Automation and the Future of Tech Careers in Canada:

What Students Need to Know

2025

ICTC CTIC

Research by

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Preface

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Executive Summary

The Canadian information and communications technology (ICT) sector is experiencing faster artificial intelligence (AI) adoption than other industries. ICT occupations will be among the first to see changes due to automation, impacting how ICT students plan careers and build skills.

ICT workers report using AI tools to augment and automate a wide range of tasks, most commonly writing documents or emails, writing code, analysing data, debugging, and getting help. In "acceleration mode," technology workers use AI to complete familiar tasks faster. In "exploration mode," technology workers learn new skills or ways of solving a problem. Some employers are repurposing staff time in response to automated tasks.

ICT workers report benefits from AI tools, such as increased efficiency and productivity, quicker learning, and reduced human resource expenses. **Despite this, most organizations still struggle to quantify the return on investment of AI tools, or they make do with indicators they know are incomplete.** Some organizations are seeing both negative and positive impacts from AI, such as privacy and security concerns, and face mixed results regarding work quality.

Employer-provided AI policies and training are a noteworthy gap in AI adoption to date. In ICTC's survey of technology workers, 77% of respondents were allowed to use AI tools to build technology products and services at work. Still, not all their organizations had specific policies for AI tools, a gap which can harm change management and create risks regarding privacy, security, and quality

assurance. Only 37% of surveyed ICT workers indicated that their organization provided training on AI tool use. Yet, "limited staff expertise" was the primary barrier hindering organizations from adopting AI tools, impacting 34% of the sample.

Globally, and in Canada, some employers report reducing their workforces because of AI automation. However, change at the task level is more apparent. **One-third of ICT sector survey respondents (31%) reported that AI had automated a task they used to do.**

Projections of how AI will impact ICT occupations predict significant exposure to automation. However, these projections typically do not consider the potential costs of adopting AI to replace human labour, such as expensive externalities introduced by security risks.

ICTC analysis suggests that many rote, lower-stakes tasks in data, programming, information technology (IT), and helpdesk roles are being automated on a trial basis. These tasks are often held by junior workers. Initial labour market signals for data roles indicate a shift towards demand for more senior positions that involve complex tasks and oversight responsibilities. Labour market analysis also shows stronger demand for back-end or full-stack roles and a decline in demand for front-end occupations like web design. Individuals in software development and engineering roles report taking on front-end tasks and responsibilities using AI. Demand for cybersecurity personnel, user experience professionals, and management-level IT professionals remains strong; however, each of these roles shows a trend toward hiring professionals with more work experience.

Despite AI transforming jobs and responsibilities, **employers emphasize that students should still acquire fundamental skills, learn to use AI tools critically, and demonstrate a combination of interpersonal and adaptable technology skills.**

Table of Contents

Introduction

Digital economy firms are leading Canada in artificial intelligence (AI) adoption, changing the way technology teams operate and transforming their labour needs. Technology teams across Canada are adopting copilots to suggest and autofill code for programmers, agents to interact with customers and triage questions, and embedded AI to enhance existing software programs and development environments.

For students in information and communications technology (ICT) programs and new graduates entering the job market, it is essential to understand how new technologies are being embraced in Canadian technology workplaces, what effects these tools are having on ICT tasks and roles, and how to navigate a shifting labour market. With the technology sector adopting AI quickly, technology occupations might also see early impact from AI automation.

While the concept of automation brings to mind robotics in manufacturing facilities or automated tellers in grocery stores and restaurants, automation has significant potential to affect a new group of professionals, ICT workers, due to the increasing capabilities of automated coding assistants and data analysis tools.

This report asks whether ICT workers in Canada are experiencing changes to their jobs because of automation, and it aggregates career advice for ICT students in light of industry trends. It examines the impact of AI productivity tools on core ICT occupations in Canada, which currently employ 1.1 million Canadians.[1] It uses new data from an employer survey, interviews with early AI adopters, and labour market information to understand the implications of AI adoption on Canada's ICT labour market.

The report concludes with a specific focus on strategies for early-career professionals and students entering these occupations. While early evidence suggests that ICT occupations in Canada are undergoing significant changes in task composition, individuals with the appropriate skills to design, build, and monitor safe, secure ICT environments still have many opportunities.

1 This project defines core ICT occupations using a set of 15 National Occupation Classifications (NOCs) listed in Appendix A. These NOCs describe occupations in software development, web development, data science, digital infrastructure, hardware, cybersecurity, and user/IT support.

PART I:
AI Tool Adoption in Canada's ICT Sector

Key Takeaways

- The technology sector is experiencing faster AI adoption than other industries. Data indicates a significantly higher level of adoption among technology occupations in Canada, particularly within the private sector.
- Employee sentiment toward AI tools is mostly positive. Employees highlight how AI tools can improve learning and help them complete a variety of tasks faster. Survey data suggests that about 59% of ICT workers feel favourably towards AI tools, 22% are indifferent, and 18% are unfavourable.
- ICT workers are using AI tools to augment and automate a wide range of tasks, most commonly writing documents or emails, writing code, analysing data, debugging, and getting help.
- ICT workers report benefits from AI tools, such as increased efficiency and productivity, quicker learning, and reduced human resource expenses. Despite this, most organizations still struggle to quantify the return on investment of AI tools, or they make do with indicators they know are incomplete. Some organizations are seeing both negative and positive impacts from AI, such as privacy and security concerns, and report mixed results regarding work quality.
- AI is being adopted in ways that change the nature of employee tasks. In "acceleration mode," technology workers use AI to complete familiar tasks faster. In "exploration mode," technology workers learn new skills or ways of solving a problem. Some employers are repurposing staff time in response to automated tasks.
- Organizational guidance on AI tool use is crucial: without guidance, employees may be disincentivized to explore new tools or may adopt tools discreetly. In response to ICTC's survey of ICT workers, 77% of respondents reported being allowed to use AI tools to build technology products and services at work, 53% reported being encouraged to use AI tools, and 12% reported being required to use AI tools.
- Organizational policies are needed to shape AI adoption. A lack of organizational policies can harm change management and create risks regarding privacy, security, and quality assurance. Still, not all organizations that allow their employees to use AI tools at work have specific policies for AI tools.
- In response to ICTC's survey of ICT workers, only 37% of respondents indicated that their organization provides training on the use of AI tools. Concurrently, respondents identified "limited staff expertise" as the primary barrier hindering organizations from adopting AI tools, cited by 34% of them. Additionally, "limited experience with AI tools" was reported as a barrier by 29% of respondents.

Automation—the use of technology to complete tasks typically assigned to humans—has been occurring for millennia, especially since the industrial revolution.[2] Economists describe "general purpose technologies" as those with the greatest potential to significantly alter human labour patterns. General purpose technologies improve over time, generate spillover innovations, and are widespread across the economy.[3] Examples include the printing press, steam engine, textile technologies, electricity, computers, and the internet.[4] These technologies improve economic productivity over time and in aggregate, often leading to the creation of many new jobs. In the short term, however, they may displace workers, who do not always benefit from rising productivity.[5]

AI encompasses a broad category of computer applications inspired by human-like intelligence. AI includes areas such as computer vision, predictive analytics, recommendation algorithms, and other tools that have long been integrated into the software we use daily. Generative AI models like ChatGPT, CoPilot, and DeepSeek, which have become common since November 2022, hold the potential to accelerate AI automation of many tasks. The term "GPT" stands for Generative Pre-trained Transformer, but some argue that generative AI could also serve as a general-purpose technology. Like to the examples mentioned, it may have "far-reaching consequences, which unfold over decades, [and] are difficult to anticipate, particularly in relation to labor demand."[6]

The remarkable advancements in generative AI models in recent years have been fueled by an increase in model parameter counts, larger training data volumes, and improved training configurations—such as fine-tuning and reinforcement learning with human feedback—which enhance their reliability and utility.[7] Reflecting on the development of generative AI models, OpenAI states that "at their limit, these trends suggest a world where LLMs [large language models] may be capable of executing any task typically performed at a computer."[8]

AI Adoption is Rapid in the ICT Sector

The global ICT sector and those working in ICT occupations are at the forefront of AI adoption.[9] At the firm level, only 6.1% of Canadian companies reported adopting some form of AI in 2024, whereas 20.9% of firms in the information and cultural industries and 13.7% of firms in professional, scientific, and technical services reported adopting AI, primarily utilizing natural language processing tools like chatbots and machine learning applications, respectively.[10] A 2024 survey by ICTC similarly found that while 17.6% of Canadian businesses planned to implement AI over the next 12 months, respondents from Canada's digital economy were significantly more inclined to do so, at 55.9%.[11]

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2 "Technology is a broad concept that refers to the state of knowledge on how to convert resources into outputs (OECD/Eurostat, 2018)." Fernando Galindo-Rueda, Fabien Verger, and Sylvain Ouellet, " "Patterns of innovation, advanced technology use and business practices in Canadian firms," *OECD Science, Technology and Industry Working Papers*, No. 2020/02, OECD Publishing, Paris, https://doi.org/10.1787/6856ab8c-en.

3 Tyna Eloundou, Sam Manning, Pamela Mishkin, and Daniel Rock, "GPTs are GPTs: An Early Look at the Labor Market Impact Potential of Large Language Models," (working paper, August 2023), https://arxiv.org/pdf/2303.10130.

4 Ibid.; Daron Acemoglu and Simon Johnson, "Learning from Ricardo and Thompson: Machinery and Labor in the Early Industrial Revolution and in the Age of Artificial Intelligence," *Annual Review of Economics* 16 (2024): 597-621, https://doi.org/10.1146/annurev-economics-091823-025129.

5 Daron Acemoglu and Simon Johnson, "Learning from Ricardo and Thompson: Machinery and Labor in the Early Industrial Revolution and in the Age of Artificial Intelligence," Annual Review of Economics 16 (2024): 597-621, https://doi.org/10.1146/annurev-economics-091823-025129.

6 Tyna Eloundou, Sam Manning, Pamela Mishkin, and Daniel Rock, "GPTs are GPTs: An Early Look at the Labor Market Impact Potential of Large Language Models," (working paper, August 2023), https://arxiv.org/pdf/2303.10130.

7 Ibid.

8 Ibid.

9 "Adoption of AI remains concentrated in the ICT sector, where on average nearly 28% of firms are using the technology," in OECD, *OECD Digital Economy Outlook 2024 (Volume 1)*: Embracing the Technology Frontier, Paris, 2024, https://doi.org/10.1787/a1689dc5-en.

10 Valerie Bryan, Shivani Sood, and Chris Johnston, "Analysis on artificial intelligence use by businesses in Canada, second quarter of 2024," Statistics Canada, June 20, 2024, https://www150.statcan.gc.ca/n1/pub/11-621-m/11-621-m2024008-eng.htm.

11 ICTC's Digital Economy Employer Survey (2024) compared business trends in the digital economy with those of the Canadian economy through a questionnaire modeled after Statistics Canada's Canadian Survey on Business Conditions. Both surveys asked respondents whether they planned to use AI tools over the next 12 months. See: Maryna Ivus et al., "Canada's Digital Economy: Talent Outlook 2030," Information and Communications Technology Council (ICTC), Ottawa, Canada, 2025.

AI faces fewer barriers to adoption within the technology sector compared to other sectors. As a recent study notes, "in contrast to physical automation, one benefit of cognitive automation is that it can often be rolled out quickly via software" and "[does] not require any hardware investment on the user's side."[12] Indeed, many AI-powered tools are readily available to any ICT workers who have an internet connection and, in some cases, a license.[13] Application programming interfaces (APIs) are also accessible for many AI-powered tools, enabling integration, plug-ins, and extensions.[14] APIs are also giving rise to "embedded AI," where AI is integrated directly into the existing platforms that workers already use, such as integrated development environments (IDEs), further facilitating adoption.[15] Finally, ICT workers may be less likely to resist new technologies compared to workers in other sectors.

The technology sector is rapidly adopting AI-powered tools like ChatGPT, GitHub CoPilot, and Cursor to automate and speed up tasks, changing the way technology products and services are built. ICT professionals in large organizations in India, the United Arab Emirates (UAE), Singapore, China, and other countries are leading the world in active AI deployment for the automation of ICT tasks.[16] At the global level, about 63% of surveyed organizations were piloting, deploying, or fully using AI code assistants in the third quarter of 2023, up from less than 10% in first quarter.[17] In 2024, 63% of surveyed developers were using AI tools in their development process, and 13.5% planned to soon.[18] By 2028, a projected 75% of enterprise software engineers will use AI code assistants.[19]

Canadian ICT workers are also adopting AI tools, though at a slower pace. To assess AI adoption at the occupation level across Canada, ICTC surveyed 210 workers in core ICT occupations, inquiring about their use of AI tools.[20] More than half (53%) of respondents indicated that they use AI tools to design or develop technology products or services at work, while 20% mentioned that they have colleagues who utilize AI tools for similar purposes. Government respondents were less inclined than private sector respondents to use AI tools (Figure 1).

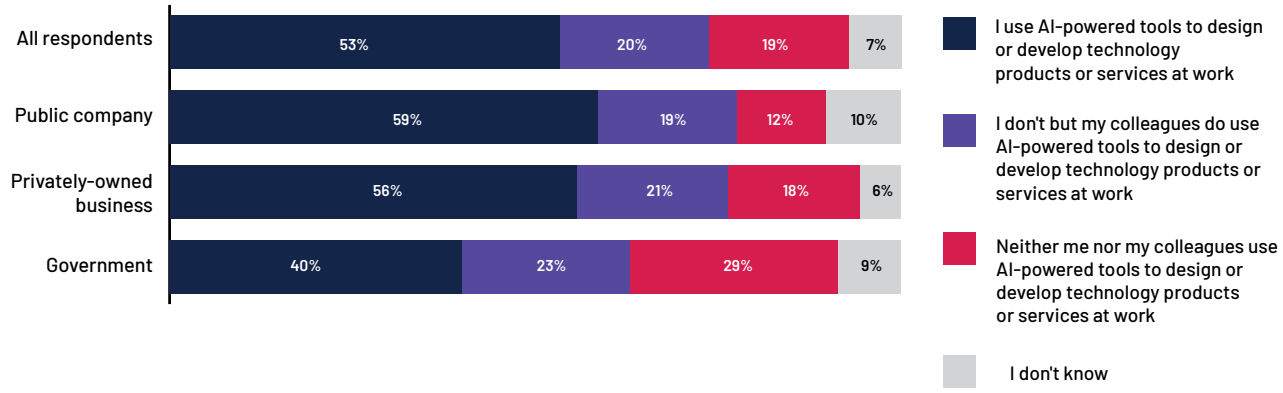


Figure 1. Use of AI-powered tools to design or develop technology products at work. Data source: ICTC's survey of ICT workers, 2024.

12 Martin Neil Baily, Erik Brynjolfsson, and Anton Korinek, "Machines of Mind: The case for an AI-powered productivity boom," Brookings, May 2023, https://www.brookings.edu/articles/machines-of-mind-the-case-for-an-ai-powered-productivity-boom/.

13 Ibid.

14 Ibid.

15 Embedded AI has two current uses as a term: AI in internet of things (IoT) devices, and AI embedded into existing software applications like Adobe Creative Cloud. Here, we refer to the latter usage.

16 "IBM Global AI Adoption Index 2023," IBM, 2023, https://www.multivu.com/players/English/9240059-ibm-2023-global-ai-adoption-index-report/.

17 "Gartner says 75% of enterprise software engineers will use AI code assistants by 2028," Gartner, April 2024, https://www.gartner.com/en/newsroom/press-releases/2024-04-11-gartner-says-75-percent-of-enterprise-software-engineers-will-use-ai-code-assistants-by-2028.

18 "2024 Developer Survey," *Stack Overflow*, 2024, https://survey.stackoverflow.co/2024/ai#sentiment-and-usage-ai-sel-prof.

19 "Gartner says 75% of enterprise software engineers will use AI code assistants by 2028," Gartner, April 2024, https://www.gartner.com/en/newsroom/press-releases/2024-04-11-gartner-says-75-percent-of-enterprise-software-engineers-will-use-ai-code-assistants-by-2028.

20 Respondents included software developers and programmers (17.6%), information systems specialists, (13.3%), computer & information systems managers (12.4%), software engineers and designers (11%), user support technicians (11%), cybersecurity specialists (7.6%), and other core technology roles. Just under half (43.3%) of respondents worked in the technology or telecommunications sector, and a similar percentage (45.2%) were senior individual contributors. The survey excluded sole proprietors and contractors. See Appendix A for a full list of NOCs used in this analysis.

When asked which AI tools they or their colleagues regularly used over the past year, survey respondents shared that ChatGPT was the most common, followed by GitHub Copilot, BingAI, and Google Bard AI/ Gemini (Figure 2). This mirrors global findings from Stack Overflow's 2024 Developer Survey, which provides an overview of the experiences, preferences, and challenges faced by developers worldwide. The survey reached 65,437 technology workers from 185 countries and offers a unique perspective on topics such as AI tool adoption and career development. The survey serves as a key data set for this report, complementing ICTC's own survey and interviews. Its findings are referenced throughout.

WHICH OF THE FOLLOWING AI CODING TOOLS HAVE YOU OR YOUR COLLEAGUES USED REGULARLY OVER THE PAST YEAR?

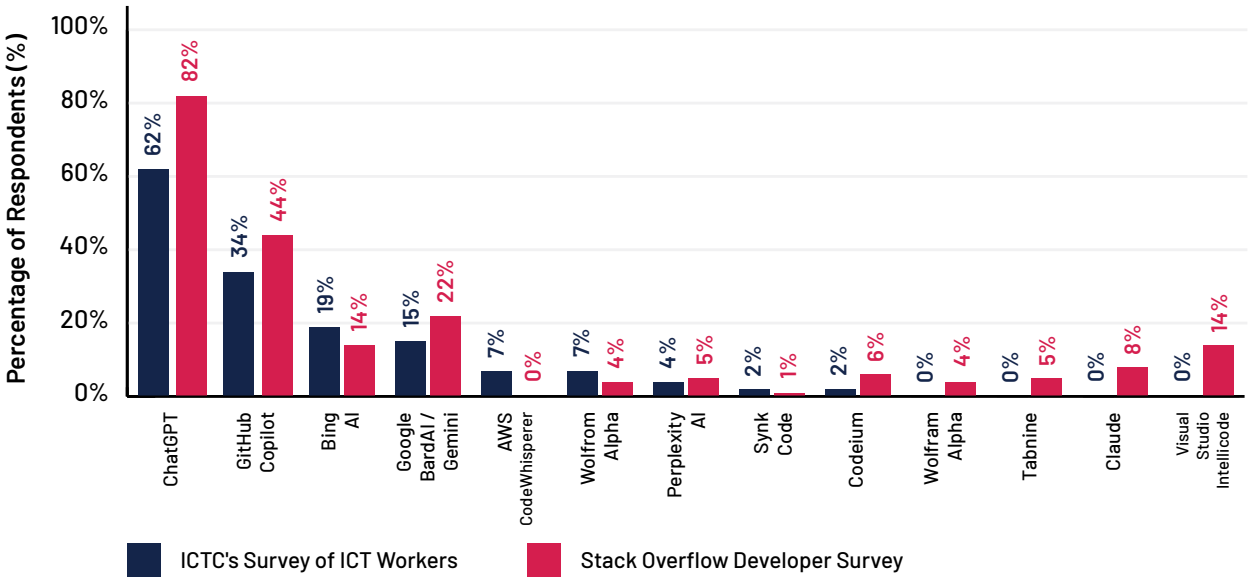


Figure 2. Use of AI-powered tools by tool. Data source: ICTC's survey of ICT workers, 2024; Stack Overflow 2024 Developer Survey.

ICT Workers Use AI for a Broad Range of Tasks, Limitations Remain

ICT workers are using AI tools for a wide range of tasks, although some tasks are more frequently completed with AI tools than others. In response to ICTC's survey of Canadian ICT workers, respondents primarily reported using AI tools to write emails, social media posts, and communications with clients (46%), write code (45%), analyze data (35%), debug and seek assistance (35%), test code (25%), learn about a codebase (21%), document code (20%), visualize data (19%), and clean data (17%). Only 5% use AI tools to design architecture.

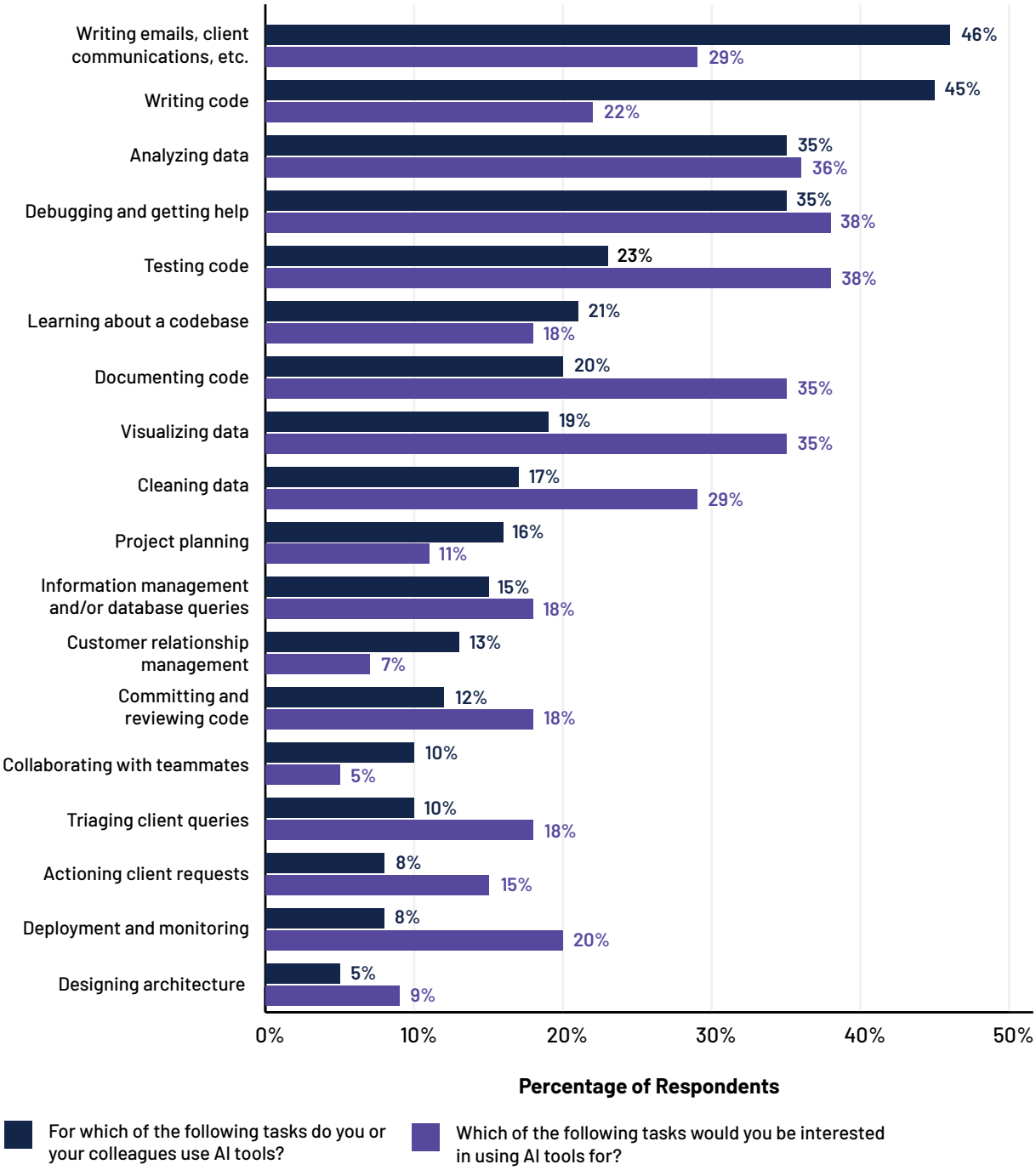


Figure 3. Which types of tasks align with AI tools? Data source: ICTC's survey of ICT workers, 2024.

This aligns with the findings from Stack Overflow's 2024 Developer Survey, which indicated that ICT workers most commonly use AI tools to write code (82%), search for solutions (68%), debug and seek help (57%), learn about a codebase (31%), use AI tools to commit and review code (13%), and plan projects (12%).

While astounding progress has been made in the quality of AI tools over the last five years, considerable limitations remain. Indeed, participants in this study surfaced concerns related to privacy, security, and quality assurance when using AI-powered tools to design and develop technology products or services.

From a quality assurance perspective, 38% of developers report that code assistants provide inaccurate information half the time or more.[21] Research also indicates that "code churn"—"the percentage of code that is pushed to the repo, then subsequently removed or updated within two weeks"—increased five percentage points from 2022 to 2023, coinciding with the availability of AI code assistants and suggesting a rise in "mistake code."[22] As one interviewee noted, the models that AI tools depend on, particularly large language models, are highly probabilistic and can hallucinate. Moreover, many AI tools are trained on online repositories such as Stack Overflow and GitHub, which can have a range of biases, bugs, errors, and security vulnerabilities. An additional challenge is that identifying hallucinations or other errors can be quite difficult. Near-perfect answers often appear correct at first glance but, upon closer inspection, are inaccurate, leading to "fundamental errors" that are "hidden in plain sight."

From a security perspective, research shows that AI tools "consistently generate insecure code," with 91.6% of respondents to a 2023 survey of North American ICT workers reporting that "AI coding tools generate insecure code suggestions at least some of the time."[23] A Stanford study, where an AI coding model was used to write an encryption function, similarly found that the AI tool "consistently recommended open source libraries that explicitly state in their own documentation they were insecure and not suitable for high security cases."[24] Worse still, research suggests that a large proportion of ICT workers perceive AI-generated code to be more secure than human code, exacerbating the potential impact of insecure code generation by AI-powered tools.[25]

Ultimately, developers are divided on their trust in AI outputs. Stack Overflow's 2024 Developer Survey reveals that 42% highly trust the accuracy of AI tool outputs in their development workflow, while 31% distrust AI tool outputs, and 27% neither trust nor distrust them. The inability to trust outputs or answers was also identified as the most common challenge faced by companies or teams when using AI coding assistance or GenAI tools, cited by two-thirds (66%) of respondents.

Because of this, research participants cautioned that it is important for ICT workers not to over-rely on AI tools, such as by copying and pasting code they have not vetted or do not understand. They further warned that relying too heavily on AI tools over time, or at the outset of one's career, could lead to an inability to check AI tool outputs for errors and assess their correctness. They emphasized the need for ICT workers to maintain strong basic programming and engineering skills, in addition to prompting skills.

Alongside quality assurance and security concerns, participants in this study noted that certain tasks are challenging for AI tools to complete. To identify the types of tasks for which AI tools are less suitable, ICTC asked ICT workers about their experiences using these tools. Research participants emphasized several key areas where AI tools have limitations:

- **Transitioning from requirements to technical designs and tasks:** AI tools face challenges in analyzing requirements, developing system designs, converting design architectures into documentation, and breaking projects into tasks. While AI can assist in brainstorming architectural designs, human judgment is still needed to review the proposed architecture, select the most suitable option for the project, and to adapt it to legacy systems. Additionally, a separate study on AI code assistants found that these tools struggle with answering high-level or architectural questions.[26]

21 Erin Yepis, "Developers get by with a little help from AI: Stack Overflow Knows code assistant pulse survey results," Stack Overflow, May 2024, https://stackoverflow.blog/2024/05/29/developers-get-by-with-a-little-help-from-ai-stack-overflow-knows-code-assistant-pulse-survey-results/.

22 William Harding and Matthew Kloster, "Coding on Copilot: 2023 Data Shows Downward Pressure on Code Quality," GitClear, January 2024, https://gitclear-public.s3.us-west-2.amazonaws.com/Coding-on-Copilot-2024-Developer-Research.pdf.

23 "AI Code and Trust," Snyk, 2023, https://go.snyk.io/2023-ai-code-security-report-dwn-typ.html.

24 Ibid.

25 Ibid.

26 Erin Yepis, "Developers get by with a little help from AI: Stack Overflow Knows code assistant pulse survey results," *Stack Overflow*, May 2024, https://stackoverflow.blog/2024/05/29/developers-get-by-with-a-little-help-from-ai-stack-overflow-knows-code-assistant-pulse-survey-results/.

- **Building complex projects:** AI tools are better suited for smaller tasks and less effective for constructing complex systems. Currently, AI tools struggle to efficiently organize large amounts of code and components into cohesive systems. One participant noted that, while using AI tools to create complex systems is feasible, at some point, the code becomes so unwieldy that extensive refactoring is necessary. A separate study similarly revealed that AI tools face challenges with complexity and obscurity.[27] When surveyed, nearly half (45%) of global developers believe that AI tools perform poorly in managing complex tasks, one third (34%) rate them positively for handling complex tasks, and 21% consider them neither effective nor ineffective.[28]
- **Projects involving internal architecture or legacy systems:** Interviewees shared that even when AI tools can feasibly complete a given task, their suitability may be impacted by not having access to the company's codebase or legacy systems. Similarly, Stack Overflow's 2024 Developer Survey identified AI tools lacking context of a company's codebase, internal architecture, or company knowledge as a challenge, with 65% of respondents selecting this response.
- **Working with niche or proprietary technologies:** AI's capabilities become more limited when dealing with niche or proprietary technologies, such as specialized coding languages or proprietary algorithms. AI tools are often trained using online repositories like GitHub and Stack Overflow, where niche and proprietary technologies are typically absent. Consequently, AI tools may be less accurate and require greater scrutiny when projects include niche or proprietary components. A study from 2023 similarly reported that AI coding tools can generate incorrect responses when working with lesser-known programming tools or languages.[29]

Employee Sentiment Toward AI Tools is Mostly Positive

Despite the limitations of AI tools, most ICT workers feel favourably toward them, though a still significant portion feel unfavourably. At the global level, Stack Overflow's 2024 Developer Survey found that 72% of developers were either favourable or very favourable of AI tools, 19% were indifferent 6% were either unfavourable or very unfavourable, and 3% were unsure. As for Canada, six in ten (59%) respondents to ICTC's survey of ICT workers were favourable towards AI tools, two in ten (22%) were indifferent, and two in ten (18%) were unfavourable (Figure 4). While some interviewees in this study were "skeptical" or "cautious" about AI tools, most felt positively, noting that AI tools can enhance learning and search functions and assist in completing tasks such as writing shell scripts, provisioning resources with Terraform, boilerplate code, or diagnosing bugs.

Worker sentiment toward AI tools can influence AI adoption. One interviewee shared their experience implementing AI tools in the workplace, noting that, "At my old company, [we] bought everyone a license, but not everyone adopted initially. And I'm seeing the same pattern in my current company—all of the developers have a license, but are they adopting on a day-to-day basis? That's a different story." How workers feel about AI tools—whether their sentiment is positive, negative, skeptical, or indifferent—affects how likely they are to fully integrate AI tools into their workflows.

27 "2024 Developer Survey," 2024, *Stack Overflow*, https://survey.stackoverflow.co/2024/ai#sentiment-and-usage-ai-sel-prof.

28 Ibid.

29 Erin Yepis, "Developers get by with a little help from AI: Stack Overflow Knows code assistant pulse survey results," *Stack Overflow*, May 2024, https://stackoverflow.blog/2024/05/29/developers-get-by-with-a-little-help-from-ai-stack-overflow-knows-code-assistant-pulse-survey-results/.

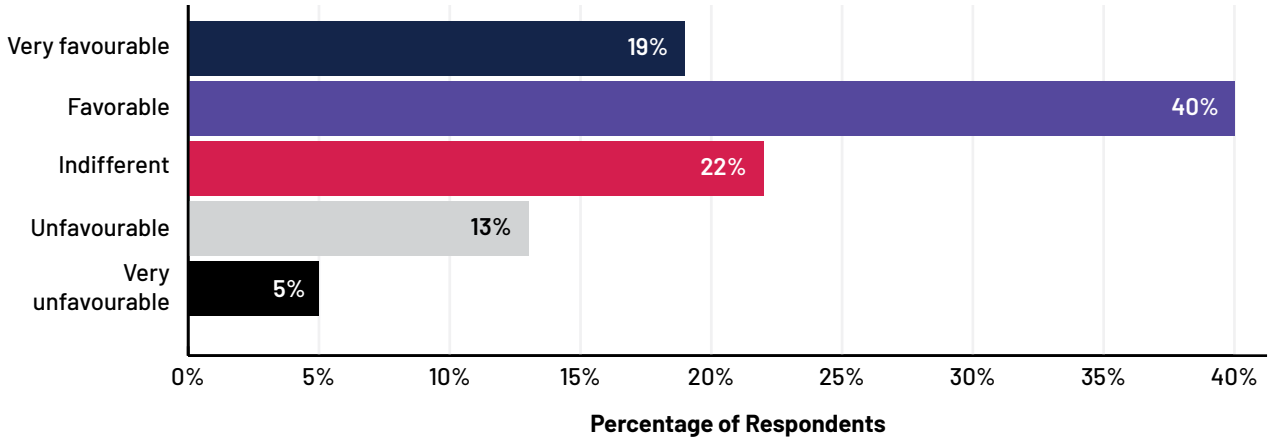


Figure 4. Employee sentiment towards using AI tools to design and develop technology products or services. Data source: ICTC's survey of ICT workers, 2024.

AI Tools Yield a Range of Benefits

AI tools offer numerous benefits for ICT workers and their organizations. ICTC's survey reveals that the primary benefit reported by ICT workers using AI tools is enhanced efficiency or productivity, cited by more than half (56%) of respondents. This is followed by faster learning (52%), reduced spending on human resources (44%), greater accuracy (25%), the ability to provide products or services at a lower cost (12%), and better collaboration (10%). Very few respondents reported having received no benefits from AI tools. The ICTC survey and Stack Overflow's 2024 Developer Survey indicate that the types of benefits ICT workers have experienced and aspire to achieve from AI tools are similar, although, in general, realized benefits tend to fall short.

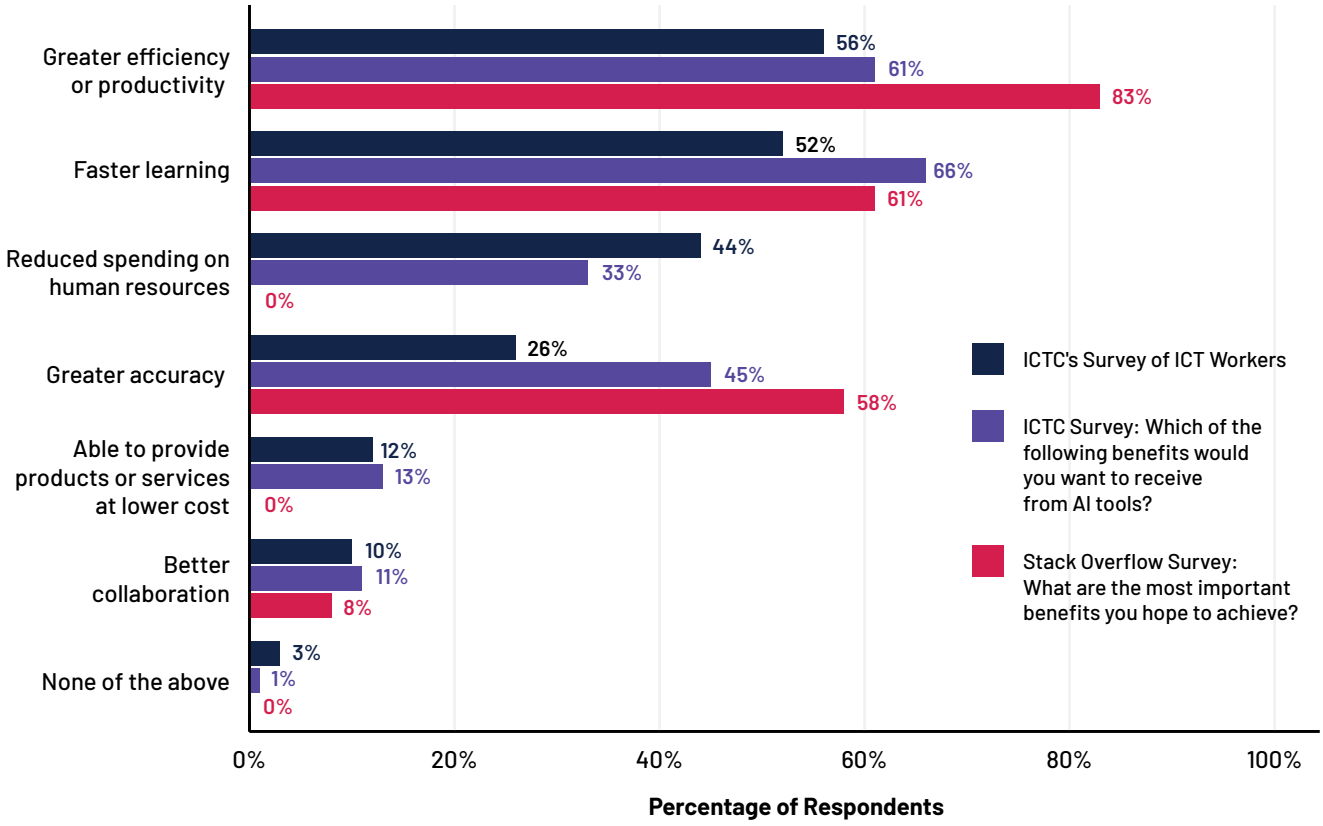


Figure 5. Employee-reported Benefits of AI Tools in the Workplace. Data source: ICTC's survey of ICT workers, 2024; Stack Overflow 2024 Developer Survey.

Acceleration and Exploration: Two Key Benefits of AI

One interviewee commented that their workplace used AI tools similarly to a recent study's observations: either "acceleration," using AI tools to work faster, or "exploration," using AI to acquire new skills or investigate alternative methods for completing a task.[30] Both modes of use could lead to a more productive and efficient workforce. Whether they were formally or informally measuring impact, ICT businesses and practitioners interviewed in this study recognized the following impacts in their workplaces:

ACCELERATION

- **Ability to offload tasks:** Many interviewees and survey respondents highlighted AI's ability to automate simple, repetitive, or mundane tasks, thereby freeing up time for value-added work. Similarly, in a different ICTC survey that engaged employers in Canada's digital economy,[31] nearly a quarter (24.6%) of respondents reported automating employee tasks to allow more time for value-added work. Almost a quarter of respondents (22.2%) repurposed employees whose tasks had been automated, and/or modified employee job scope (19.7%).
- **Increased productivity or efficiency:** Seven in ten (69%) respondents indicated that AI tools have accelerated the pace at which they perform their tasks. Meanwhile, 56% of respondents noted that AI tools have enhanced their efficiency and productivity. Similarly, interviewees reported that AI was reducing the time required to complete tasks. One individual stated that their productivity had "at least doubled" due to code generators. Another mentioned that they observe AI enabling customer service representatives in technology to be much more efficient by summarizing information about customer issues and linking relevant support materials. Yet another participant felt that AI tools could improve turnaround times for data reports, visualizations, and dashboards.
- **Cost savings:** Many organizations in this study reported that AI could lead to cost savings, although few performed an analysis of cost-effectiveness. For instance, when asked about the greatest negative or positive impacts of AI tools on their field, survey respondents noted, "cost savings will be the most significant impact of AI tools," "an increase in overall revenue for the organizations," and "reduced resource costs." Additionally, cost savings was seen as both a benefit and a negative impact by survey respondents who believed that AI tools would lead to job displacement and loss, a topic discussed in more detail in Part II.

EXPLORATION

- **Learning, problem solving, and democratization of technology skills:** Many study participants felt that AI tools are making it easier and more accessible to learn technology skills. As one interviewee commented, "I think ChatGPT has basically lowered the bar for developers—people can do a lot more than they could before without much development experience. So, normal people, they can write simple tools and simple software too now. I think it will keep lowering the bar and making it easier for normal people to get into development and into the software industry." Another shared, "A junior developer coming in is going to be able to do something quicker, even on a code base they've never worked on for a product they don't know what it does."

30 Shraddha Barke, Michael James, and Nadia Polikarpova, "Grounded Copilot: How Programmers Interact with Code-Generating Models," Proceedings of the ACM on Programming Languages 7 (2023): 85-111, https://dl.acm.org/doi/abs/10.1145/3586030.

31 This survey was conducted for ICTC's Digital Economy Labour Market Outlook Outlook 2030 study: Maryna Ivus et al., "Canada's Digital Economy: Talent Outlook 2030," Information and Communications Technology Council (ICTC), Ottawa, Canada, 2025.

How Are Organizations Measuring the Impact of AI?

Some organizations are trying to measure the return on investment of technology adoption. While many economists expect AI tools to enhance business productivity,[32] assessing this within an organization is more challenging than it seems. AI tools can improve speed, work quality, and access to new skills. In response to ICTC's survey of ICT workers, 30% of respondents indicated that their organization measures the impact or return on investment of AI tools, 43% stated that their organization does not, and 27% were unsure.

Among respondents whose organization measures the impact of AI tools, 42% of respondents selected quality of documentation and code efficiency as the most common metrics. For example, AI tools may enable employees to generate higher-quality documentation or make their code more efficient. Other considered metrics include code readability, the number of tickets addressed, the number of features completed, and the number of feature requests addressed.

Some researchers have sought to measure the impact of AI adoption on productivity using metrics like the number of completed tasks or software "commits"[33] or A/B testing to compare the outputs of people using and not using AI tools.[34] Several employers interviewed in this study reported trying to measure productivity gains using metrics like lines of code, lines of code removed after being added, lead time (the length of time it takes for a new piece of code to be deployed to production), and other outputs.

Several interviewees expressed caution regarding the measurement of AI's impact on productivity. Most did not view lines of code as a reliable metric: "More code doesn't necessarily mean it is usable, reusable, or of good quality," one said. Another respondent noted that improvements over time might simply result from a team becoming more proficient. Still another warned: "You can game the system as a developer if you know you're being measured by metric X."

While some employers track specific metrics, others simply ask their teams to report back on whether AI was helping them in the workplace.

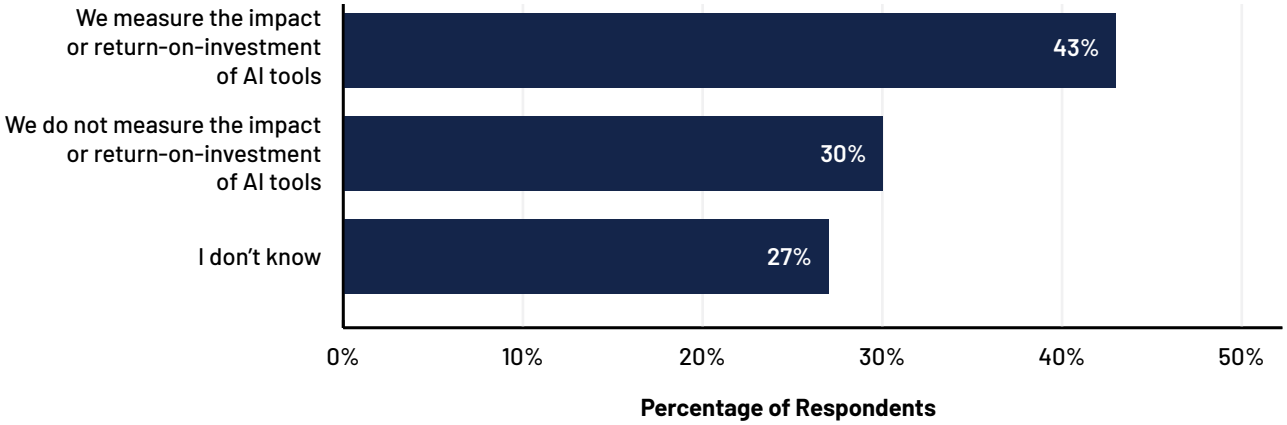


Figure 6. Distribution of firms according to whether they measure the impact or return-on-investment of AI Tools. Data source: ICTC's survey of ICT workers, 2024.

32 "Many economists expect generative AI to profoundly affect the organization of economic activity (Agrawal, Gans, and Goldfarb 2019; Frank et al. 2019; Furman and Seamans 2019)" in Kevin Zheyuan Cui et al., "The Effects of Generative AI on High Skilled Work: Evidence from Three Field Experiments with Software Developers," (working paper, 2024), https://papers.ssrn.com/sol3/papers.cfm?abstract_id=4945566.

33 "Our preferred estimates suggest that usage of the coding assistant causes a 26.08% (SE: 10.3%) increase in the weekly number of completed tasks. When we look at outcomes of secondary interest, our results support this interpretation, with a 13.55% (SE: 10.0%) increase in the number of code updates (commits) and a 38.38% (SE: 12.55%) increase in the number of times code was compiled. For Microsoft we observe both the developers' tenure and their seniority as measured by job title. We find that Copilot significantly raises task completion for more recent hires and those in more junior positions but not for developers with longer tenure and in more senior positions" in Kevin Zheyuan Cui et al., "The Effects of Generative AI on High Skilled Work: Evidence from Three Field Experiments with Software Developers," (working paper, 2024), https://papers.ssrn.com/sol3/papers.cfm?abstract_id=4945566.

34 Eddie Aftandilian, "Lessons Learned from Building GitHub Copilot(s)" (webinar, AMC Tech Talk, Oct 2, 2024).

Organizational Guidance on AI Tools is Crucial

In this study, employees whose organizations explicitly permitted them to use AI tools had a much clearer understanding of which AI tools they could use, how to use them, and for what purposes. In response to ICTC's survey of ICT workers, 77% of respondents stated that their organization allows employees to utilize AI tools for designing or developing technology products or services at work, while 17% reported that they are not permitted to use AI tools at work, and 6% did not know. Research indicates that the most common reasons organizations restrict the use of AI tools among technology teams are code security, data privacy, and code quality.[35]

Stack Overflow's 2023 Developer Survey found that three-quarters (73%) of surveyed ICT workers were either unaware of or uncertain about whether their companies had an AI policy, which may hinder adoption. Several ICT workers from organizations that did not provide explicit guidance on the use of AI tools shared experiences of hiding their use of such tools from their employers due to the lack of an official stance.

> **"Some of my folks ran off and started [using AI tools] without talking to anybody, and so customer data goes into ChatGPT… We don't have a lockdown on all our machines, and really, everything's browser-based now anyway, so it's not like you can prevent them from visiting every website under the Sun… So, about a year ago, I said, if you're going to use a tool, you need to ask somebody first." – Employer**

> **"My company recently approved GitHub CoPilot… But I've been working at this company for two years, and though I never directly used AI on my work laptop, what I did do was use it on my personal laptop… It wasn't that we had policies against using these tools. It was a grey area. No one really says yes or no." – Employee**

While 77% of Canadian ICT worker respondents are allowed to use AI tools at work, only about half (53%) are encouraged to do so. Some organizations provide paid-for licenses to ensure their employees can fully adopt AI tools into their workflows with no limitations. Some have leaders set an example by using and then showcasing new tools. Others encourage adoption by creating opportunities to share their learnings. Still others provide incentives or rewards to employees who use automation in their workflows or include them in performance reviews. Encouraging employees to use AI tools was also a common theme among interviewees:

> **"We encourage staff to use AI tools to increase their productivity and get things done faster." – Employer**

> **"Our workplace got us CoPilot subscriptions and they encourage us to use ChatGPT… They encourage us… like, 'if there are tools out there that can make you more productive, use them.'" – Employee**

> **"Yes, our company [is encouraging us to use AI tools at work] because they know it should make us work faster… They write posts on our company's Facebook for work site saying, 'I built this feature using just this tool, you should try it!' or they'll push messages to us saying 'Hey, our company is now trialling Cursor, maybe you should give it a try!'" – Employee**

Just over one in ten respondents (12%) indicated that their organization requires the use of AI tools. Similarly, one interviewee from a very large technology firm reported not only being permitted or encouraged to use AI tools at work but also being *required* to do so.

> **"There is a clear expectation for us to do more of this—to automate the tasks in our roles that are well-defined for automation… From the highest level, including the CEO, down to the front-line staff, they're recording us and seeing how much we use AI in our day-to-day work, the idea being that we want to use AI as extensively as we can to automate or streamline any tasks that we can." – Employer**

35 "AI Code and Trust," *Snyk*, 2023 https://go.snyk.io/2023-ai-code-security-report-dwn-typ.html.

In response to ICTC's survey, several respondents expressed concerns about being required to use AI tools. One shared, "A negative [impact of AI tools] would be management forcing the use of AI without understanding how it works or overestimating its ability to reduce workload." Another shared that a negative impact would be, "executives taking credit for rolling out new technology that adds no value to the bottom line." Another shared that a negative impact would be, "executives taking credit for rolling out new technology that adds no value to the bottom line."

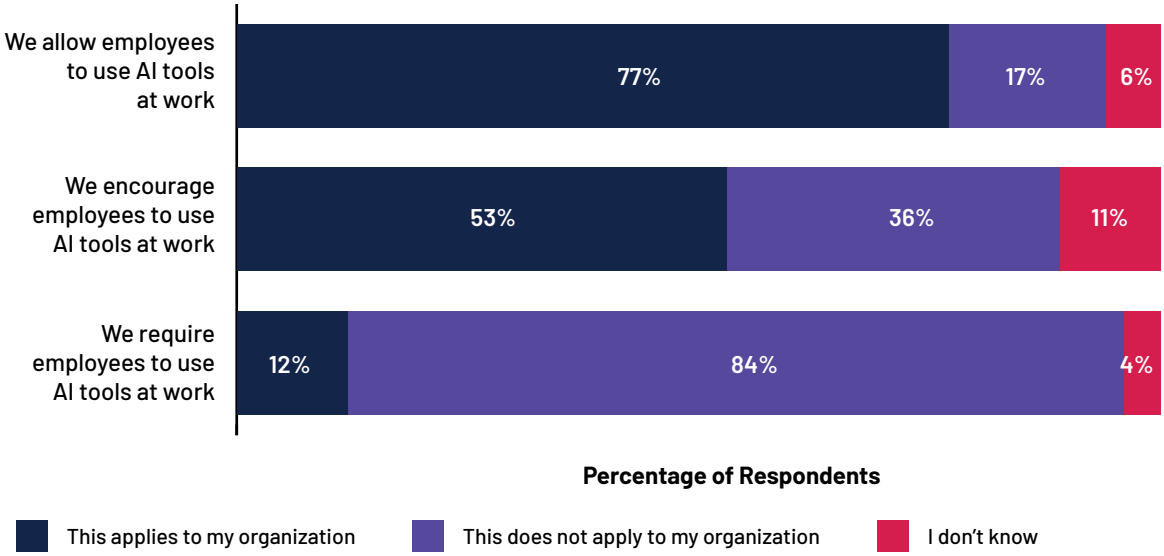


Figure 7. Ability to use AI to tools at work. Source: ICTC's survey of ICT workers, 2024.

Organizational Policies Shape AI Adoption

Clear organizational policies shape AI tool adoption and enable successful change management. A lack of clear organizational policies can discourage employees from adopting new technologies: in response to ICTC's survey, 29% of surveyed ICT workers reported that "a lack of policies governing the use of AI tools" prevents their organization from adopting AI tools, while 23% reported that "a lack of organizational clarity about what AI tools I or my employees are allowed to use" is a barrier. In the worst cases, this can lead to privacy and security risks, particularly if employees adopt new tools without clear guardrails to guide their use. Indeed, in response to Stack Overflow's 2024 Developer Survey, a third of respondents reported not having the right policies in place to reduce security risks. Still, not all organizations that permit employees to use AI tools at work have specific policies for them. While 77% of respondents to ICTC's survey of ICT workers reported being allowed to use AI tools at work, only 60% indicated that their organization has specific policies.

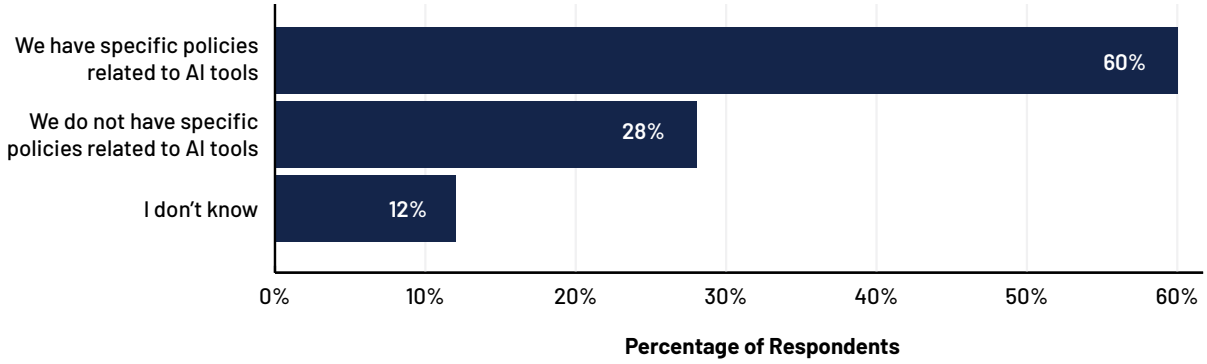


Figure 8. Possession of specific policies related to AI tools. Data source: ICTC's survey of ICT workers, 2024.

Workers who reported having specific policies regarding AI tools were asked about the types of policies their organizations implement. Cybersecurity policies emerged as the most prevalent, followed by privacy policies, commercially sensitive data policies, ethics policies, and quality assurance policies. Only one-fifth of respondents had hiring and candidate interview policies, while just 15% reported having environmental sustainability policies.

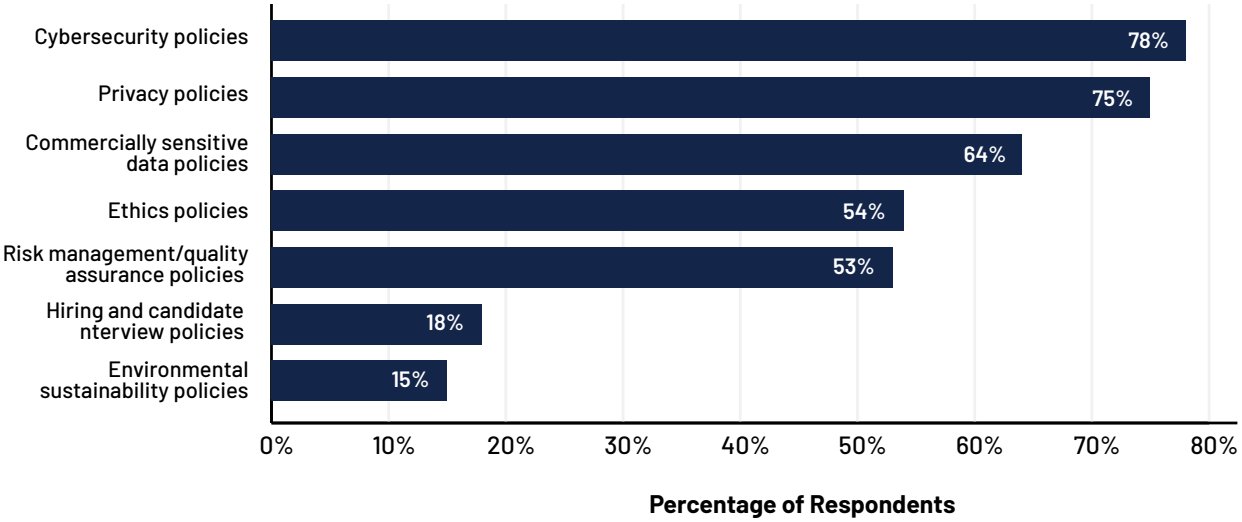


Figure 9. Prevalence of different kinds of policies for AI tools. Question: You indicated that your organization has specific policies for AI tools. Which of the following types of policies does your organization have? Data source: ICTC's survey of ICT workers, 2024.

What Types of Policies do Organizations Need?

ICTC asked interviewees about the types of policies their organizations have and the policies that are important for shaping AI tool use. They highlighted several policies, including privacy, security, and quality assurance policies.

Privacy and security policies: Interview participants were most likely to report possessing policies related to security, privacy, and commercially sensitive data. These policies encompass guidelines that identify which AI tools have been vetted for security risks and are permitted for use; whether confidential or commercially sensitive information can be shared with AI tools; and what settings should be implemented when utilizing AI tools. For instance, one interviewee shared:

> **"We're really focusing on… saying look, if you're using something and it has any kind of sensitive or confidential information, including customer info… our business plans, our product features, you need to make sure that [the tool you're using has] been vetted. Talk to me our CFO and make sure we've approved it." – Employer**

> **"Our company has sent out a document that says these are our guidelines around how we should be engaging on the internet, and in that, there is guidance that says you shouldn't share anything sensitive externally, especially on ChatGPT. So, if I copy the code that I'm writing for something and put all of it in ChatGPT, that's wrong. You're encouraged to take out any of the coding styles or syntaxes that are very specific… If you're sharing little bits at a time, then it's easier to manage what you share and make sure you don't share anything that's private to the company." – Employee**

From a security perspective, the most rigorous approach to adopting AI tools is through formal integration, whether technically within a company's development environment or legally through agreements such as non-disclosure agreements. Several interviewees shared how their organizations mitigate risks related to security, privacy, and commercially sensitive data through formal integration:

> **"We can only use specific tools that the company has vetted from a security and legal perspective and established NDAs [non-disclosure agreements] and data storage agreements for. Once that has happened, we can use them very freely because we have agreements with the companies that run them. So, our company first reaches out to those companies, ensures they won't store any of our data, and then we can use them as needed to build products." –Employee**
>
> **"We have a security team, and they define... how to use [AI Tools], which products to use. There is a narrow list of products that we have relationships with and specific settings that we need to employ while using them in order to help us keep our trade secrets, IP, and data secure." –Employee**
>
> **"My company decided to subscribe to GitHub copilot, which essentially attaches to the integrated development environment [IDE] that we use for the coding. So, it is an integral part of our IDE. We can select snippets of code and ask questions about it. ...so, it seems the previous concern about our code leaking into the cloud is no longer an issue because at this point of time, we have a copilot essentially plugged into our IDE." –Employee**

Risk management and quality assurance policies: Quality assurance policies are crucial due to the drawbacks and limitations of AI tools. Organizations should clearly express that they expect their staff to review outputs from AI tools, verify, test, and validate them before deploying to production, and establish standard operating procedures to ensure a consistent standard. In addition to clear policies, organizations should foster a culture that does not overly depend on AI tools.

Ethics Policies: While about half (54%) of survey respondents selected ethics policies, there was limited discussion of ethics policies among the study's interviewees. Still, it is important for organizations to develop ethical guidelines to ensure AI tools are being used responsibly.

Hiring and candidate interview policies: About a fifth (18%) of respondents selected hiring and candidate interview policies. Interviewees reported changing their hiring processes to adapt to the use of AI in assignments and interviews. For example, one interviewee noted that they were receiving very similar answers to in-interview coding assignments and suspected they were AI generated. As a consequence, they prioritized candidates who could speak critically about the code they provided or who could produce more efficient code.

Environmental sustainability policies: Just 15% selected environmental sustainability policies. A 2023 study by ICTC similarly found that the ICT sector lacks concrete policies to reduce the environmental impact of their technology stack. Despite ICTs' broad range of environmental impacts, including carbon emissions, energy consumption, and water consumption, many technology firms do not factor environmental impact into their decision making in a robust enough way.[36]

36 Allison Clark and Mairead Matthews, "Building a Sustainable ICT Ecosystem," Information and Communications Technology Council (ICTC), Ottawa, Canada, 2024, https://ictc-ctic.ca/reports/building-a-sustainable-ict-ecosystem.

Employee Training on AI Tools is Uncommon

ICT workers desire more hands-on training with AI-assisted technology; however, employee training on AI tools remains relatively rare given the widespread adoption of these tools. According to ICTC's survey of ICT workers, only 37% of respondents indicated that their organization offers training on the use of AI tools (Figure 10). During interviews for this study, many research participants noted that their organizations do not provide training on AI tools.

The lack of training on AI tools presents challenges. "Limited staff expertise" was identified by respondents to ICTC's survey as the top barrier preventing organizations from adopting AI tools, cited by 34% of the sample. Additionally, 29% of respondents reported "limited experience using AI tools" as a barrier. Similarly, in Stack Overflow's 2024 Developer Survey, one-third (30%) of respondents indicated they lack adequate training and education on new tools.

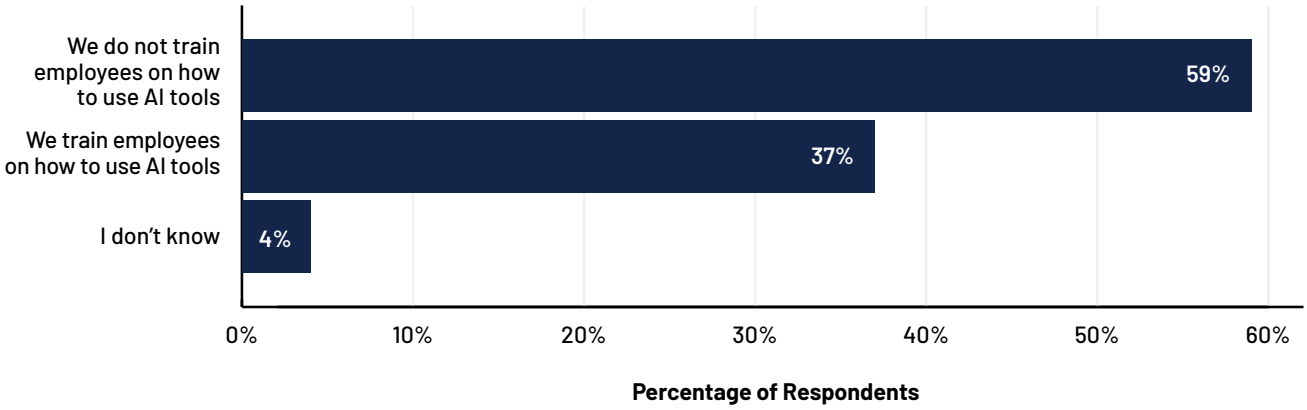


Figure 10. Frequency of employer-provided training on ICT tools. Data source: ICTC's survey of ICT workers, 2024.

When asked why their organizations do not provide training on AI tools, some research participants indicated that it is not part of their organizational culture to engage in work-sponsored training or community learning. While some organizations had dedicated channels for sharing experiences with new tools, several noted that in the technology industry, learning and trialing new tools often occurs individually. As one interviewee shared, "learning takes place on your own… it's a part of my job to keep up with changes in the industry and learn about new tools."

Still, some interviewees' organizations did facilitate on-the-job learning. One indicated that their organization encourages staff to take part in vendor-provided training if it is available. If it is not, it often has team leads take courses or independently improve their knowledge and then share their learnings with their teams.

Overall, most research participants felt that learning about new tools is important; when employees are trained on these tools, they better understand when to use them and how.

PART II:
AI Tool Adoption's Impact on Canada's ICT Labour Market

Key Takeaways

- Canada's economy is rapidly evolving. AI's impact cannot yet be separated from other factors, such as technology companies offshoring talent or the workforce restructuring that followed the technology sector's expansion during the COVID-19 era.
- Globally, and in Canada, some employers report reducing their workforces because of AI automation. However, change at the task level is more apparent. One-third of ICT sector survey respondents (31%) reported that AI had automated a task they used to do.
- Projections of how AI will impact ICT occupations predict significant exposure to automation. However, these projections typically do not consider the potential costs of adopting AI to replace human labour, such as expensive externalities introduced by security risks.
- ICTC analysis suggests that many rote, lower-stakes tasks in data, programming, IT, and helpdesk occupations in technology can be automated. Moreover, the types of tasks that can be automated tend to be assigned to junior roles.
- Initial labor market signals for data roles indicate a shift towards demand for more senior positions that involve complex tasks and oversight responsibilities.
- Furthermore, labour market data show stronger demand in back-end or full-stack programming roles, and a decline in demand for front-end occupations like web design. Individuals in software development and engineering roles report taking on front-end tasks and responsibilities using AI.
- Demand for cybersecurity personnel, user experience professionals, and management-level IT professionals remains strong; however, each of these roles shows a trend toward hiring mid-career professionals.
- Despite AI transforming jobs and responsibilities, employers emphasize that students should still acquire fundamental skills, learn to use AI tools critically, and demonstrate a combination of interpersonal and adaptable technology skills.

Converging Trends are Transforming Canada's ICT Labour Market

The Canadian economy has experienced dramatic shifts over the past five years and so has its technology sector. In 2020 and 2021, technology employment in Canada expanded significantly: the number of technology workers in the sector grew by 9.6% in 2020 and 8.8% in 2021. Additionally, the number of technology workers outside the technology sector increased by 9.5% in 2021,[37] likely reflecting heightened demand for digital services in areas such as commerce and healthcare, driven by the COVID-19 pandemic. From 2022 to 2024, the technology labor market adjusted as many large technology companies implemented significant layoffs in the US and Canada.[38] Despite this restructuring, technology workers continue to be in high demand. Even today, the unemployment rate among technology workers remains lower than that of the general economy. In 2024, the unemployment rate for ICT workers across the economy was 3.9%. Meanwhile, national unemployment in Canada averaged 6.3% (Table 1). Furthermore, average employment growth rates in the ICT sector today are comparable to those seen pre-pandemic.[39]

OCCUPATION GROUPS	EMPLOYMENT 2024	EMPLOYMENT GROWTH 10-YEAR CAGR	EMPLOYMENT GROWTH 2022-2024	UNEMPLOYMENT RATE 2024	YOUTH UNEMPLOYMENT RATE 2024
ICT Occupations	2,138,200	4.5%	6.1%	3.9%	6.7%
All Occupations	20,730,500	1.6%	5.0%	6.3%	13.1%

Table 1. Key employment figures across all Canadian occupations and ICT occupations in Canada. Data Source: Statistics Canada Labour Force Survey. Youth refers to workers aged 15-24.

However, COVID-19 was not an isolated phenomenon. The pandemic ignited national discussions about international supply chain risks and introduced fully remote work as a viable option for many employers.[40] In 2024, 13.2% of employed Canadians were still working entirely from home.[41] The rise in remote work is also making it easier and more feasible for technology companies to offshore or outsource talent to cheaper markets in Western Europe, South America, and Asia; while offshoring has occurred in the technology sector for decades, it is reportedly becoming more prevalent. As global uncertainty surrounding trade and tariffs continues, Canada has yet to fully experience the impact on its labour market from the twin forces of reshoring supply chains and offshoring some remote workers.

37 Maryna Ivus et al., "Canada's Digital Economy: Talent Outlook 2030," Information and Communications Technology Council (ICTC), Ottawa, Canada, 2025.

38 "These Companies Have Laid off Canadian Workers in 2024," *CityNews Toronto* (blog), December 4, 2024, https://toronto.citynews.ca/2024/12/04/these-companies-have-laid-off-canadian-workers-in-2024-10/.

39 Maryna Ivus et al., "Canada's Digital Economy: Talent Outlook 2030, Information and Communications Technology Council (ICTC)," Ottawa, Canada, 2025.

40 Stijn Broecke, "Offshoring, reshoring, and the evolving geography of jobs: a scoping paper," OECD Social, Employment, and Migration Working Papers No. 38, OECD, 2024, https://www.oecd.org/en/publications/offshoring-reshoring-and-the-evolving-geography-of-jobs_adc9a9d5-en.html.

41 "Labour Force Survey, May 2024," The Daily, Statistics Canada, June 7 2024, https://www150.statcan.gc.ca/n1/daily-quotidien/240607/dq240607a-eng.htm.

It is challenging to separate the impact of AI on the labour market from that of other current trends, such as offshoring. One interviewee expressed this issue through the perspective of their clients: a large company might pursue cost-saving measures either by automating or offshoring processes:

> **"Companies have limited money to invest. We have large clients with technology that was built 20, 30 years ago, and they need to invest in modernizing that technology stack... Historically what have companies done? They have used offshore capabilities in India and Latin America who are paid less. They use lower-paid resources and mix these into their human resources mix—some people make more while others make less. Most large clients we talk to will ask us, 'do you have offshore capability,' thinking, 'how can I fit all of this work that I need to do in with the money that I have?' Well, with automation, there is a roadmap for that that can be used." – Employer**

Automation Will Impact Tasks, Jobs, and Productivity

AI adoption globally is not new,[42] and international evidence has shown that investment in AI can improve firm productivity.[43] However, the slower pace of adoption in Canada means that the impact of AI on Canadian firms is largely yet to be observed. Interviewees in this study suggest that AI could lead to automation, cost-cutting, or productivity gains that allow companies to "do more with the same number of staff." Recent analyses have attempted to determine which way this trend is going. A study by The Dais examined companies' AI adoption and firm-level productivity in Canada and found no causal relationship in the short term: more productive firms were more inclined to adopt AI, but AI adoption did not enhance their productivity.[44]

Data from across the OECD shows that while businesses adopting AI report no change in employment, more employers say AI has resulted in a decrease in staff than an increase.[45] In 2024, a Statistics Canada investigation found that 85% of businesses who had adopted AI in Canada reported "no change in their employment levels after implementing AI in producing goods or delivering services."[46] Only 6.3% of Canadian businesses using AI reported a decrease in the number of employees after the introduction of AI.[47] However, 39.2% of businesses using AI found that "tasks were reduced to a moderate or large extent."[48]

Across Organization for Economic Co-operation and Development (OECD) member countries, many workers are worried about losing their jobs due to AI. In a study of finance and insurance staff, younger workers, women, and those with a university degree expressed the greatest concern about job stability.[49] According to ICTC's survey of ICT-intensive workers, most respondents believed that AI would affect the overall demand

42 Researchers have examined patterns in company hiring to spot when firms bring on staff who can develop AI solutions for their businesses. By this measure, AI adoption in the US for applications like automated data analysis accelerated as early as 2015. See: Daron Acemoglu, David Autor, Jonathon Hazell, and Pascual Restrepo, "Artificial Intelligence and Jobs: Evidence from Online Vacancies," *Journal of Labour Economics* 40, no. S1 (2022), https://doi.org/10.1086/718327.

43 Tania Babina, Anastassia Fedyk, Alex He, and James Hodson, "AI, firm growth, and product innovation," *Journal of Financial Economics* 141 (2024): 103745, https://doi.org/10.1016/j.jfineco.2023.103745.

44 Viet Vu et al., "Waiting for Takeoff: The short-term impact of AI adoption on firm productivity," The Dais, December 2024, https://dais.ca/reports/waiting-for-takeoff/.

45 Marguerita Lane, Morgan Williams, and Stijn Broecke, "The impact of AI on the workplace: Main findings from the OECD AI surveys of employers and workers," OECD Social, Employment and Migration Working Papers No. 288, 2023, https://www.oecd.org/en/publications/the-impact-of-ai-on-the-workplace-main-findings-from-the-oecd-ai-surveys-of-employers-and-workers_ea0a0fe1-en.html, p. 43.

46 Valerie Bryan, Shivani Soo, and Chris Johnston, "Analysis on artificial intelligence use by businesses in Canada, second quarter of 2024," Statistics Canada, June 20, 2024, https://www150.statcan.gc.ca/n1/pub/11-621-m/11-621-m2024008-eng.htm.

47 Ibid.

48 Ibid.

49 Marguerita Lane, Morgan Williams, and Stijn Broecke, "The impact of AI on the workplace: Main findings from the OECD AI surveys of employers and workers," OECD Social, Employment and Migration Working Papers No. 288, 2023, https://www.oecd.org/en/publications/the-impact-of-ai-on-the-workplace-main-findings-from-the-oecd-ai-surveys-of-employers-and-workers_ea0a0fe1-en.html, p 48.

for technology workers (68%). Of those, 59% anticipated a decrease in demand for technology positions. Approximately a quarter of respondents (24%) reported concerns about being left behind in the workplace, and less than half (44%) agreed that they trusted their employers to consider workers' views when making decisions about AI tools. When asked to provide open-ended comments in response to the question, "Thinking about the impact of AI on your field, what do you think will be the most significant positive or negative effects? Please be specific," concerns about job displacement and related issues dominated the negative sentiments.

In response to an ICTC survey that was conducted as part of separate research for ICTC's Digital Talent Outlook 2030 report, respondents from digital economy companies were more likely to expect AI to impact employment compared to individuals from companies in the general economy. However, companies were similarly likely to predict an increase in employment as they were to foresee a decrease (Figure 11).

EXPECTED AI EFFECT ON TOTAL EMPLOYMENT

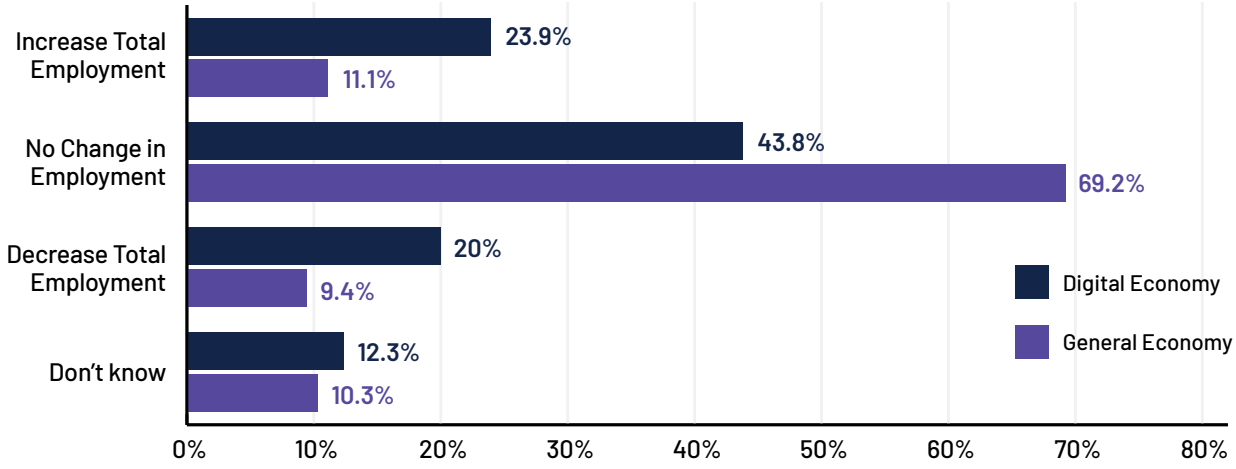


Figure 11. Expected AI effect on total employment. ICTC Digital Economy Employer Survey, 2024, compared with Statistics Canda Survey on Business Conditions data, 2024.

Another investigation in 2024 sought to evaluate the potential impact of AI tools on Canadian occupations. It used a balance of ***complementarity*** (the degree of human oversight required, for example, in jobs with high levels of socio-emotional communication or responsibility for outcomes) and ***exposure*** (an estimate of what abilities AI applications can perform compared with abilities required for the role).[50] Complementarity might mean that AI can automate small parts of a job, but human oversight is still indispensable.[51]

Figure 12 displays selected Canadian occupations plotted on a chart of exposure (x-axis) and complementarity (y-axis). The axes intersect at median levels of exposure and complementarity across all Canadian occupations. Core ICT occupations are highlighted (yellow) while several other occupations from various sectors are depicted in the chart for comparison.[52] The bottom right-hand quadrant includes occupations with high exposure and low complementarity, which are susceptible to AI automation and do not require a high degree of oversight. The authors hypothesize that these occupations may be most at risk of having substantial numbers of tasks replaced by AI-powered productivity tools.

50 Tahsin Mehdi and Marc Frenette, "Exposure to artificial intelligence in Canadian jobs: Experimental estimates," Statistics Canada, Sept 25, 2024, https://www150.statcan.gc.ca/n1/pub/36-28-0001/2024009/article/00004-eng.htm.

51 Martin Neil Baily, Erik Brynjolfsson, and Anton Korinek, "Machines of Mind: The case for an AI-powered productivity boom," *Brookings*, May 2023, https://www.brookings.edu/articles/machines-of-mind-the-case-for-an-ai-powered-productivity-boom/.

52 Not all of this paper's 15 NOCs of interest are represented in Figure 12. The analysis for Statistics Canada used NOC 2016 rather than NOC 2021.

ESTIMATED COMPLEMENTARITY & EXPOSURE OF CANADIAN OCCUPATIONS TO AI (ICT OCCUPATIONS + COMPARISONS)

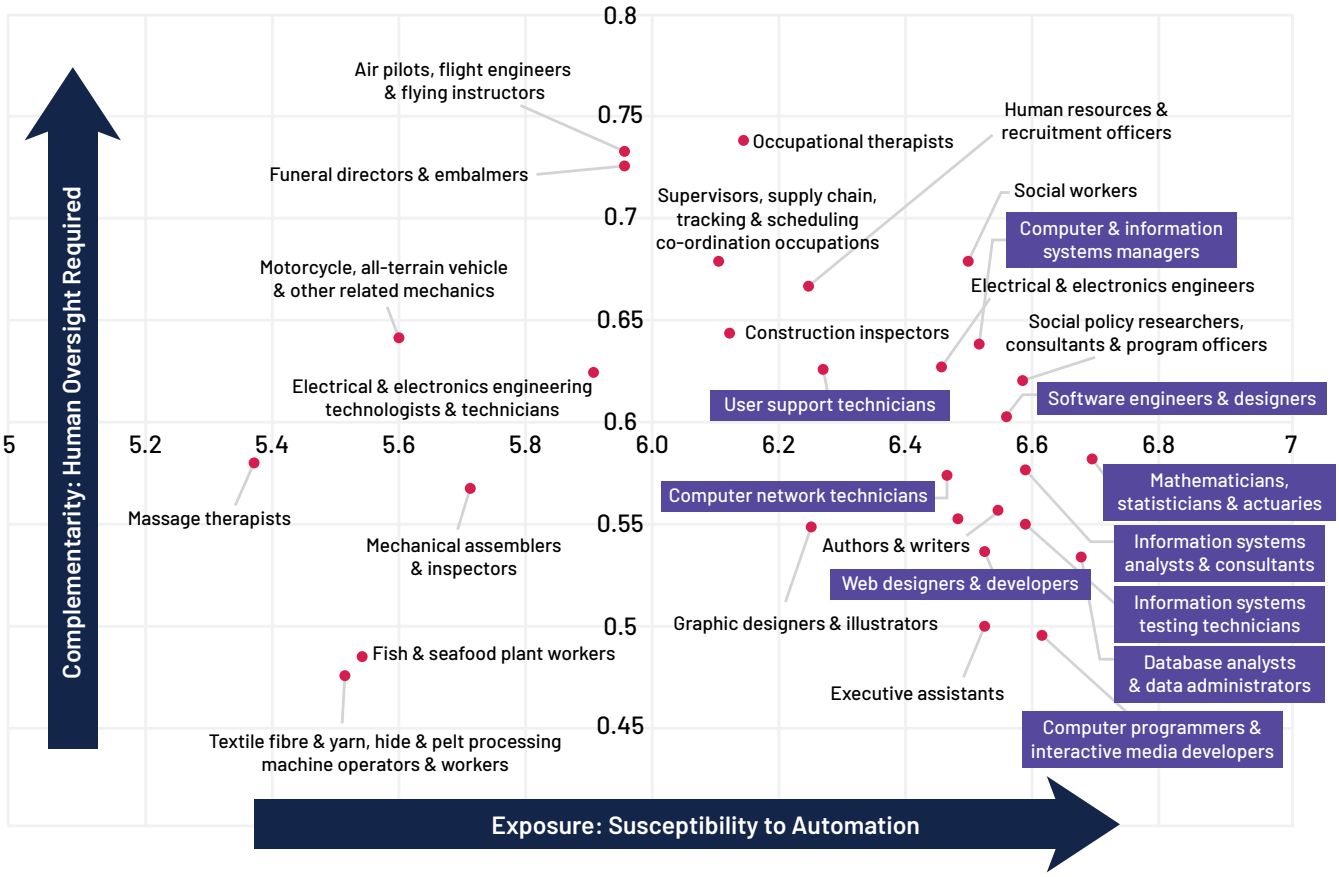


Figure 12. Many core ICT occupations are ranked as high-exposure, low-complementarity. Data Source: Tahsin Mehdi and Marc Frenette, "Exposure to artificial intelligence in Canadian jobs: Experimental estimates," Statistics Canada, Sept 25, 2024.

Estimates of How Automation Will Impact Workers Often Leave Out Cost-Benefit Analysis

Most estimates of how ICT workers will be affected by AI are projections based on how many of their tasks or abilities a machine or program could perform.[53] Measuring susceptibility to automation, or "AI Exposure," is challenging because it does not examine the economic viability of AI adoption or conduct a cost-benefit analysis of human workers compared with AI tools.[54] Implementing automation and productivity tools, or developing customized ones, can involve a range of expenses: some applications require minimal computing power, while others demand significant resources.[55] For certain organizations, it may be crucial to invest time and money in developing a solution tailored to their company's needs. For example, an interviewee in creative technology commented that they would not be using AI until they could develop a solution entirely trained on their own intellectual property to avoid copyright infringement.

53 Tuhin Bhatt, "Automation In Software Development: Benefits, Challenges, Tips," *Intelivita*, February 2024, https://www.intelivita.com/blog/automation-in-software-development/.

54 Maja Svanberg, Wensu Li, Martin Fleming, Brian Goehring, and Neil Thompson, "Beyond AI Exposure: Which Tasks are Cost-Effective to Automate with Computer Vision?," (working paper, January 2024), http://dx.doi.org/10.2139/ssrn.4700751.

55 Ibid.

Adopting AI tools without appropriate guardrails can lead to unexpected and costly externalities. While the consequences of generative AI use in the workplace have yet to be fully established, companies have already reported security and privacy risks, as discussed in Part I. In the past, some early adopters of technology aimed at automating human labor have encountered setbacks regarding market viability, technical feasibility, and lawsuits (most infamously, investments in autonomous vehicle taxis by companies like GM and Uber).[56] Generative AI productivity tools are provided to many companies as enterprise Software as a Service and require much less financial investment and infrastructure than autonomous vehicles. However, in a recent study about GitHub Copilot, developers expressed concerns about the impact of AI on code quality,[57] with AI coding tools already introducing vulnerabilities (e.g., suggesting open-source modules that developer teams have not validated, which introduces security risks).[58] We may not have yet seen the full cost of errors in production resulting from uncritical adoption of AI-generated code.

This study asked interviewees about the impact of AI on their workplaces to fully understand whether firms are adopting AI to replace human tasks or occupations. We then examine early labour market signals, literature examining real-time impacts on ICT occupations (rather than estimates or projections of exposure), and insights from interviewees to assess the immediate impact of AI automation tools on Canadian ICT workers.

Role-Specific Impacts of Automation in the ICT Labour Market

Automation, or the introduction of new tools in the workplace, tends to change occupations at the task level faster than it changes jobs.

One-third of ICTC's survey respondents reported that AI had automated a task they used to perform (31%). Meanwhile, only 15% felt that AI had created a new task that hadn't been part of their role before. One subject matter expert interviewee noted that a gradual shift in tasks is what ultimately leads to job changes, and even job elimination:

> **"Technology leads to a recombination or a bundling of things that were once separated… It used to be, for example, professionals wrote things out on paper and then handed them to other people to type them up and format them using a typewriter. Now, professionals do their own typing, and it's not just to save money, it's also because there is this sort of natural complementarity between thinking and writing when you're using a word processor—which wasn't true when you were using a typewriter… But obviously, as jobs get narrower and narrower, they tend to be more and more at risk of being eliminated altogether." – Automation Economist**

In the following section, core ICT occupations are categorized based on shared task characteristics, skill sets, and/or settings. Employers' and practitioners' perspectives on each role are compared with labour market information. Within each category, interviewees note that they observe role blending, where individuals in one traditional occupation are taking on the tasks of another. Like workers who previously focused on typewriter formatting, some employees may see tasks related to their roles redistributed to different positions.

56 Darryl Campbell, *Fatal Abstraction*, (New York, NY: W.W. Norton, 2025).

57 William Harding and Matthew Kloster, "Coding on Copilot: 2023 Data Shows Downward Pressure on Code Quality," *GitClear*, January 2024, https://gitclear-public.s3.us-west-2.amazonaws.com/Coding-on-Copilot-2024-Developer-Research.pdf.

58 "AI Code Security and Trust," Snyk, 2023, https://go.snyk.io/2023-ai-code-security-report-dwn-typ.html.

Data Roles Continue to See Employment Growth, but Interviewees Suggest Entry-Level Data Tasks Can Be Automated

Data roles involve understanding and manipulating data to solve problems or make predictions. They range from entry-level to advanced, but most data-related occupations require a post-secondary degree.[59] People in data roles ensure that datasets are clean and appropriate to tasks. They then conduct quantitative analysis, using mathematical and statistical techniques, technology such as statistical software or programming languages, and often machine learning algorithms, to make predictions, draw insights, solve problems, and communicate results.

Interviewees commented that they saw many data analysis tasks being automated:

> **"From my perspective, data analysis and data science are becoming automated. Model development still isn't, but these are highly specialized roles: most of my team are researchers and scientists with MSCs and PhDs. But data analysis tasks? Cleaning the data, crunching the data, extracting insights from the data? Most of these things can be done automatically or semi-automatically these days." – Employer**

Interviewees noted utilizing AI to parse data from files, input it into a database, categorize it, and generate key findings, all with human oversight. They also mentioned the democratization of even complex model development tasks.

> **"In 2015, if I wanted to develop and deploy an AI model, I had to do low-level coding on GPU, build my own CI [Continuous Integration] pipeline with Jenkins, and deploy to a server. Now, there are services on Amazon and all I need is five lines of code to deploy my model in the cloud and give the world access to use it." – Employer**

Another employer noted that their software developers and engineers felt "more empowered" to perform machine learning (ML) engineering work because of AI tools: "It's not automation in the sense we normally talk about, or the way we thought it would happen—using copilot to generate code—but the roles of the software developer and ML engineer are being blended together."

Figure 12, above, showed that data roles are projected to be in the high exposure, low complementarity quadrant. Importantly, it uses the NOC 2016 system, which did not include *NOC 21211—Data Scientists* (see Table 2). Prior to the NOC 2021 system, most Data Scientists were classified as Database Analysts and Data Administrators.[60]

Labour market data indicates that the number of Data Scientists, Database Analysts, and Data Administrators has been steadily increasing over the past 10 years. However, a decline in job postings suggests a flattening demand for these occupations after 2022. The comparatively high youth unemployment rates in these occupations, relative to the average worker, may indicate labour market challenges for early-career workers in these roles.

59 Statistics Canada's NOC classification system includes Training, Education, Experience, and Responsibility (TEER) codes. When the second digit of a NOC is 1, these jobs usually require completion of a university degree or equivalent previous experience. Each of the core NOCs identified as data roles in this paper have a second-digit 1 (21223, 21221, and 21210).

60 Nearly two-thirds, or 63.7% of data scientists were NOC 2172 in NOC 2016. See: "Empirical concordance: National Occupational Classification (NOC) 2021 Version 1.0 and National Occupational Classification (NOC) 2016 Version 1.3," Statistics Canada, October 4, 2023, https://www12.statcan.gc.ca/census-recensement/2021/ref/98-26-0007/982600072021001-eng.cfm.

NATIONAL OCCUPATION CLASSIFICATIONS (NOCS)	EMPLOYMENT 2024	EMPLOYMENT GROWTH 10-YEAR CAGR	EMPLOYMENT GROWTH 2022-2023	EMPLOYMENT GROWTH 2023-2024	JOB POST GROWTH 2022-2024	UNEMPLOYMENT RATE 2024	YOUTH UNEMPLOYMENT RATE 2024
21223 Database analysts and data administrators	49,400	6.7%	24.1%	3.5%	-28.3%	3.4%	13.7%
21211 Data scientists	43,400	26.4%	2.7%	2.1%	-31.6%	1.8%	5.3%
21210 Mathematicians, statisticians and actuaries	15,100	1.9%	18.2%	-6.0%	-54.1%	4.2%	n.d.

Table 2. Key labour market data for data roles. Data Sources: Statistics Canada Labour Force Survey and Vicinity Jobs, Inc. Note: Data with missing values is suppressed by Statistics Canada due to low response numbers and/or data quality concerns. Youth refers to workers age 15-24.

IT, Helpdesk, and Client-Facing Roles Show Growing Demand for Technicians Working in User Support, or IT Professionals in Management, but a Decline in Other Areas

IT support roles encompass a wide variety of occupations today. User support technicians may work for software or hardware companies, providing technical assistance to clients facing challenges. Computer network and web technicians work to repair computer networks and web servers in homes and businesses. Meanwhile, testing technicians and information systems specialists are typically employed in IT departments in both the public and private sectors to evaluate IT system performance, troubleshoot, and resolve errors. Finally, computer and information systems managers are an organization's IT support lead and combine technical experience with management and business expertise. Each of these roles contributes to a well-functioning IT environment across the economy.

These occupations range from entry-level roles to senior leadership. Many of them do not require a university degree at the entry level; people can enter them via college, apprenticeship, or related experience.[61]

Interviewees described using AI tools to triage customer inquiries, address small problems, and escalate complex questions to a human agent. They saw a lot of automation in front-line support but emphasized that human workers were still important for dealing with complex dynamics, such as understanding what a client or customer wants if they are unable to articulate it precisely. One interviewee also felt that technical skills expectations were increasing for roles in IT and customer support.

Although interviewees did not explicitly provide examples of automation in information systems roles (NOC 22222, 21222 in Table 3), one respondent speculated that some testing roles might disappear.

> **"Some companies have a role specifically for creating test scripts and test cases, and I think that could probably be replaced by AI because as far as I know, AI can automatically create tests and the quality is acceptable." – Post-Secondary Computer Science Professor**

61 See note 59 about Statistics Canada's TEER system.

In Figure 12 above, IT support, helpdesk, and client-facing roles fall in the high exposure, low complementarity quadrant, except for user support technicians and computer and information systems managers. For user support technicians, this is likely due to the high proportion of tasks deemed to require human communication and interaction. This may change as users become more comfortable interacting with AI chatbots and agents. For managers, this is likely due to the high degree of human oversight currently required to manage a successful IT department or strategy.

Labour market data shows that demand is growing for User Support Technicians and Computer and Information Systems Managers. However, high youth unemployment in User Support roles might point to labour market challenges for early-career talent. Demand for other types of IT Technicians, however, may be flattening as job post growth declines.

NOCS	EMPLOYMENT 2024	EMPLOYMENT GROWTH 10-YEAR CAGR	EMPLOYMENT GROWTH 2022-2023	EMPLOYMENT GROWTH 2023-2024	JOB POST GROWTH 2022-2024	UNEMPLOYMENT RATE 2024	YOUTH UNEMPLOYMENT RATE 2024
22221: User Support Technicians	128,200	5.2%	21.0%	6.6%	19.8%	4.8%	9.0%
22220: Computer Network & Web Technicians	40,900	-4.3%	-26.3%	-0.7%	-8.1%	2.3%	n.d.
22222: Information Systems Testing Technicians	23,800	3.9%	1.6%	19.0%	-15.5%	3.9%	2.2%
21222: Information Systems Specialist	221,700	3.7%	-6.3%	-3.2%	-20.1%	3.0%	0.1%
20012: Computer & Information Systems Managers	148,200	10.5%	18.7%	18.6%	12.8%	3.8%	n.d.

Table 3. Key labour market data for IT, helpdesk, and client support roles. Data Sources: Statistics Canada Labour Force Survey and Vicinity Jobs, Inc. Note: Data with missing values is suppressed by Statistics Canada due to low response numbers and/or data quality concerns.

Software, Computer, & Web Programming Roles Show Churn in Demand and Task Type

Software, computer, and web development professionals use programming languages to create software applications, web applications, and interactive websites. While all these roles involve the use of programming languages, the languages differ significantly by role (e.g., HTML or CSS for a web designer, JavaScript for a web developer, or Python for a software developer). Moreover, web roles typically emphasize front-end usability and user experience, whereas software roles often contribute to building back-end digital

infrastructure, such as cloud development environments. Meanwhile, computer systems developers concentrate on software systems closely related to hardware or operating systems, and their tasks may focus on embedded systems and applications for specific industries. These positions generally require at least an undergraduate degree.

Interviewees described using AI as coding assistants in numerous use cases:

- Generating prompts that can draft code
- Generating code as a self-learning tool, using Stack Overflow and other resources to troubleshoot generated code
- Generating documentation for clients
- Writing shell scripts (a batch of commands grouped together for quick execution)
- Writing commands and code more efficiently
- Learning about a less familiar programming language (e.g., doing UI work as a back-end developer)
- Learning how to revise existing software programs and platforms
- Reviewing and triaging or escalating security-related notifications
- Describing and searching for existing pieces of code in documentation

Some interviewees felt that workplaces were not far from having AI agents in coding environments.

> **"So, [let's say] I'm the developer and when I finish my code, I can send my code to an agent and that agent can be responsible for a package of multiple tasks, including code review, writing documentation, task creation... They would essentially be a part of the workflow with humans." – Employer**

However, many interviewees still felt that it required significant human expertise to troubleshoot bugs or inefficiencies in the generated code.

> **"You're always going to need somebody overseeing the strategies, the quality, double checking outputs and everything else." – Employer**

Stack Overflow's 2024 Developer Survey found that 70% of respondents do not view AI as a threat to their jobs, 12% do, and 19% are uncertain. The same survey in 2023 indicated that developers focused on backend systems, hardware, and applications were less likely than those working in front-end, full-stack, and cloud infrastructure roles to adopt AI tools currently or plan to in the future.[62] When asked whether role blending was happening in their organizations (i.e., whether AI tools allowed some workers to perform the tasks/jobs of others), two interviewees stated that they viewed UI/UX as a domain that developers could enter. One employer noted that they hadn't observed role blending "as a pattern," but "if we don't have someone available—so for instance, we have to a UX task, but we don't have a UX engineer—let's use AI and that's where we see people get more creative."

62 "Developer sentiment around AI/ML," Stack Overflow, June 12, 2023, https://stackoverflow.co/labs/developer-sentiment-ai-ml/.

Several organizations have researched the impact of AI-assisted software development, and in general find that AI tools help software workers with productivity, particularly by speeding up simpler tasks like code documentation and generation.[63] Several interviewees commented that the types of tasks they saw being automated were concentrated in junior roles:

> **"The people that are in very high positions spend 75% of their time not actually coding but doing organizational stuff like ensuring things are aligned across the org. The people immediately under them are code wizards and can write code faster than how long it takes to ask an AI tool to write the same code and then review it. The junior roles under them are using [AI] more." – Employer**
>
> **"[AI] is great when they need to write a test or something basic, but if they're trying to figure out how to fix our valuation algorithm because something is not quite working out the way we expected, it's useless." – Employer**

In Figure 12 above, programming roles occupy the high exposure, low complementarity quadrant, with the exception of Software Engineers and Designers, likely due to their seniority and task complexity. Labor market data for these occupations indicates employment growth in software roles, but a decline in growth for web/front-end occupations and for computer systems developers and programmers. Moreover, employment data for some of these roles reveals a boom-and-bust cycle: those in this group may experience significant workforce churn due to project cycles, preceding layoffs in large technology companies, and other factors.

NOCS	EMPLOYMENT 2024	EMPLOYMENT GROWTH 10-YEAR CAGR	EMPLOYMENT GROWTH 2022-2023	EMPLOYMENT GROWTH 2023-2024	JOB POST GROWTH 2022-2024	UNEMPLOYMENT RATE 2024	YOUTH UNEMPLOYMENT RATE 2024
21232: Software Developers & Programmers	198,500	7.9%	-1.6%	24.1%	-7.0%	3.9%	8.4%
21231: Software Engineers & Designers	142,900	11.5%	-3.2%	23.9%	-31.5%	3.0%	7.3%
21233: Web Designers	10,100	-3.2%	-2.2%	-16.7%	n.d.	2.7%	7.0%
21234: Web Developers & Programmers	23,000	1.0%	-4.0%	-25.4%	181.2%	5.6%	14.5%
21230: Computer Systems Developers and Programmers	26,400	-6.3%	-34.7%	-40.4%	-13.6%	6.7%	2.4%

Table 4. Key labour market data for programming roles. Data Sources: Statistics Canada Labour Force Survey and Vicinity Jobs, Inc. Note: Data with missing values is suppressed by Statistics Canada due to low response numbers and/or data quality concerns.

63 E.g., Bergum Karaci et al., "Unleashing developer productivity with generative AI," McKinsey Digital, June 27, 2023, https://www.mckinsey.com/capabilities/mckinsey-digital/our-insights/unleashing-developer-productivity-with-generative-ai#/.

Cybersecurity Roles Continue to See Strong Demand

Other core ICT roles include Cybersecurity Specialists, who are not depicted in Figure 12 because this occupation classification did not exist in the 2016 NOC system. Interviewees believe that the demand for skilled cybersecurity professionals will likely remain strong, partly due to the many new cybersecurity risks that AI may present. However, cybersecurity is recognized as a field with few clear pathways or onramps for junior talent, and most demand for cybersecurity professionals is for workers with substantial job experience.[64]

In addition, many workers focus on ICT hardware, such as computer or electrical engineers. This report focuses on occupations impacted by AI-software integrations rather than robotics. Hardware occupations face their own labour market dynamics but merit a focused discussion.

Table 5 presents labour market data for cybersecurity specialists and computer engineers to compare with the other NOCs discussed in this section. Growth for Cybersecurity Specialists holds strong, including job post growth, which has flattened for the other occupations discussed throughout this section.

NOCS	EMPLOYMENT 2024	EMPLOYMENT GROWTH 10-YEAR CAGR	EMPLOYMENT GROWTH 2022-2023	JOB POST GROWTH 2022-2024	UNEMPLOYMENT RATE 2024	YOUTH UNEMPLOYMENT RATE 2024
21220: Cybersecurity Specialist	32,500	18.0%	50.7%	9.2%	3.5%	n.d.
21311: Computer Engineers	34,100	4.4%	19.8%	-33.3%	3.4%	n.d.

Table 5. Key labour market data for Cybersecurity Specialists and Computer Engineers. Data Sources: Statistics Canada Labour Force Survey and Vicinity Jobs, Inc. Note: Data with missing values is suppressed by Statistics Canada due to low response numbers and/or data quality concerns.

64 Maryna Ivus et al., "Canada's Digital Economy: Talent Outlook 2030," Information and Communications Technology Council (ICTC), Ottawa, Canada, 2025.

PART III:
Career Advice for ICT Students

As Parts I and II of this report illustrate, organizations and workers in Canada's ICT sector are incorporating AI tools into their workflows. AI tools assist ICT workers in writing code, analyzing data, debugging issues, seeking help, testing code, learning about codebases, documenting code, and visualizing and cleaning data. Additionally, AI tools are helping teams increase their productivity, potentially reducing their reliance on entry- or junior-level staff. Meanwhile, broader economic trends are exerting downward pressure on Canada's labor market, making job searches more competitive and complicating the ability of students and new graduates to find their first jobs in their field.

Considering these trends, ICTC asked ICT workers across Canada for advice to students in their field, considering the impact of AI tools on their profession. Their advice is summarized below:

Don't Get Overwhelmed by AI Hype

First and foremost, participants in this study want ICT students and new graduates to avoid getting overwhelmed by AI hype. They commented that there will always be a revolutionary new technology around the corner that threatens to reshape the technology industry. When faced with this, it is important not to become overwhelmed by or afraid of new technologies. Instead, it is important to separate the hype from the actual benefits so that you can understand what they can and cannot do and begin to apply them in your workflow.

Learn the Fundamentals First

Nine out of ten (89%) respondents to ICTC's survey believe that even when a task can be automated, it remains crucial for students to learn the underlying skills. Eight out of ten (81%) emphasized that students in their field must still understand how to create technology without relying on AI. Similarly, nearly all experts interviewed for this study agree that it is essential for students to acquire the underlying knowledge and skills despite the possibility of automation. When asked why they think this, study participants identified several significant reasons:

- **If you know how to build solutions and solve problems independently, you will be a more effective and efficient technologist than if you rely on AI tools.** Ultimately, workers who grasp the fundamentals first will excel in their craft and become more efficient and effective performers.
- **There is a lot that AI cannot do.** For example, study participants shared that AI tools are less able to assist with niche or proprietary technologies, such as niche programming languages or proprietary algorithms. Similarly, AI tools are unable to diagnose issues in complex software systems or create new solutions. It is crucial for technologists to grasp the fundamentals, enhance their critical thinking skills, and learn how to analyze and resolve complex problems to address challenges that extend beyond AI's capabilities.
- **AI tools are most useful when you have a basic understanding of how to solve the problem.** Study participants indicated that AI tools are particularly effective when you are familiar with the context and subject matter but may struggle to recall specific details. Furthermore, if you are unsure about how to complete a task, you will be less capable of providing sufficiently specific prompts to achieve the task using AI. As one interviewee remarked, "You need to learn how to do x first, and then you can use the tools to streamline that task later on."

- **Even when using AI tools to automate or streamline a task, you still need to know how to review, test, debug, edit, and perfect the solution before deploying it.** Given the limitations and errors prevalent in AI tools, robust quality assurance is critically important. Study participants shared that ICT workers need to understand what specific lines of code mean, why they exist, and what they do, as well as whether they are necessary at all. As one interviewee noted, "A successful day of coding is when you delete code… reducing a 1,000-line file to 100." Furthermore, ICT workers must verify whether their approach has met the requirements or solved the problem they set out to address. One interviewee stated, "You can find the solution online or using Chat GPT, but you should still be able to justify the solution, understand it, comprehend it, interpret it, and explain it and its behaviour. We can't settle for a black box scenario." A computer science professor similarly remarked, "Even though these types of tools can change how people write code, they still need to know the fundamental knowledge behind how systems work."
- **If you don't understand the fundamentals, it will impact your career progression.** Participants noted that junior ICT workers who lack a grasp of the fundamentals and overly depend on AI tools are less likely to advance to senior positions, hindering their career growth. Understanding the fundamentals is not only essential for career progression, but AI is also generally less effective for tasks performed by senior ICT workers.

Become an Expert in AI Tools and Best Practices

The most common feedback that research participants provided to students and new graduates was to become proficient in AI tools and best practices. Indeed, in response to ICTC's survey, most respondents (73%) agreed that students in their field need to understand how to use AI tools. Research participants believed it is essential for students and new graduates to learn to utilize AI tools to enhance their productivity and ensure they "don't get left behind." Some of the topics they suggested for students to learn were:

- How to write effective prompts when using generative AI tools to build technology
- How to showcase their knowledge and understanding of AI tools in technical interviews
- How to augment their technical interviews using AI tools
- How to use critical thinking skills to apply AI tools in a beneficial way
- What the ethical implications of AI tools are
- What security vulnerabilities AI tools can introduce
- What privacy and intellectual property vulnerabilities AI tools can introduce
- Best practices for using AI tools to build technology products and services
- What types of biases, risks, challenges, and limitations are associated with different types of AI models

Importantly, interviewees noted that post-secondary institutions may not be prepared to teach students how to integrate AI tools into their workflow. They cautioned that students must take on a leadership role in their own careers by actively seeking out electives, research papers, and online resources that enable them to keep pace with AI tools.

Showcase AI Tool Knowledge in Recruitment Processes

Students and new graduates who learn how to use AI tools proficiently and to their advantage will "have a 'leg up'" in recruitment processes. One interviewee commented, "Somebody that not only understands how to do their work but also how AI can help them do their work will be more marketable than somebody who just understands how to do their work."

Research participants noted that most recruitment processes require candidates to write code or complete a technical project, seeing this as a key opportunity for students and new graduates to showcase their knowledge and understanding of AI tools.

During interviews, students and new graduates are expected to demonstrate how they can leverage AI to enhance their productivity. For instance, one interviewee shared that students and new graduates can use AI tools to augment their projects in technical interviews by spending most of their interview time building a high-quality product, then using AI tools to display their understanding of test-driven development by quickly writing test cases for their product.

At the same time, interviewees felt it is important for candidates not to rely on AI tools during interviews. As one interviewee expressed, "One thing that I sometimes notice in interviews is candidates offering solutions to questions they don't actually understand… you can find the solution online… but you should still be able to justify the solution, comprehend it, interpret it, and explain its behavior."

Don't Over-Rely on AI Tools

ICT workers in this study shared that while AI tools have made remarkable progress over the past five years, they still have significant limitations.

The models that AI tools rely on, especially large language models, are highly probabilistic and can hallucinate. Furthermore, many AI tools are trained on online repositories like Stack Overflow and GitHub, which can contain various biases, bugs, and errors, including severe security flaws.

Consequently, study participants warned that students and new graduates should avoid over-relying on AI tools, noting that students should, "use AI as a tool, not a crutch." While it can be tempting to completely depend on AI tools to complete tasks, their considerable limitations make it essential for students and new graduates to think critically about and scrutinize AI outputs before incorporating them into final products.

Additionally, study participants mentioned that relying too heavily on AI tools over time can lead students and new graduates to lose their skills and fall behind. As one interviewee shared, there is a risk that "[students] stop having experiences where [they] have to think about hard problems," and over time, lose their ability to think critically, ask questions, analyze and solve complex problems, or work on complex projects.

Learn Technical Skills That Are Difficult to Automate

As AI tools enhance the productivity of ICT workers, they may affect the demand for specific job types or alter the skills that employers require. One recommendation from study participants for students and new graduates is to acquire skills that are difficult to automate. For example, the participants suggested learning how to:

- Engage with and build complex projects
- Organize code and individual components and make them work as a whole system
- Analyze requirements, come up with the system's design, transfer the design architecture into a design document, and split up projects into actionable tasks

- Design systems and system architecture
- Work with and adapt products and services to legacy systems
- Work with niche or proprietary technologies

Finally, participants suggested that students and new graduates should embrace their creativity and learn to be innovative by developing new processes or approaches.

Strike the Right Balance Between Broad and Specialized Skills

Technology evolves rapidly, resulting in a constantly changing technology labour market. For instance, over the past two decades, the rising popularity of cloud computing has increased demand for cloud-related skills while moderating demand for traditional IT roles. Likewise, manual code deployment and testing have increasingly been replaced by continuous integration and continuous delivery pipelines. Additionally, as the ICT sector adopts AI tools, some technical skill sets may become automated or face decreased demand.

Participants in this study warned that workers with very narrow, specialized skill sets face a higher risk of job displacement and are less able to rebound and find work in related fields if they lose their jobs. They believed that students and new graduates should prioritize acquiring a broad range of knowledge and ensure they are comfortable with their general knowledge before specializing in a specific technology area, framework, language, or tool. At the same time, participants advised against attempting to learn everything: "balance your generalist skills with targeted specialization" and "don't try to learn every tool, framework, or language, but also don't just learn one. Pick a few and get really good at them."

Build Strong Interpersonal Competencies

Study participants advised students and new graduates to distinguish themselves by developing strong workplace, soft, and interpersonal competencies. They emphasized that many technically skilled individuals struggle to secure employment or advance in their careers due to a lack of essential interpersonal skills, such as communication, listening, and relationship building. One interviewee shared their recent experience mentoring a student preparing for an interview at a high-profile technology firm: "She asked me, what skills should I highlight in my interview? And I said, I would highlight collaboration, self-starting, communication, thinking outside the box. Highlight those because the technical skills are easily adopted and learned. And actually, she failed the technical test but still got the job and she thanked me afterward because it was those other skills—not the technical skills—were why they ended up hiring her."

Some of the interpersonal competencies that study participants identified as important were verbal communication, including speaking, listening, and confidence; problem solving and critical thinking; teamwork; leadership; relationship building, including networking, client engagement, and upward management; navigating complex corporate structures or organizational politics; and expanding one's sphere of influence in one's organization.

Interviewees emphasized the importance of work-integrated learning in developing students' interpersonal skills: "The technical skills will come and go… that's why we need things like work-integrated learning—to teach all the other skills."

Specialize and Solve Problems in an Industry or Domain

Study participants emphasized the importance for ICT workers not only to specialize in technology but also to develop expertise in a specific industry or domain, such as healthcare, agriculture, distribution and shipping, or manufacturing. As one interviewee remarked, "The first priority should not be to learn the [technical] skills. The first priority should be to learn about a specific domain, understand the challenges they face, and learn how to add value. The tooling is important, but it is not as important as the value it can generate when applied to a problem… You can be an expert in coding, but coding itself is not a domain."

They stressed the importance of using domain expertise to shape a career in the ICT sector and help protect one from fluctuations in the job market: "In light of automation, learning the challenges in a domain will be extremely important to insulate yourself from the negative impacts." Domain knowledge is a valuable asset: It helps technical workers build better-quality products and services and is an asset ICT workers can rely on if their technical skills become automated, obsolete, or less in demand.

Domain knowledge is also an important precursor to entrepreneurship, which interviewees felt is a growing area of opportunity for ICT workers in light of automation. One interviewee noted, "Because there is a lot of automation happening, the potential for people to become entrepreneurs and lead one-person organizations is increasing. It's true that big organizations need fewer human beings to operate, but it's also true that you can now run a billion-dollar company with just one person… so I would recommend they work on their business knowledge, their product knowledge, their ability to add value in society by building a product and then selling it… I think we will have more and more companies with high valuation that only have one to five people as a headcount in the next decade." Another interviewee similarly encouraged students and new graduates to start building, saying, "Build cool things like web apps or mobile apps and share them to the public. Tinker with a Raspberry Pi or how light switches work, or build something with motors. Just build projects. Have an idea and figure out how to build it and then showcase it."

Keep Learning and Adapting to New Tech

Ultimately, the ICT sector changes rapidly, and specific technologies come and go. While students and new graduates can set themselves up for success by learning technical skills that are difficult to automate and by striking the right balance between broad and specialized skills, it is highly likely that they will need to keep adapting, learning, and adopting new tools to remain current. As one interviewee noted, "Our industry develops very fast. If you're not learning, you could be ruled out by automation or the evolution of new techniques." Another shared that "the most important [piece of advice] is to train your ability to quickly process new information… and apply newly gained knowledge rapidly."

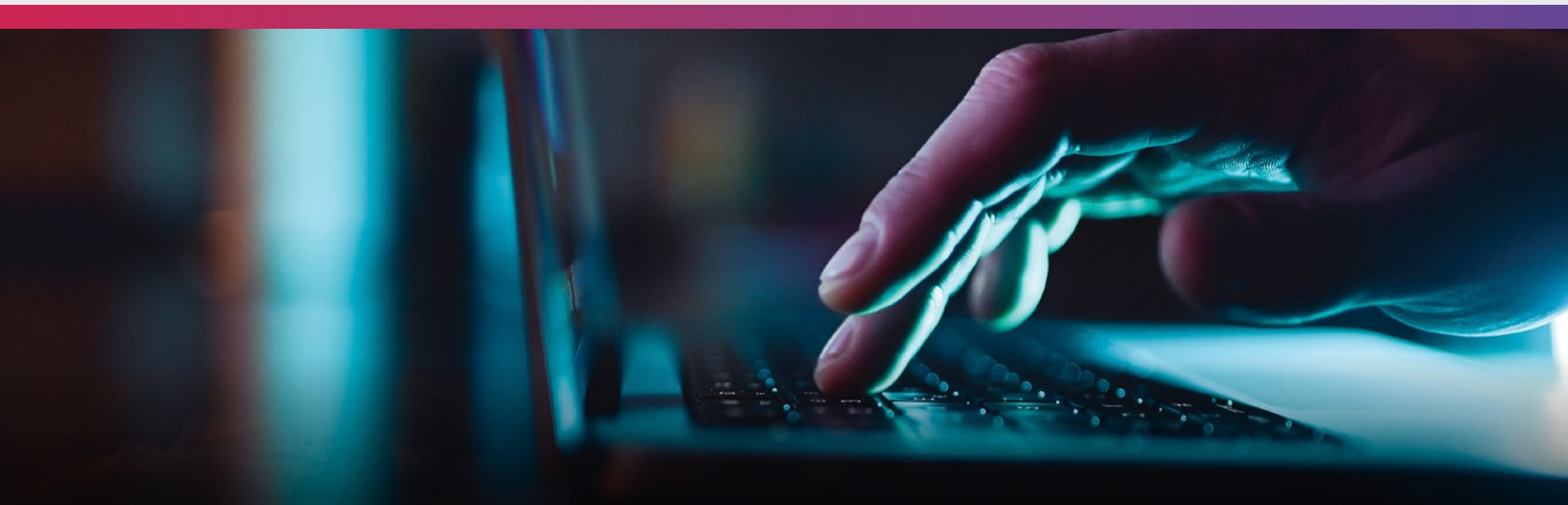
Conclusion

As early adopters of AI tools, ICT workers in Canada are beginning to witness task automation and changes in occupations. This reality has implications for employers, workers, regulators, and educators. First, ICT workplaces in Canada need to enhance their efforts regarding clear AI adoption policies that promote an integrated approach, safeguard privacy and security, and consider the environmental impacts of tool adoption. Furthermore, few employers currently provide AI-related training, placing the responsibility on employees to keep pace with technological change.

ICT workers in Canada generally favour AI, but they also voice concerns about job displacement and responsible adoption by their employers. Projections of how AI will impact ICT occupations see potential for significant displacement of tasks or roles. ICT workers are already beginning to see a change in how their jobs are structured, with some using AI to take on unfamiliar tasks, learn new skills, or eliminate previous rote work.

While this paper primarily focuses on the impact of AI in the workplace, these trends are likely to influence how post-secondary, and even secondary, education approaches ICT programming. Throughout this study, employers emphasized their desire for junior talent to acquire fundamental skills and think critically about AI. Additionally, they wanted junior talent to have exposure to AI tools and use them effectively. In response to these trends, post-secondary institutions are beginning to teach skills such as the critical evaluation of AI-generated code and emphasize transferable business skills through capstone or entrepreneurial programs.

It is too early to distinguish a clear, Canada-wide trend showing the impact of AI on jobs or firm productivity. However, this paper has illustrated that ICT workers are already experiencing changes to their jobs. Research and regulatory organizations should keep a close eye on economic and labour market trends. ICT workers, employers, and post-secondary education institutions, meanwhile, can support junior talent navigating a changing labour market by providing mentorship and programs that allow new ICT workers to gain all-important work experience.



APPENDIX A
Research Methodology and Limitations

Methodology

Primary Research

SURVEY OF ICT WORKERS

A survey of Canadian ICT workers was conducted through Angus Reid in October 2024. The survey consisted of 33 questions about AI tool adoption within Canadian organizations and the impact AI tool adoption will have on employment in Canada's technology sector. A total of 210 respondents completed the survey. Respondents included software developers and programmers (17.6%), information systems specialists, (13.3%), computer & information systems managers (12.4%), software engineers and designers (11%), user support technicians (11%), cybersecurity specialists (7.6%), and other core technology roles. Just under half (43.3%) of respondents worked in the technology or telecommunications sector, and a similar percentage (45.2%) were senior individual contributors. The survey excluded sole proprietors and contractors. Below is the list of National Occupation Classification codes that were included:

- Computer and information systems managers (20012)
- Mathematicians, statisticians and actuaries (21210)
- Data scientists (21211)
- Cybersecurity specialists (21220)
- Information systems specialists (21222)
- Database analysts and data administrators (21223)
- Computer systems developers and programmers (21230)
- Software engineers and designers (21231)
- Software developers and programmers (21232)
- Web designers (21233)
- Web developers and programmers (21234)
- Computer engineers (except software engineers and designers) (21311)
- Computer network and web technicians (22220)
- User support technicians (22221)
- Information systems testing technicians (22222)

KEY INFORMANT INTERVIEWS

ICTC conducted 19 key informant interviews with ICT workers and executives as well as experts on the impact of automation on the technology labour market. The interviews spanned six Canadian provinces, including Ontario, British Columbia, Alberta, Nova Scotia, Manitoba, and Quebec. Two international interviews were held. Interviewees held titles like Chief Technology Officer, Chief Executive Officer, Senior Software Engineer, Head of Artificial Intelligence, Principal Engineer, Engineer, Associate Dean, and Professor. While the insights gathered through these interviews were used to inform qualitative findings and to elaborate on trends identified through quantitative data, they should not be considered representative of the entire technology industry due to the small sample size.

FOCUS GROUPS

During the study, ICTC held two focus groups with ICT workers to validate early findings about the impact of automation on the technology labour market. One focus group was held virtually in November 2024 and the other was held in-person, in Toronto, Ontario in December 2024. The focus groups were attended by a total of six people. Participants listened to a short presentation summarizing early findings from the study and then worked through a series of discussion questions with an ICTC facilitator. The focus groups helped to validate early findings and ensure the research team was on the right track.

Secondary Research

LITERATURE REVIEW

To inform the development of the research materials and the final report, ICTC conducted a literature review of existing research on the AI tool availability and adoption in the global technology sector, including in Canada's technology sector; the impact of AI and automation on the labour market; the impact of AI tool adoption on the technology labour market; trends impacting Canada's technology labour market; and trends impacting the ability of students and new graduates to find employment in their field.

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