcome in Canada, which has a long-standing productivity problem. In 1981, Canada's GDP per capita was about C$3,000 above the average of 19 similar OECD countries (adjusted for purchasing power parity).[5] Today, it has fallen to C$5,000 below the average. Presenting Budget 2022, finance minister Chrystia Freeland called this lack of productivity "the Achilles heel of the Canadian economy."[6] This manifests as low business expenditures in R&D, lagging tech adoption, and a lack of high-tech exports.[7]

The reasons for this gap are myriad. According to the OECD,[8] regional differences in regulations hinder interprovincial trade, and government subsidies interfere with the natural life cycles of businesses, keeping unproductive companies alive instead of letting talent and resources flow to more successful firms. Robert Gagné, the director of the Centre for Productivity and Prosperity, argues that lack of competition also contributes to Canada's below-par performance. Many of Canada's largest companies— banks, telecoms, and airlines—enjoy stable oligopolies, so they don't need to invest in research and development or adopt new technologies to maintain market dominance. Small firms can do well without ever expanding beyond their home city. As a result, only a minority of large firms that face competition from abroad are forced to innovate and increase productivity to survive.

If Canada's productivity continues to be outpaced, the country will be C$18,000 behind the OECD average by 2060, resulting in a significantly lower quality of life. "It will become more difficult for government to finance public services: hospitals, schools, roads, and public transit," says Gagné. "We will become, relatively speaking, a poor country."

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2   Mehdi, "Announcing Microsoft Copilot."

3   Noy and Zhang, "Experimental Evidence."

4   Public First, "Google's Economic Impact in Canada."

5   Deslauriers and Gagné, "The Low Productivity of Canadian Companies."

6   Department of Finance Canada, *Budget 2022.*

7   Conference Board of Canada, The, "Innovation Report Card 2024."

8   Organisation for Economic Co-operation and Development, *Economic Policy Reforms 2023.*

Hesitation nation

Canada is home to several of the world's most influential machine-learning researchers and outperforms many of its OECD peers when it comes to developing AI. According to Deloitte, Canada's pool of AI talent is growing faster than that of any other G7 country, and we rank fourth globally in the number of generative AI companies per capita.[9]

According to statistics compiled by The Conference Board of Canada, generative AI could add 1.97 per cent to the national GDP (see Chart 1). If the potential for generative AI to create entirely new categories of products and services is taken into consideration, the effect could be even bigger. In this case, the non-profit Forum IA Québec predicts that a significant increase in AI adoption could boost Quebec's GDP by 7 per cent to 15 per cent by 2035.[10]

In other words, if any nation needs to reap the benefits of generative AI, it's Canada. Yet, Canadian businesses have so far taken a timid approach to generative AI. Only 6 per cent of 16,000 businesses polled by Statistics Canada reported that they were planning to adopt it over the following 12 months.[11] By April, when generative AI had entered the mainstream, KPMG found that 37 per cent of Canadian companies were exploring ways to use ChatGPT, but in the United States, that figure was 65 per cent.[12]

For evidence of Canada's sluggishness, consider the clientele of Cohere, a Toronto company that helps businesses implement large language models like GPT. Ronak Shah, the firm's privacy and regulatory affairs counsel, says that only 1 per cent or 2 per cent of Cohere's customers are from Canada.

Chart 1

Productivity impact of generative AI as a share of regional GDP
(potential productivity impact of generative AI for selected metro regions, percentage of 2022 regional GDP)
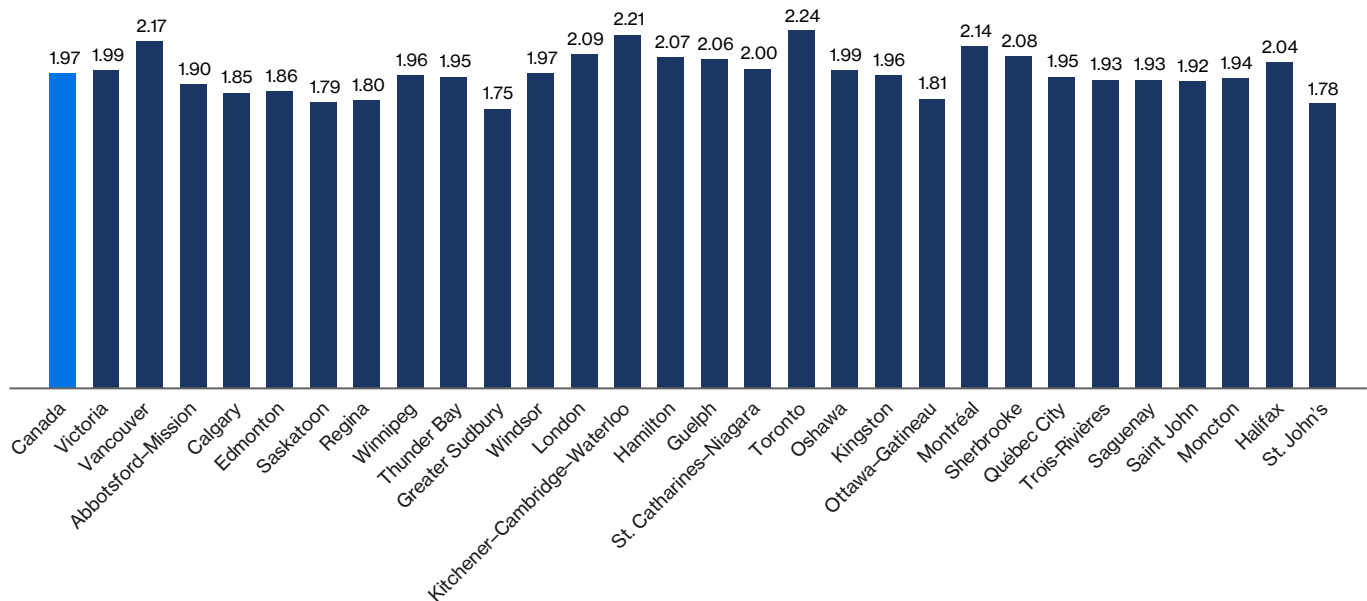
Sources: The Conference Board of Canada; McKinsey & Company.

9   Deloitte, *Impact and Opportunities.*
10 PricewaterhouseCoopers LLP and Forum IA Québec, *Analyse économique.*
11 Statistics Canada, "Canadian Survey on Business Conditions."
12 KPMG, "Canadian Businesses Experimenting With ChatGPT."

This may indicate that few Canadian companies are adopting generative AI, or even if they are, they seek out services of international AI firms rather than local businesses, hindering the growth of potentially successful GDP-boosting start-ups.

To get a more robust, up-to-date view of how Canadian companies are adopting generative AI, we conducted an online survey. The survey was distributed to approximately 1,300 ventures by 10 accelerators/innovation hubs. A total of 221 start-ups participated in the survey, headquartered in eight provinces and operating in 19 sectors (see Appendix A). We asked a range of questions to determine how extensively these ventures are using generative AI, what they expect its productivity impact to be, and what, if anything, is holding them back from integrating it further. In addition, we conducted 17 interviews with start-up founders, AI specialists, and productivity experts.

We chose to poll start-ups because they tend to adopt new technologies more readily, provide informative case studies, and often indicate where the business community at large is headed. The experiences of these early adopters could inform executives and leaders in other parts of the economy as they consider how to use generative AI in their businesses.

If the responses from the start-up community are any indication, Canada is making inroads—but there is still a long way to go.

Putting the I in AI: How three tech pioneers are boosting their personal productivity

The coding collaborator
When Western University's chief AI officer Mark Daley does programming, he uses Github Copilot, an AI-powered tool that can autocomplete code. "If I'm on a flight and I don't have access to it, I feel like a part of my brain is missing. It's a massive productivity enhancement."

The custom-built summarizer
Martin Bufi, a former senior technical advisor at MaRS, custom-built himself a generative AI tool that can summarize 50-page documents and respond to queries about what it just learned. "This saves huge amounts of time, since it allows me to ask questions about the documents and go more in-depth if needed."
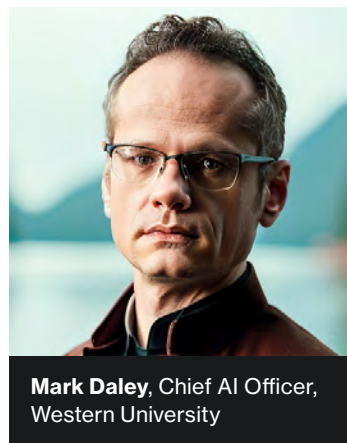
The personal office manager
In November 2023, Ronak Shah, Cohere's privacy and regulatory affairs counsel, travelled to the U.K. to attend the AI Safety Summit. When he visited the company's London office, he needed to know how to get on the Wi-Fi network. Rather than bug a coworker, Shah asked Coral, Cohere's internal chatbot. It instantly helped him connect. "I joined the company six months ago, and it's really helped with onboarding," he says. "Instead of finding someone, I can just ask Coral."

Mark Daley, Chief AI Officer, Western University

"The best way to think about large language models is that they are really enthusiastic but naive interns."

Results

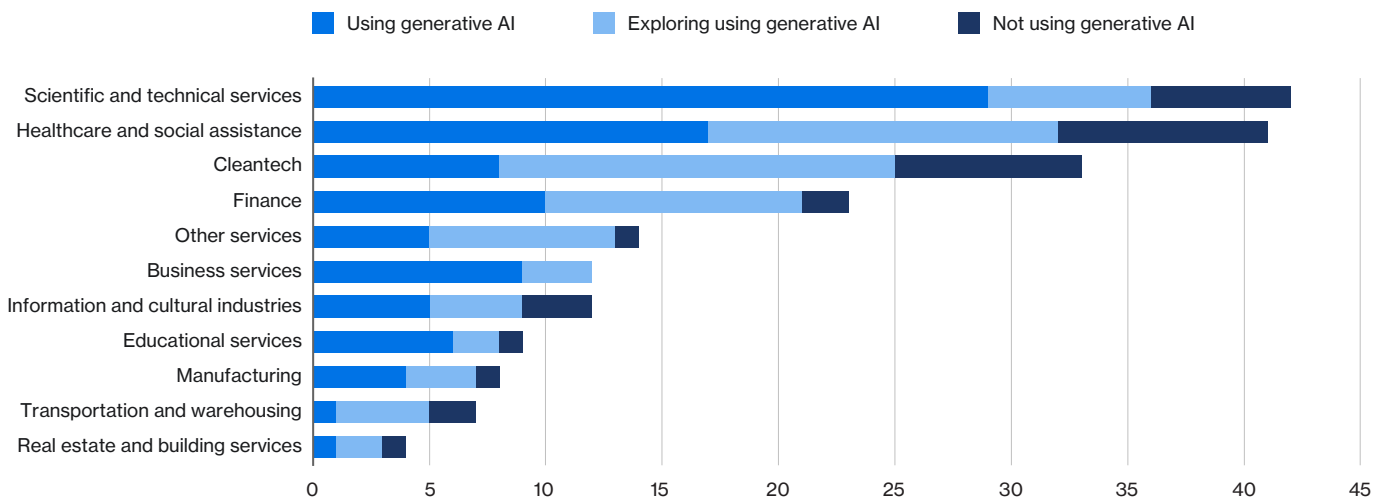# Today's promises and tomorrow's challenges

Who's using it?

A range of industries are already using generative AI (see Chart 2). From the start-ups we polled, scientific and technical services is the main industry using generative AI, followed by healthcare and social assistance. Start-ups in cleantech were most likely to say they are exploring the use of generative AI.

We're in an age of experimentation

Start-ups have been quicker to embrace generative AI than Canadian firms at large. Of the 221 companies we polled, 46 per cent were already using generative AI, and 38 per cent said they were exploring it. They were adopting generative AI across a range of functions, including using it to organize their data to support traditional AI applications—a process known as semantic data mapping.

Chart 2
Attitude toward adopting generative AI across sectors
(number of respondents)

■ Using generative AI   ■ Exploring using generative AI   ■ Not using generative AI

Sector	Chart
Scientific and technical services	
Healthcare and social assistance	
Cleantech	
Finance	
Other services	
Business services	
Information and cultural industries	
Educational services	
Manufacturing	
Transportation and warehousing	
Real estate and building services	

0   5   10   15   20   25   30   35   40   45

Source: MaRS Discovery District.

Four categories emerged as areas of focus: research and development; sales and marketing; operations and production; and customer service and support. (See Chart 3.)

These results are in line with a McKinsey report[13] from January 2023 that found that 75 per cent of the potential value created by generative AI would fall into four categories: customer operations; marketing and sales; software engineering; and research and development.

Real-world examples of how generative AI is being deployed were provided by several of the interview subjects.

Automating customer service

Canadian financial technology firm Wealthsimple has grown rapidly in recent years. To more effectively manage the rising number of customer queries it receives, in 2022, Wealthsimple began working with Toronto company Ada, which helps its clients automate customer service operations. It created a chatbot for Wealthsimple's website that can answer straightforward customer queries by extracting relevant information from knowledge databases that are maintained by human specialists. The bot now handles about 70 per cent of customer inquiries, mostly "how-to types of questions and general
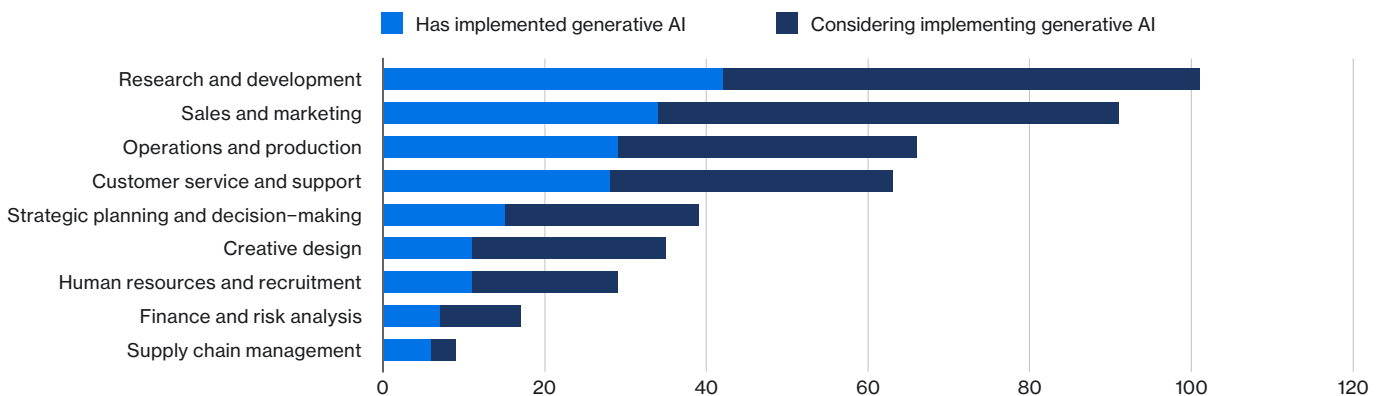
instructions," says Sam Talasila, Wealthsimple's large language model lead. Staff can improve the bot's performance over time by providing it with feedback and steering its responses using natural language. But for complicated or sensitive questions, it automatically connects users to an employee. "Even with the chatbot, human advisors do the more sophisticated and difficult tasks, like building trust and helping clients make smart decisions about investing," Talasila says.

Surfacing soundbites

Toronto-based OneCliq is using AI to streamline social media content creation. "If you make content for your business, you probably spend hours editing and repurposing it to share across different platforms," says OneCliq co-founder Tanika McLeod. "It's expensive, it takes hours, and it's exhausting." OneCliq uses AI to analyze videos and find what McLeod calls "shareable moments." The technology reworks and resizes footage to meet the disparate requirements of numerous social media platforms, and it can generate copy to run with the posts. McLeod believes this is just the start: "Soon you'll be able to research, write content, and manage your content with a simple conversation with your assistant instead of doing those things yourself."

Chart 3

Which business functions have you implemented or considered employing generative AI for?
(number of respondents)

■ Has implemented generative AI   ■ Considering implementing generative AI

Business function	Value
Research and development	~101
Sales and marketing	~91
Operations and production	~66
Customer service and support	~63
Strategic planning and decision–making	~39
Creative design	~35
Human resources and recruitment	~29
Finance and risk analysis	~17
Supply chain management	~9

Note: Respondents could select more than one option.
Source: MaRS Discovery District.

13 McKinsey & Company, "The Economic Potential of Generative AI."

A new window on the Internet

The start-up Blue J's platform shows how generative AI could change the way we interact with the web. When tax professionals need to consult statutes or regulations, they usually turn to specialized search engines to locate the documents they need and then comb through them to find the right parts. Blue J has developed a chat-based system that does the legwork. Its chatbot finds relevant information from an approved set of reliable sources and then deploys generative AI to pull out insights and compose an answer for the user to review. "Tax professionals have to piece together information from lots of different documents—it's incredibly complex," says chief operating officer Avi Brudner. "We can pull out the insights and give users an answer in seconds that could have taken them hours to research themselves."

Deploying AI across the board

Mercator AI is a software platform that connects general contractors to projects at their earliest viable stage. The Calgary start-up is leveraging generative AI to label and categorize large unstructured data on its platform. Internally, it's also using the technology to analyze and summarize sales calls and follow up with customers. The company also uses generative AI to produce the first drafts of marketing content (such as repurposing podcasts into blog posts), summarize meeting notes, and document next steps. Chloe Smith, co-founder and CEO, says, "We are a remote-first culture so over-communication is critical but also time consuming."

Businesses are adopting generative AI to be productive

Why use generative AI? Our survey respondents said their main motivations were enhancing productivity and introducing a new product or service (see Chart 4). Only a handful of start-ups said they'd adopted generative AI because a competitor had already done so.

Whatever their reasons for adopting generative AI, more than three-quarters of our survey respondents reported that it has made their businesses more competitive (see Chart 5). Another 17 per cent said it was too early to tell.
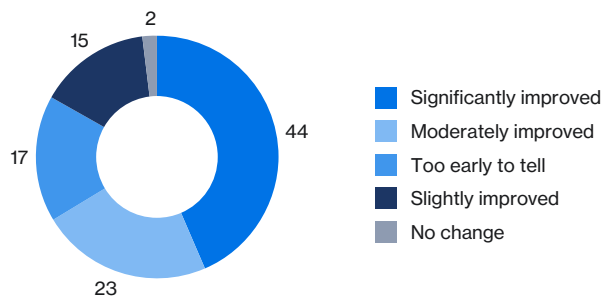
Chart 4
What were your motivations for adopting generative AI in your organization?
(number of respondents)
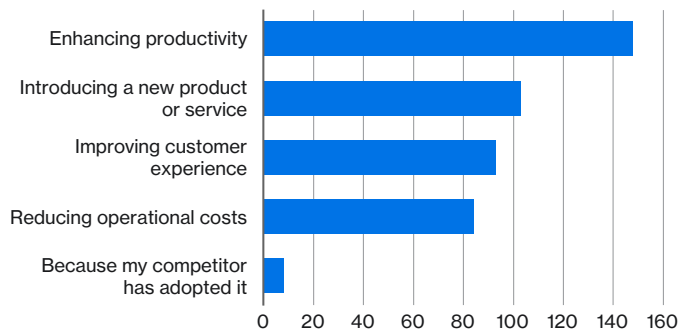
Note: Respondents could select more than one option.
Source: MaRS Discovery District.

Chart 5
To what extent do you believe generative AI has improved the competitiveness of your business?
(percentage of respondents)

Note: Total may not add to 100 due to rounding.
Source: MaRS Discovery District.
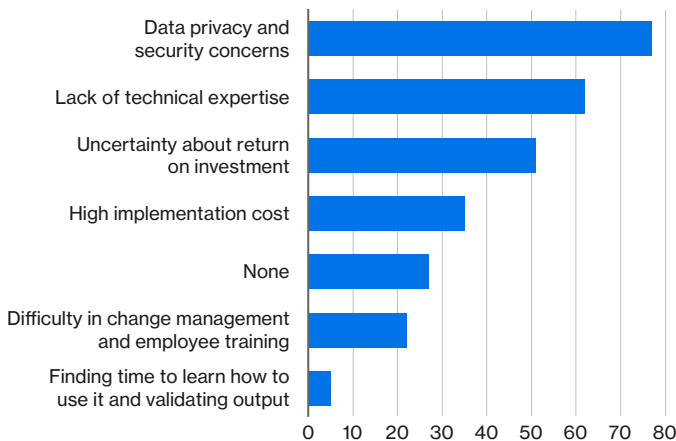
There are obstacles to further adoption

When we asked participating start-ups about the challenges they had faced in adopting generative AI, the leading ones were concerns over data privacy and security, a lack of technical expertise, and uncertainty that the time and money they put into AI would yield a worthwhile return on investment (see Chart 6).

It's worth digging deeper into a few of these roadblocks and examining how they may change in the near future.

Chart 6
What challenges have you faced in integrating generative AI into your business processes?
(number of respondents)

| Challenge	Value
Data privacy and security concerns	~77
Lack of technical expertise	~62
Uncertainty about return on investment	~52
High implementation cost	~36
None	~28
Difficulty in change management and employee training	~23
Finding time to learn how to use it and validating output	~5

Note: Respondents could select more than one option.
Source: MaRS Discovery District.

Computing costs

Although generative AI has the potential to save companies money through efficiencies, these systems still have costs. Generative AI models use billions of parameters and so require tremendous amounts of computing power to develop and operate. But computing power is a limited resource in Canada.

On the 2023 Global Artificial Intelligence Index compiled by media firm Tortoise,[14] Canada ranked 23rd for its AI infrastructure. That rank was eight places below the previous year's and significantly lower than our performance in other parameters, such as talent and research, in which we were comfortably in the top 10. To reverse this trend, the government will need to consider developing a strategy ensuring that we have the infrastructure in place to be AI leaders.

Our comparative lack of supercomputers and other infrastructure particularly impacts researchers and SMEs, which can be priced out by larger organizations with deeper pockets. Melissa Judd, a vice-president at the Vector Institute, says that Canada needs a bold vision to fill this gap. While Canada has made early investments with the Pan-Canadian AI Compute Environment (PAICE), which is part of the national AI strategy, Judd points to the U.K., which is investing £500 million (C$850 million) in its computing capacity, and France. "[France], too, invested heavily in infrastructure and made their supercomputers available to both researchers and SMEs founded in France and those that choose to relocate there," she says.
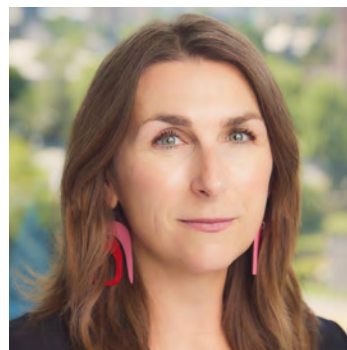
Melissa Judd, a vice-president at Vector Institute, says there's work to be done to bolster Canada's computing capacity.

14 Mostrous, White, and Cesareo, "The Global Artificial Intelligence Index."

Clouds of carbon

Generative AI takes an enormous amount of computing resources, and its energy demands are already significant. In July 2023, researchers at the University of Washington estimated that ChatGPT-3 could consume as much power as 33,000 homes each day.[15] That number is likely to grow as the technology becomes more widespread. Himanshu Joshi, a senior manager of applied AI projects at the Vector Institute, says that some companies may forgo generative AI because its carbon footprint doesn't align with their environmental, social, and corporate governance priorities.

However, the carbon emissions from generative AI have received modest attention so far, and only a handful of the people we interviewed raised the issue unprompted. One of these participants was Iryna Andriushchenko, co-founder of Handy.ai, a Canadian-Ukrainian company that streamlines communication in industries like mining, pharma, retail, and hospitality. Handy.ai uses AI to interpret requests in multiple languages, turn them into workflow tasks, and match them with an appropriate person to carry them out.

"We see two different types of clients: Either they are excited to use AI or they are terrified, and nothing in between," says Andriushchenko, although she points out that some people who are against deploying it in business are comfortable using ChatGPT for their personal tasks. "I always tell clients that you only use AI if you need to. Use regular automation or rule-based processes for tasks that don't require AI. Also, after an initial AI implementation, consider transitioning ongoing interactions back to rule-based processes, avoiding unnecessary AI involvement in routine and repetitive communication."

Andriushchenko notes that several online tools have been created to help users better understand generative AI's energy use.[16] "They help calculate emissions reductions when AI is applied selectively and as needed," she says. "We have to be mindful; AI has a carbon footprint."

15 McQuate, "Q&A."
16 Mineault, "How Much Energy Does ChatGPT Use?"

Technical expertise

More than half of the respondents who are using or exploring generative AI reported that a lack of technical expertise was holding them back from integrating it into their businesses. Yet only 29 per cent of those firms said that finding talent was a roadblock. Jim Monroe, chief customer officer at Ada, says the company has been able to find almost all the personnel it needs in Canada. What, then, is behind start-ups' troubles with technical expertise?

One explanation is the dearth of formal training materials on how to use generative AI. In our interviews, a common theme was that start-ups were relying on upskilling their existing engineering talent to meet development needs, but given the pace of change, there are few reliable, up-to-date sources of information on AI skills training. "There's no university-based course out there that you can really take," says McLeod of OneCliq. She and her team have instead used more do-it-yourself methods. "It's other engineers sharing what they're learning as they go on YouTube, short courses on deeplearning.ai, Substack, GitHub, and other means."

Data readiness and security

Many firms are still operating in an analog world. Their institutional knowledge is stored on paper documents and in employees' brains, not properly labelled digitized files that an AI model can access. "It is a big change for most organizations to go down a path of digital transformation," says Catherine Fortin LeFaivre, a vice-president at the Canadian Chamber of Commerce. "You need a change-management strategy and leadership from the C-suite. That takes time. It can't happen overnight."

Even among companies that are ready, there is clearly hesitation about placing sensitive data into an AI model, particularly if they are unsure who might be able to access it. To deal with this uncertainty, many of the start-ups we interviewed are eschewing open AI models. Cohere, for one, allows its customers to house AI models on their own premises, inaccessible even to Cohere. "Privacy and cybersecurity are top of mind, but I don't know if they're limiting factors for our customers anymore," says Shah.

The spectre of hallucinations

Finally, there is concern that generative AI is simply not reliable enough yet. Despite their impressive abilities, chatbots still occasionally provide wrong answers. They can reflect biases in their training data, and they sometimes make things up entirely. For businesses, errant AI presents a material risk. When Google Bard provided an incorrect answer to a prompt in a promotional video in February 2023, for example, the company briefly lost US$100 billion in market value.[17] "If a chatbot puts out something that doesn't make sense to a client, your reputation goes down," says the Vector Institute's Joshi. "So, you may not want to take that risk."

In broad strokes, companies are using generative AI for relatively straightforward or repetitive tasks, such as summarizing documents, answering common queries, and completing basic design work. But at a granular level, predicting how successful it will be at a given task can be difficult.

Daley, the Western University AI chief, cites a Boston Consulting Group experiment that revealed that much depends on the particular nuances of a project.[18] " It's hard to say *a priori* what it is going to be good at," he says. "There are things that people thought it would be good at, and it really wasn't. And there are other things where they thought, 'There's no way the machine is going to be good at this,' and then it turned out it actually was. You have to experiment to figure out, for your use cases, where it works and where it does not."

Ronak Shah, Privacy and Regulatory Affairs Counsel, Cohere

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17 Olson, "Google Shares Drop $100 Billion."
18 Candelon and others, "How People Can Create."

The way we work will change

Will machines replace human workers? A June 2023 report by KPMG found that AI could automate large portions of work done by writers, translators, and computer programmers as well as public relations and information technology professionals.[19] But when we asked Canadian start-ups whether they expected to replace workers with AI, 63 per cent said that implementing AI would not reduce their headcount. Another 30 per cent said they weren't sure, and a few outliers predicted it would decrease the size of their workforce. Survey participants were young, growing operations, and the equation is likely different for large legacy organizations.

Separate research from the Conference Board on ChatGPT suggested its effects would be felt mostly in labour productivity rather than disruption to the labour market broadly.[20] Jobs it deemed at highest risk make up only 4 per cent of total employment. These jobs are concentrated among STEM and knowledge workers.

Talent: Searching high and low

Though it's still too early to draw any conclusions about how generative AI might affect the labour market as a whole, some companies are already adjusting their approach to hiring. One of these is Kaitongo, a GPT-powered platform that aggregates and refines business news to provide its clients with actionable market insights. Based in Toronto, the company quickly grew to a staff of seven and anticipated needing to hire 30 or 50 people to tag and curate content.

The company has now deployed generative AI for this work and other tasks and is reevaluating its staffing plans. "Before, we were looking for mid-level analysts with maybe two to three years' experience," says founder Sumathi Pundit. "Now, we're looking for junior interns for work that doesn't require a lot of analysis, and then at the other end we're looking for very senior data scientists who can pound GPT and other [large language models] and help us prompt engineer."

Respondents who predicted no change to staffing numbers said that generative AI would make employees more productive when fulfilling their existing responsibilities and therefore grant them more time to perform new tasks. "It's less about job replacement and more about job augmentation," says Cohere's Shah. "The narrative—and we're not denying it—is that some jobs are going to go. But AI is also going to create new types of jobs."

What those jobs are remains unclear. Much has been made about "prompt engineering," the practice of optimizing queries to elicit the best possible responses from generative AI tools. McKinsey predicts that "prompt engineering is likely to become a larger hiring category in the next few years,"[21] and dozens of courses on it are available online. But not everyone is convinced. "I think it's bogus," says MaRS's Bufi, pointing out that, when a user enters a prompt into the latest version of DALL·E, it automatically rephrases the prompt to create a better output. In other words, AI has already automated a job that AI was expected to create.

Rhonda McEwen, the president of Victoria University at the University of Toronto, believes that there will be new roles for people, such as checking the sources AI draws upon and validating outputs. In general, she adds, the most valuable workers will be those who can use generative AI to complement their work. "That is going to be a differentiating skill and competency," she says.

Rhonda McEwen, President of Victoria University, University of Toronto

19 KPMG, "Productivity Boost From Generative AI."
20 Burt, *ChatGPT.*

21 McKinsey, "What Is Prompt Engineering?"

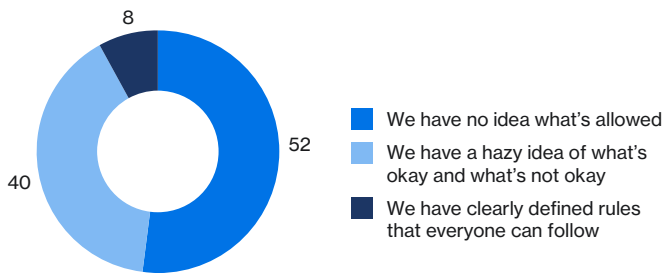# Businesses want clear AI regulation—but not too much of it

More than 90 per cent of our survey respondents said that they weren't sure about AI rules under current Canadian regulations (see Chart 7).

Canada's voluntary code of conduct asks (but does not require) companies to commit to accountability, safety, equity, transparency, and human oversight of AI models.[22]

Chart 7
What do you think of the regulatory environment in Canada for generative AI?
(percentage of respondents)

- We have no idea what's allowed
- We have a hazy idea of what's okay and what's not okay
- We have clearly defined rules that everyone can follow

8
52
40

Source: MaRS Discovery District.

Regulating AI is a tall order because introducing guardrails that are out of step with international standards could hamper Canadian companies competing globally. "It has to be a global effort on policy and regulation," says Victoria University's McEwen. "We can't have Europe going one way and America going the other."

Cohere's Shah says that large organizations are wary of how governments might regulate the kinds of data that can be used to train AI models. Will policy-makers, for example, allow AI models to be trained on copyrighted material? And who will own the content that generative AI creates? "None of the people in the ecosystem—not the developers or the deployers or the rights holders—have any clarity on that," he says.

Fortin LeFaivre from the Chamber of Commerce recommends that the Canadian government work closely with industry to develop precise regulations that strike a balance between safety concerns and the needs of businesses. If the regulations are too stringent, she says, they could discourage innovation, repel investment, and prevent multinational companies from setting up in Canada: "It's okay to have sticks, but you also need carrots. If we're dissuading companies, that's going to hurt our ability to be competitive, and we're not going to be world leaders."

22 Innovation, Science and Economic Development Canada, "Voluntary Code of Conduct."
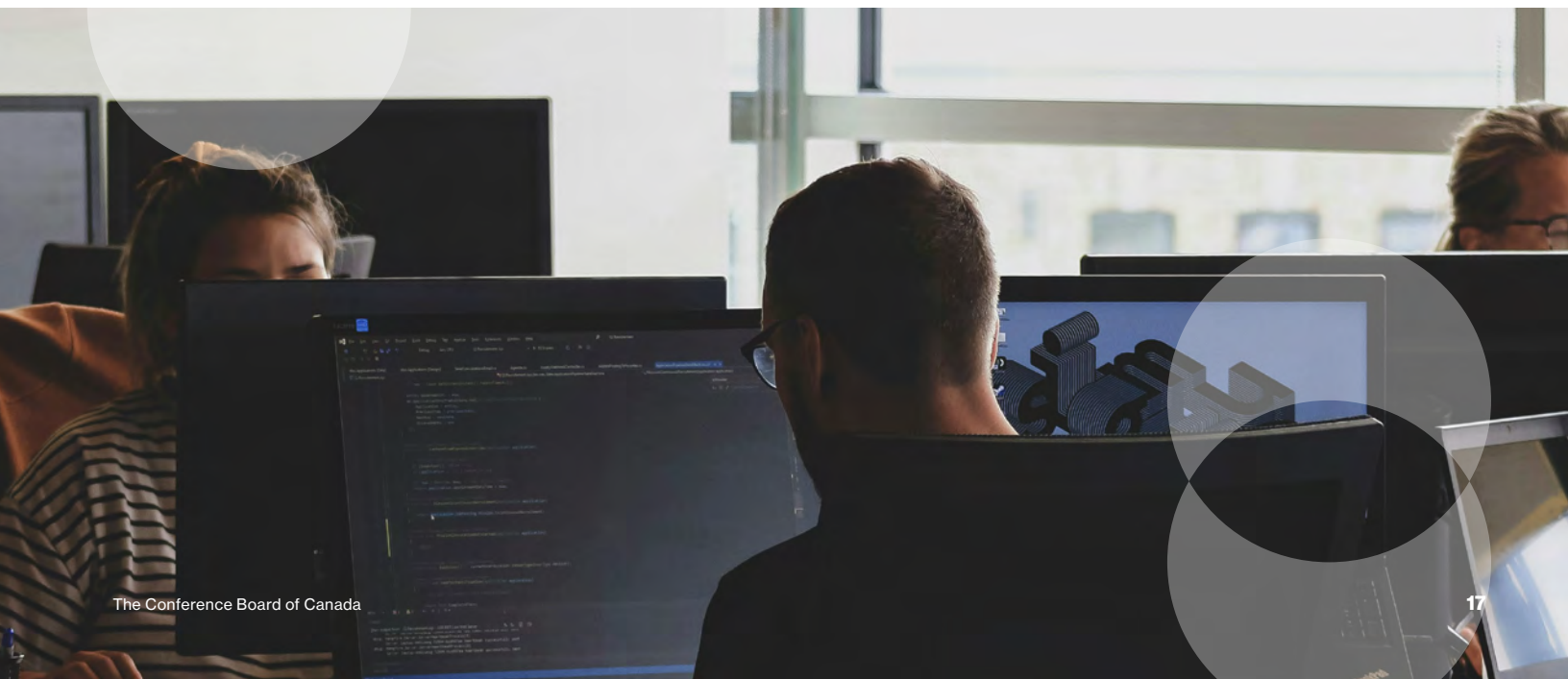
Proceeding with caution

"We do not yet feel it is ready for primetime, but we believe it could get there." That's how Foteini Agrafioti, Royal Bank of Canada's chief science officer and head of Borealis AI, sums up her view on recent advances in generative AI.

Borealis AI is RBC's in-house research arm that leverages AI to better understand clients, deliver personalized experiences, and make the bank's operations more efficient. Agrafioti is working on generative AI applications across RBC. She envisions it handling simple customer queries, helping surface relevant information for financial advisors, and supporting market analysts in their research. But she is also cognizant of its pitfalls, which can be particularly deep in an industry like banking, where trust is everything.

The known problems with generative AI—uncertainty over data security, its occasional habit of blurting out confidential information, its capacity to make things up— could shatter trust in a financial institution. And though none of those issues are insurmountable, Agrafioti feels more development and testing is needed before the technology can be used with customer data. "We know what our relationship is with our clients, and we won't compromise on that," she says.

"The biggest data assets a bank has are its transaction risk and market data. Where we get more excited is taking the science from large language models and adapting it to a business's own data types."

There's also a broader issue that limits the usefulness of the current crop of AIs in financial services: Most are large *language* models. But banks deal with numbers, not words. "The biggest data assets a bank has are its transaction risk and market data. Where we get more excited is taking the science from large language models and adapting it to a business's own data types."

Borealis AI has been developing large transaction models that have potential to underpin a range of the bank's activities. "The old way of doing AI would be to have a custom model for each aspect of the business. The new way is to have a foundation model behind it and then fine-tune for each application as needed. That allows for better governance and generalization as well as going to market and deploying faster."

Foteini Agrafioti, Chief Science Officer, Royal Bank of Canada

What's next for generative AI?

Dustin Zhang, Cohere's strategy and operations lead, explains what's next for generative AI.[23]

Phase 1: Generic language AI

What: The tools today, such as ChatGPT and Google Bard, have been trained on publicly available data — billions of books, articles, and webpages — and can analyze users' prompts and output text.

Example tasks: Writing emails and computer code, translating and summarizing documents, and conducting Internet searches.

When: Now.

Phase 2: Retrieval augmented generation

What: Bespoke upgrades of current tools could access enterprise data — reports, emails, spreadsheets — to provide highly specific responses.

Example tasks: Summarizing annual sales, identifying products with the highest gross margins.

When: Next several years.

Phase 3: Autonomous knowledge assistants

What: Tools act on behalf of workers.

Example tasks: Just about anything. If, for example, a company receives an order for 100 computer chips, an employee could ask the assistant to ship them and send an invoice to the customer. "You can imagine the change in productivity once the agent can not only give you the right answer but also take that answer and then do what you were going to do yourself with it," says Zhang.

When: Uncertain.

23 Shepherd and Zhang, "How Generative AI and LLMs Unlock Greater Workforce Productivity."

Needed: A dash of daring

Canada's productivity problem is intensifying. According to Statistics Canada, our national output per hour worked — which exhibited lacklustre growth before the pandemic — has gone into reverse, declining in seven of the past eight quarters.[24]

The advent of generative AI is a potential reset moment. It's widely seen as a truly transformative technology that could reshape jobs and businesses in numerous industries. As with most innovations, there will likely be a first-mover advantage. But our data suggest Canadian businesses are moving slowly.

To avoid falling further behind, urgent action is needed. The early successes and challenges of the high-tech start-up community can provide valuable insights into actions that businesses, governments, and individuals can take today to seize this moment.

Recommendations

Invest in experimentation

Canada holds a hallowed place in the history of AI. Many of the breakthroughs that led to the current AI boom were made in labs here. Canada has deep pools of specialized talent and a significant amount of best-in-class generative AI firms. As this report shows, we also have numerous start-ups that are integrating generative AI into their products. This should be a rich environment for businesses to find talent and create partnerships around developing AI technologies.

But in order to take advantage, Canadian businesses have to break out of their historic pattern of under-investing in research and development (R&D) and new technologies. While weak competition in the Canadian market has insulated many companies from needing to invest in R&D in the past, the already extensive use of generative AI among Canadian start-ups suggests that its effects will be felt widely, and all businesses need to prepare for these changes. Generative AI also presents opportunities to reduce the costs of R&D, which businesses should explore.

24 Statistics Canada, "Business Output."

Develop a national AI infrastructure strategy

Good availability of computing power is fundamental to developing and implementing AI, but Canada is slipping relative to its peers. The federal government could significantly enhance its national strategy to support the development of supercomputing and data infrastructure. This strategy should include measures to bolster access to affordable computing power for researchers and SMEs.

Lower barriers for small businesses

AI adoption is particularly difficult for SMEs. A study from Toronto Metropolitan University found that 20 per cent of large firms are using AI, but only 3 per cent of smaller businesses are.[25] Our findings show that even tech-savvy start-ups are spending significant time and resources in determining where to use generative AI and how to integrate it.

Some help is available. For instance, Scale AI, a public–private consortium and one of Innovation, Science and Economic Development Canada's five Global Innovation Clusters, provides advice to businesses and funds AI-adoption projects across the country. Canada also has the Pan-Canadian Artificial Intelligence Strategy, and the federal government funds upskilling programs for SMEs through the three national AI institutes (Amii in Edmonton, Mila in Montréal, and Vector in Toronto). However, given the number of SMEs in Canada, support will need to be more widely available as generative AI technology becomes more deeply embedded in the economy.

Regulate smartly

The federal government should work alongside industry and the international community to craft regulations that mitigate the potential harms of AI without dissuading innovation and international investment. With carefully considered guardrails in place, businesses will have the clarity they need to adopt generative AI with confidence.

Engage the public

Our interviewees suggested that the public service could better prepare Canada for the ways AI will change our day-to-day lives. "I don't think we're doing a good enough job of preparing our communities, students, and young folks who are going to be entering the labour markets," says OneCliq's McLeod. "I think our political leaders are maybe a little slow to understand the impact that we're talking about here." Bufi, the former MaRS advisor, says that educating citizens on AI will help mitigate paranoia over job losses and doomsday scenarios: "Whether Canada trains its people to learn and use AI is really up to the government. Who else is going to mandate that?"

Upskill employees

Although it's not yet clear how generative AI will alter the broader labour market, it certainly will do so. There are signs that workers who are highly proficient in narrow skill sets might lose out to those who are better able to strategically use AI for tasks it's best suited for. And existing career pathways where progression is based on gradual accumulation of skills may be reshaped, as AI has been shown to flatten performance differences between the best- and worst-performing knowledge workers in some instances. Businesses and the education sector will need to rethink how they're preparing current and future workers for this new reality and adjust their approaches.

We're still in the early innings of the AI game, and there's time to catch up. This report has identified several barriers to further integration of these technologies, but none are insurmountable. With buy-in from businesses, support from government, and a healthy dash of daring, Canada could solve its long-standing productivity problems.

25 Lockhart, *Automation Nation*?

Appendix A
Methodology

Definition of generative AI in this report

Generative AI is any form of machine learning that can produce creative outputs such as images, text, videos, and music based on inputs from a human user. Generative AI models learn patterns from training data to generate new data with similar characteristics. Generative AI differs from earlier forms of AI that perform specific tasks based on predefined rules and patterns. Generative AI goes beyond this limitation to create entirely new data that resembles human-created content.

Survey

We conducted a survey of 221 Canadian start-ups to understand how ventures are using or exploring using generative AI to enhance their productivity and some of the challenges that they are facing in adopting the technology. We also sought out ventures that are not using or planning to use it.

To recruit ventures from across Canada, we contacted 92 accelerators and innovation hubs to help distribute the survey to companies in their portfolios. The survey was distributed to approximately 1,300 ventures by the following 10 accelerators/innovation hubs:

- adMare BioInnovations
- DMZ
- The Forge
- MaRS
- Mitacs
- Startup Canada
- Toronto Fashion Incubator
- University of Toronto
- Vector Institute
- Venture Lab

Ventures that participated in the survey are headquartered in eight provinces and operate in 19 sectors.

We interviewed 11 start-up leaders and experts (six men, five women). The start-up leaders were drawn from sectors that were identified in the survey data as having high adoption rates of generative AI. We further interviewed another six experts in this area (e.g., academics, lawyers). The interviews were designed to understand the challenges that the ventures were facing in adopting generative AI and the steps that the founders took to overcome these challenges.

Study limitations and potential biases

The proportion of ventures that are leveraging generative AI may be inflated by self-selection bias. It seems reasonable to assume that companies that are using generative AI are more likely to have completed the survey. Since the survey was distributed to ventures that are in the early stages of growth, there could be a larger adoption rate as they attempt to become more competitive with limited resources.

Chart 1
What stage is your company at?
(percentage of respondents)

- Seed
- Pre-seed
- Series A
- Series B+

37, 30, 24, 9

Source: MaRS Discovery District.

Chart 2
Location of the venture's headquarters
(number of respondents)

- Ontario
- Alberta
- Quebec
- British Columbia
- Manitoba
- Saskatchewan
- Nova Scotia
- Newfoundland and Labrador

164, 20, 14, 14, 4, 2, 2, 1
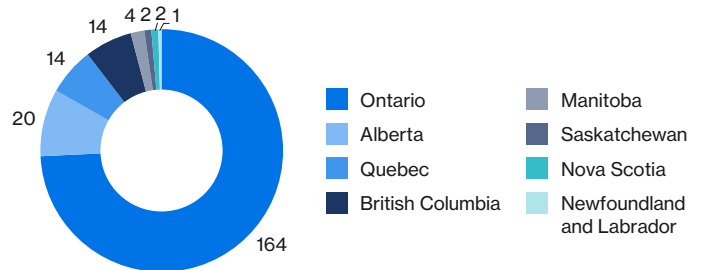
Source: MaRS Discovery District.

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Acknowledgements

Real Talk: How Generative AI Could Close Canada's Productivity Gap and Reshape the Workplace—Lessons From the Innovation Economy
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