Report

Impact of Automation and AI on the Workforce in Quebec

Who are the most vulnerable workers?

January 2025

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Reasons for this study

The launch of ChatGPT in November 2022 unquestionably marks a major inflection point in the general public's perception of artificial intelligence (AI), transforming an abstract concept into an everyday tool and sparking a collective awareness of the imminent impact of AI on work and society.

There is nothing new, however, about reflecting on the future of work: in the early 2000s, many people were already wondering about the potential impact of IT on employment. In 2010, the focus was mainly on the platform economy and the "gig economy" (Uber, Airbnb, etc.). Today, the questions being raised revolve more around AI-induced automation in both the goods and services sectors.

To fully understand the current challenges of work transformation, we must first point out that, while the general public was exceptionally quick to embrace certain applications, such as ChatGPT, the full integration of AI into Quebec organizations has progressed rather gradually. This integration is dictated by the accessibility and costs of technologies, investments, user demand and the regulatory framework. What we are looking at is therefore an evolution rather than a technological revolution. These technologies are being integrated into a job market characterized by labour shortages and significant recruitment difficulties in some sectors. Replacing jobs offering less attractive pay and poorer working conditions can then be seen as an opportunity.

Every technological wave has aroused the same collective apprehension, namely workers' fears of potential machine replacement. And in each case, these predictions have hinted at a radical revolution in the short term; however, they have been wrong about the deeper – and longer-term – transformations that technologies bring about, such as the development of new valued skills, the transformation and creation of business models or their impact on productivity. Normally, however, such transformations are spread out over decades.

Experience has also shown that the most promising technologies – for society as a whole and private enterprise alike – are those that enhance human capabilities but do not replace them. AI will therefore be no exception to this rule.

It is against this background that the Future Skills Centre (FSC), with its mission of helping Canadians acquire the skills they need to stand out in a rapidly changing job market, approached the Institut du Québec (IDQ) to explore the concrete impact of AI on employment in Quebec.

Thanks to a first-time application to the Quebec context of an internationally proven methodology, the IDQ was able to identify which workers are most vulnerable to AI.

This analysis moves away from alarmist visions of massive job replacements to explore the actual transformations in the various occupations, as well as the opportunities and adaptation challenges that await Quebec businesses and workers in the years to come.

About us

About the Institut du Québec

The Institut du Québec is a non-profit organization that focuses its research and studies on the socioeconomic issues facing Quebec. It seeks to equip public authorities and the private sector with the tools they need to make informed decisions and thereby contribute to building a more dynamic, competitive and prosperous society.

This report was prepared by Anthony Migneault with the collaboration of Emna Braham, Simon Savard and Jean-Baptiste Vallantin-Dulac.

About the Future Skills Centre

The Future Skills Centre (FSC) is a forward-thinking centre for research and collaboration dedicated to driving innovation in skills development so that everyone in Canada can be prepared for the future of work. We partner with policymakers, researchers, practitioners, employers and labour, and post-secondary institutions to solve pressing labour market challenges and ensure that everyone can benefit from relevant lifelong learning opportunities. We are founded by a consortium whose members are Toronto Metropolitan University, Blueprint, and The Conference Board of Canada, and are funded by the Government of Canada's Future Skills Program.

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Summary

Artificial intelligence as an automation accelerator

- Artificial intelligence (AI) represents a new generation of technologies that differ from others by their potential to augment the capabilities of other automation technologies and thus make them more efficient and autonomous. One example is natural language processing systems that now boost conversational robot performance.
- AI is part of a constant stream of digital innovations; however, it could well become a disruptive technology because some of its applications, such as ChatGPT, have been adopted at remarkable speed – thanks in part to the fact that AI does not require any special skills. AI has the capability of performing certain tasks – and not just repetitive ones but also creative tasks and tasks previously carried out by humans – as well as the ability to create new business models.
- For the time being, there are a number of human activities that cannot be replaced by technology, particularly those requiring social intelligence, creativity or complex physical manipulations.

Beyond the risk of machine replacement: understanding occupational vulnerability

- Given the likelihood that many jobs will be transformed by AI in the coming years, the main concern for workers is that their jobs could disappear.
- In a labour shortage context, however, the real concern should be that some workers will be unable to make a career transition. These workers are described as vulnerable in this report since their jobs are at high risk of automation and they have few occupational options to quickly retrain for less threatened jobs.
- Thanks to a first-time application to the Quebec context of an internationally proven methodology for identifying these vulnerable workers, the Institut du Québec was able to estimate that approximately 810,000 people, or 18% of the province's workforce, are working or looking for work in 96 occupations currently vulnerable to automation. Here we are referring to automation through both robotization and AI applications.

- Young people aged 15 to 24 are more likely to work in sales and service jobs and are at greater risk. The situation is particularly concerning for those who do not continue their education and wish to pursue a career in these vulnerable jobs. Some 27% of adults over the age of 25 without a degree or diploma are employed in, or looking for work in, a vulnerable occupation.
- Although university graduates aged 25 and over are not entirely spared, they continue to have very little exposure: 8% are working in or looking for jobs in vulnerable occupations, even though new forms of generative AI capable of creating original content are exposing them to the risk of automation more than before. The advantage they hold is their ability to rely on their many transversal skills to facilitate occupational retraining if their jobs are robotized or if a large number of their tasks are automated.

Artificial intelligence could improve productivity... under certain conditions

- Artificial intelligence has the potential to improve Quebec's productivity. On the one hand, it can increase individual productivity by assisting humans in their tasks, such as helping them summarize long reports. On the other hand, AI also makes it possible to automate certain tasks and reallocate workers to higher value-added tasks.
- Such an increase in productivity would be timely for Quebec, which needs to be more productive in order to support its growth and reduce recruitment difficulties in a number of sectors.
- However, AI will not lead to increased productivity if it is adopted merely to replace humans and therefore maintain low value-added economic activities. Worse still, if AI does not re-skill vulnerable workers, such applications of this technology could potentially produce even more losers.
- The general public has been very quick to embrace some AI applications, such as ChatGPT. Quebec organizations, however, may take longer to transform their processes through the use of AI. For example, only 12% of Quebec companies are planning to use AI to produce goods or deliver services in the coming year.

Promising training and reskilling practices

- Unlike other technologies that often call for specific technical knowledge, the latest artificial intelligence applications provide democratized access because they are so easy to use. We can now simply speak to a computer, and it will carry out our commands.
- Such accessibility calls for a shift – rather than a reduction – in training needs. What is important now is that we train experts to create AI software solutions, train managers to integrate these solutions into their organizations and provide support to the most vulnerable employees in developing transversal skills to ensure their occupational adaptability.
- Recent practices implemented in Canada by the Future Skills Centre (as can be seen in a few examples in this report) include creating a mentorship centre that pairs some 5,000 health care workers with technology experts to promote the integration of AI into their innovation projects, or reskilling vulnerable retail employees for sales positions focused on customer interaction or on skills training for digital technology jobs in SMEs.

Courses of action

If organizations are to ensure that AI will be instrumental in augmenting Quebec's productivity, they should accelerate their investments in this technology to address labour shortages and reallocate their staff to more rewarding and value-added tasks.

To make workers more resilient, governments and their education and training partners should do a better job of factoring the retraining needs of working people into their training support measures – and not just the needs of the unemployed.

To better anticipate future needs, governments should systematically integrate the impact of new technologies into their labour requirement forecasts, which are used in particular to plan vocational and college training programs and immigration policies.

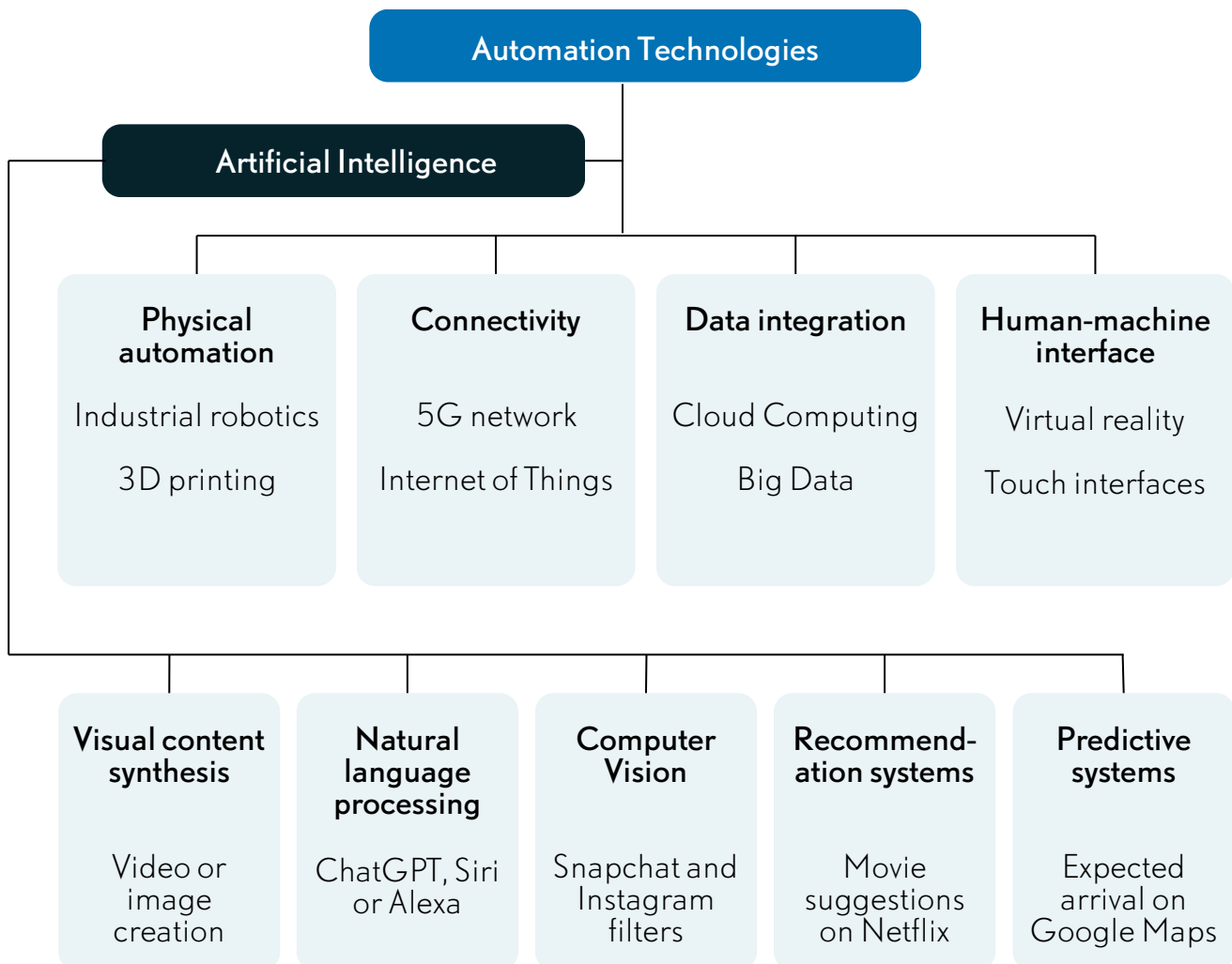# ARTIFICIAL INTELLIGENCE AS AN AUTOMATION ACCELERATOR

Key points

- Artificial intelligence (AI) represents a new generation of technologies that differ from others by their potential to augment the capabilities of other automation technologies and thus make them more efficient and autonomous. One example is natural language processing systems that now boost conversational robot performance.
- AI is part of a constant stream of digital innovations; however, it could well become a disruptive technology because some of its applications, such as ChatGPT, have been adopted at remarkable speed – thanks in part to the fact that AI does not require any special skills. AI has the capability of performing certain tasks – and not just repetitive ones but also creative tasks and tasks that were previously carried out by humans – as well as the ability to create new business models.
- For the time being, there are a number of human activities that cannot be replaced by technology, particularly those that require social intelligence, creativity or complex physical manipulations.

What is AI?

Artificial intelligence represents a new generation of technologies – new in that it has the ability to integrate with other automation technologies to make them more efficient and autonomous and endow them with decision-making capabilities (Chart 1). For example, AI can be integrated into an anomaly detector in the manufacturing sector and flag predictive and optimized maintenance needs for maintenance managers.

In contrast to technologies that follow pre-programmed rules, AI is characterized by its ability to discover data patterns on its own and improve its performance by learning from its experience. AI is often combined with other physical or software technologies that perform the tasks.

Chart 1 **Examples of automation technologies and artificial intelligence**

Automation Technologies

Artificial Intelligence

Physical automation	Connectivity	Data integration	Human-machine interface
Industrial robotics 3D printing	5G network Internet of Things	Cloud Computing Big Data	Virtual reality Touch interfaces

Visual content synthesis	Natural language processing	Computer Vision	Recommend-ation systems	Predictive systems
Video or image creation	ChatGPT, Siri or Alexa	Snapchat and Instagram filters	Movie suggestions on Netflix	Expected arrival on Google Maps

Source: Institut du Québec, McKinsey & Company (What are Industry 4.0, the Fourth Industrial Revolution, and 4IR?) and Google Cloud (What are AI Applications?).
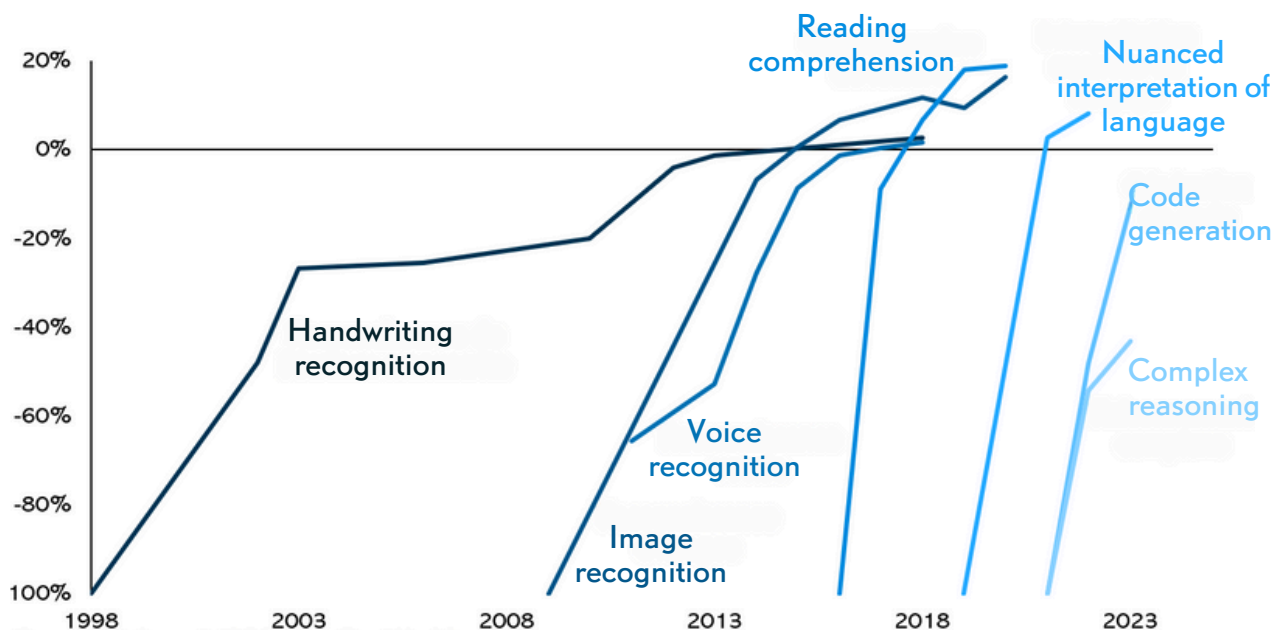
Will AI be a disruptive technology?

AI differs from earlier digital technologies in that it has a greater capacity to perform cognitive tasks that were previously reserved for human beings.

Initially, artificial intelligence was used largely for writing recognition and human voice recognition; then came objects and the environment in which we live (Chart 2). As technology advanced, it became possible for AI to understand and interpret written texts, speech and dialogue. The result is that we are now seeing AI carry out complex and non-repetitive tasks, such as the generation of computer code – and doing so as well as human beings.

Chart 2

AI performance on various tasks compared to humans
0% = performance equal to humans

Source: Kiela et al. (2023) via Our World in Data

Although AI forms part of a constant flow of digital innovations, it could well become a disruptive technology in the sense that it risks obsoleting certain tasks previously performed by humans and would allow the creation of new business models.

AI is an avenue that is being discussed more and more, not only because of its immense potential but also because its adoption has been so rapid, far outstripping that of other recent technologies (Chart 3). As proof, a U.S. household survey showed that 39% of 18- to 64-year-olds were using generative AI in August 2024, less than two years after the ChatGPT launch. By comparison, it took smartphones five years after their public launch in the U.S. to reach such a level of adoption.

A partial explanation for this phenomenon lies in the fact that the ChatGPT application was made available at no charge – and this motivated many people to test and then adopt it. Another possible explanation is that users can quickly take advantage of the application **without needing any particular technological knowledge. All they have to do is talk to it**.

Chart 3

U.S. household adoption rates for various recent technologies
Adoption rate vs. number of years since launch to the general public
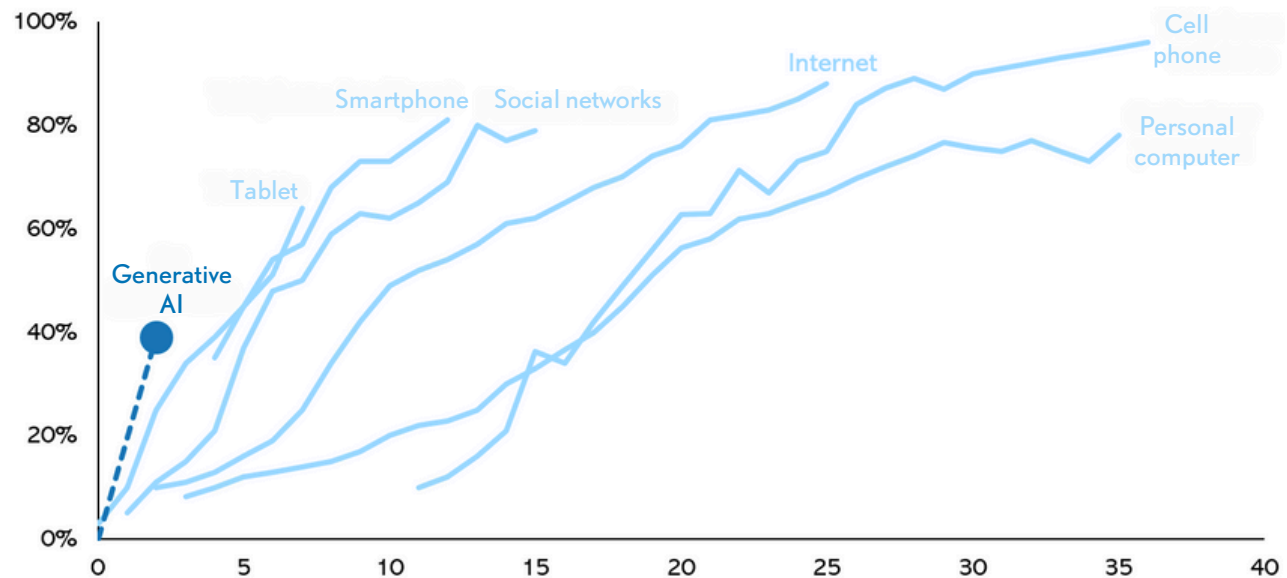
Sources : Institut du Québec, Bick et al. (2024) et Our World in Data

AI in our organizations: a complex transformation

Within organizations, however, artificial intelligence technologies for the production of goods and services are adopted according to a sequenced trajectory that stands in contrast to the general public's spontaneous enthusiasm for tools such as ChatGPT. There are a number of structuring factors that explain this evolution, such as the variable maturity levels of available technological solutions; budgetary considerations vis-à-vis the investments required; the level of organizational readiness; and users' specific needs.

Moreover, the integration of AI into organizations could be slowed down by current and future legislation governing technology adoption. Further reflection, especially of an ethical nature, is required in light of the proliferation of standards for regulating the use of AI, e.g., its use in applications that pose a risk to humans, such as crucial infrastructure management or assisted driving.

In Canada, the Artificial Intelligence and Data Act, proposed in 2022 as part of Bill C-27, aims precisely to establish requirements for the design, development and use of AI-based systems. More specifically, it would introduce measures to mitigate the risks of harm and biased outcomes, while also prohibiting certain AI practices that might cause serious damage to individuals. While this Act offers legitimate protections to the community, these same protections frequently need to be audited, documented and certified with the organizations that are integrating AI into their processes, and this in turn could slow down deployment and increase the costs of AI.

Ethical barriers ask fundamental questions about the impact of AI on society, particularly in terms of bias, fairness and respect for human rights. One manifestation of these barriers can be seen in workers' reluctance to have their employers integrate AI into their processes, or in consumers' reluctance towards AI-supported products. As is the case with any technological revolution, there are two coexisting issues, i.e., the fundamental ethical questions about the place of AI in our society and practical concerns about its direct impacts, particularly on employment.

How could the workforce be replaced?

The threat of machines replacing humans is nothing new, however. Long before the advent of artificial intelligence, some digital technologies had already played a role in downsizing organizations.

We need only think about the cash registers and ATMs that have replaced many cashiers in businesses and financial institutions. Today, thanks to artificial intelligence, we can go much further. Not only are these same tasks now automated, but they are also executed faster and with greater focus. In other areas, AI can even automate more complex cognitive tasks that were beyond the reach of earlier digital technologies. While still not very common in Quebec, interactive tables and waiter robots are already automating order-taking and table service in restaurants, for example. AI will even be able to make food recommendations in place of waiters and waitresses by referencing customers' histories and preferences through apps offered on their phones.

Table 1 provides concrete examples of how AI and other digital technologies could automate certain tasks inherent in some of the occupations analyzed in this study.

Table 1 Examples of automated tasks

Occupation	Automation technologies	Boosting automation through artificial intelligence
Cashiers	Self-service checkout with automatic payment and anti-theft verification	Virtual recognition systems for unbarcoded product identification
Waiters/waitresses	Interactive tables and food-delivering waiter robots	Automated ordering systems offering personalized recommendations based on customer history
Auditors	Continuous auditing software with automated verification of supporting documents	Automatic analysis of transaction anomalies and fraud detection
Manufacturing machinery operators	Centralized digital control systems and remote supervision	Machine-based predictive maintenance
Specialized livestock workers	Automated feeding and milking systems	Animal health monitoring through image and sound analysis

Source : Institut du Québec

While AI will be used to automate a number of tasks in the future, it is important to remember that there are still quite a few tasks that technology cannot handle. These involve the skills that slow down automation progress and are basically the same skills that impede existing technologies, i.e., social intelligence, creativity and the ability to perceive and manipulate space. For example, the social intelligence essential to the social worker field suggests that robots will not be able to carry out this type of work in the near future.

BEYOND THE RISK OF MACHINE REPLACEMENT: UNDERSTANDING OCCUPATIONAL VULNERABILITY

Key points

- With the likelihood that many jobs will be transformed by AI in the coming years, the main concern for workers is that their jobs could disappear.
- In a labour shortage context, however, the real concern should be that some workers will be unable to make a career transition. These workers are described as vulnerable in this report since their jobs are at high risk of automation and they have few occupational options to quickly retrain for less threatened jobs.
- Thanks to a first-time application to the Quebec context of an internationally proven methodology for identifying these vulnerable workers, the Institut du Québec was able to estimate that approximately 810,000 people, or 18% of the province's workforce, are working or looking for work in 96 occupations currently vulnerable to automation. Here we are referring to automation through both robotization and AI applications.
- Young people aged 15 to 24 are more likely to work in sales and service jobs and are at greater risk. The situation is particularly concerning for those who do not continue their education and wish to pursue a career in these vulnerable jobs. Some 27% of adults over the age of 25 without a degree or diploma are employed in, or looking for work in, a vulnerable occupation.
- Although university graduates aged 25 and over are not entirely spared, they continue to have very little exposure: 8% are working in or looking for jobs in vulnerable occupations, even though new forms of generative AI capable of creating original content are exposing them to the risk of automation more than before. The advantage they hold is their ability to rely on their many transversal skills to facilitate occupational retraining if their jobs are robotized or if a large number of their tasks are automated.

Who is vulnerable to automation?

In recent years, a number of authors have repeatedly pointed to the threat that certain new digital technologies could automate tasks, or even outright replace workers in some occupations. An analysis by the C.D. Howe Institute estimated that nearly one third of jobs in Quebec were at high risk of automation.

This means that a good many workers considered at high risk of replacement by new technologies will have to change careers. However, some of these workers will not require lengthy retraining to take on other jobs with similar conditions, but with a lower automation risk. This is particularly true of translators, whose profession has been threatened by the advent of large-scale language models (Chart 1). Based on text comprehension and analysis, this form of AI technology has significantly enhanced the performance of translation software. In fact, these applications have been gradually taking the place of translators for several years now. That said, one possibility for these translation experts would be to use their skills and language proficiency to become teachers.

Automation can pose a much more definitive threat, however. This is especially true when occupational retraining for jobs less threatened by automation is more difficult or even impossible. This phenomenon can already be observed in hotels where receptionists have been replaced by an automated reception service.

The most vulnerable workers are those in occupations with a high risk of automation and who are unable to quickly change careers. Our study analyzes this group of workers – also known as the vulnerable workforce - for the first time (Chart 4).

Moreover, workers seem to be well aware that employment vulnerability today has more to do with their inability to re-skill than with the disappearance of jobs themselves. In 2023, only 20% of Canadians believed that their jobs might be threatened by technological changes and climate change, while 37% stated that it was their job tasks that would be affected and that they would need training.

High risk of automation

Workforce vulnerable to automation

Low occupational mobility

High occupational mobility

Low risk of automation
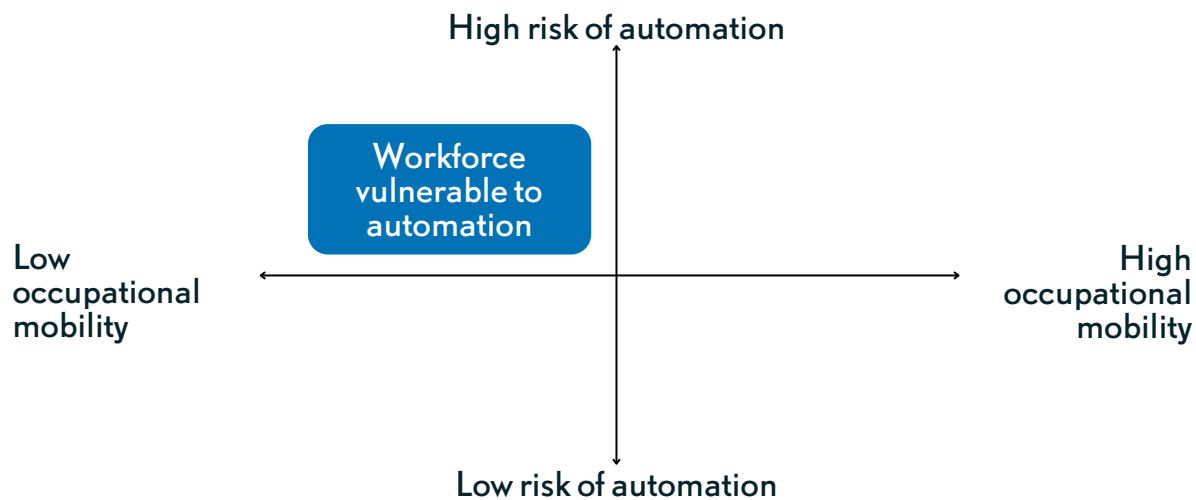
Source : Institut du Québec

Measuring job vulnerability to automation

The Institut du Québec drew on the widely cited work of Frey and Osborne (2013), also used by the OECD (2019), to gain a better understanding of how automation is impacting employment in Quebec. The methodology of these two researchers is well recognized and has been put to the test internationally. Thanks to this first-time application to the Quebec context, we were able to identify the most vulnerable workers in Quebec. Here we are referring to automation through both robotization and AI applications.

To achieve this, the authors of our report first targeted those occupations that, according to the methodology proposed by Frey and Osborne (2013), are likely to be more than 70% automated in the foreseeable future. From this number they extracted the occupations for which an automation-induced career transition is considered "acceptable" according to the OECD, i.e., when such a transition represents or requires:

- No more than six months of training to enable a worker to fill a job that is not at high risk of automation
- A modest increase in literacy and numeracy skills
- Similarities in the skills required (e.g., technology or management and communication skills)
- At least one field of study also required for the current job
- A salary reduction of less than 10%
- Limited overqualification in literacy and numeracy skills

This exercise made it possible to identify 96 occupations potentially posing a threat to Quebec workers. Calculations were also made to determine the number of at-risk people and analyze the most exposed demographics and industries. Data from the 2021 Census and compilations provided by Statistics Canada were used to paint this picture. The Appendix contains further details on the methodology used.

Some 18% of Quebec's workforce is vulnerable to automation

First of all, this analysis tells us that 18% of Quebec's working population can be considered part of the workforce vulnerable to automation. According to the 2021 Census, this would translate to some 810,000 people working mostly in the sales and services sector (Chart 5), such as cashiers or waiters and waitresses. Workers in the business, finance and administration sector, such as administrative assistants and auditors, are also at risk.

A completely different picture emerges, however, when we analyze the share, rather than the number, of vulnerable jobs by major occupational categories. Such an analysis shows that 59% of people working in manufacturing and public utilities are the most threatened by automation (Chart 6). This is the case, for example, for manual labourers and machine operators, many of whose tasks could potentially be automated.

Interestingly, no vulnerable occupations whatsoever are found in education, social and community services and in the arts and culture sectors. These occupations often require skills that cannot be fully automated, and when there is an occasional exception to this generalization, career transitioning is not especially difficult, according to the methodology used in our study.

Researchers Frey and Osborne also made the observation that within the same occupational category, the risk of vulnerability could vary considerably depending on the occupation. For example, within the sales and service sector, there are some jobs that are either highly likely (e.g., cashiers) or highly unlikely (e.g., hairdressers) to be automated. By way of comparison, there would appear to be a more even distribution of automation risk in the business, finance and administration sector.

Chart 5

Vulnerable workforce in Quebec by occupational category
Number of vulnerable people

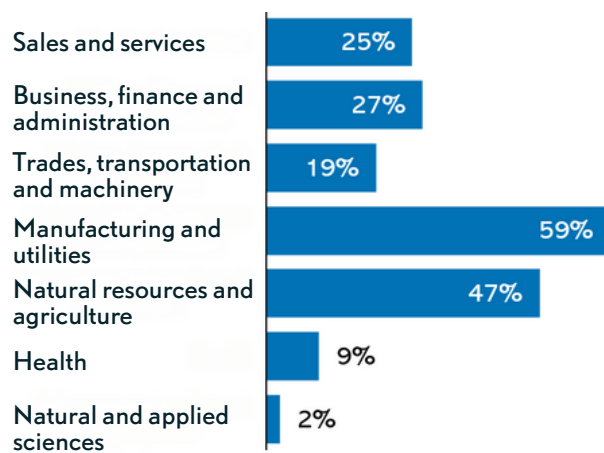| Category	Value
Sales and services	266 205
Business, finance and administration	208 760
Trades, transportation and machinery	132 140
Manufacturing and utilities	122 490
Natural resources and agriculture	40 565
Health	32 635
Natural and applied sciences	8 360
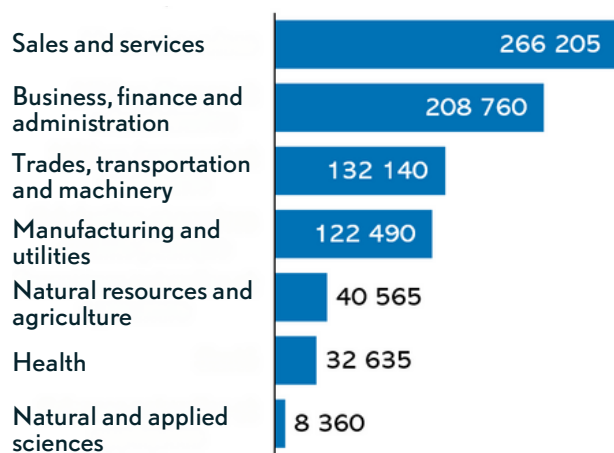
Source: Statistics Canada, Table 98-10-0449-01

Chart 6

Vulnerable workforce in Quebec by occupational category
Share of workforce in each category

Category	Value
Sales and services	25%
Business, finance and administration	27%
Trades, transportation and machinery	19%
Manufacturing and utilities	59%
Natural resources and agriculture	47%
Health	9%
Natural and applied sciences	2%

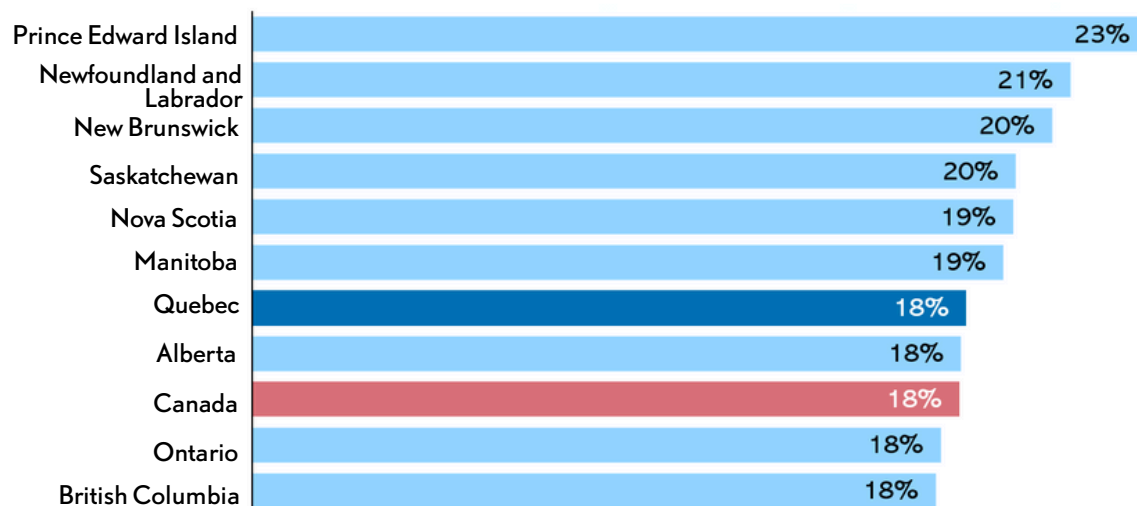Source: Statistics Canada, Table 98-10-0449-01

Will Quebec fare better than elsewhere?

This IDQ study also indicates that, as far as automation vulnerability is concerned, the risk average for Quebec and Canada as a whole is the very same (Chart 7).

In fact, most Canadian provinces show a very similar exposure to job automation risk, a finding echoed in the C.D. Howe Institute work mentioned earlier. This similarity can be explained by the fact that the most vulnerable occupations in each province's economy carry a similar weight. In other words, and relatively speaking, the number of administrative assistants would be largely the same from one province to another, for example. This is especially true in the more populous provinces of Quebec, Alberta, Ontario and British Columbia.

Chart 7

Share of vulnerable workers in total employment by province and in Canada

Province	Value
Prince Edward Island	23%
Newfoundland and Labrador	21%
New Brunswick	20%
Saskatchewan	20%
Nova Scotia	19%
Manitoba	19%
Quebec	18%
Alberta	18%
Canada	18%
Ontario	18%
British Columbia	18%

Source: Statistics Canada, Table 98-10-0449-01

Automation vulnerability by demographics

The analysis reveals that a few demographic groups in some vulnerable occupations are overrepresented. This section paints a picture of the situation and offers some avenues for analysis.

Women
Although women make up 48% of Quebec's workforce, they account for 52% of workers vulnerable to automation. It is true that many women are spared this vulnerability, especially those working in the health, education and social services sectors, such as childcare; however, they are particularly affected and over-represented in some occupations, especially administrative assistants and receptionists who are exposed to AI automation.

Men
Men are less vulnerable than women. They make up 52% of Quebec's workforce and account for 48% of workers vulnerable to automation.

There are, however, a few automation-vulnerable occupations in which men are over-represented, e.g., machining and tooling inspectors, among others.

Immigrant population
While immigrants represent 26% of Quebec's workforce, they account for 17% of workers vulnerable to automation. The analysis also tells us that recent immigrants, i.e., those who arrived in Canada between 2011 and 2021, are not more affected by automation than immigrants who have been here longer. This population group would appear, however, to be slightly over-represented in some occupations, i.e., occupations with greater exposure to automation risk because of manufacturing sector robotization, such as manual labourers or cutting supervisors in the textile industry.

Visible minorities
Visible minorities represent 15% of the Quebec workforce and account for 16% of the vulnerable population. These workers are generally over-represented in the same manufacturing occupations as immigrants.

Experienced workforce
Experienced workers (55 years and older) represent 23% of the active workforce in Quebec and account for 24% of workers vulnerable to automation. They are over-represented in the administrative assistant and auditor occupations.

Forecasts are divided, however, as to the threats posed by the adoption of AI for this population group. Some experts believe that their wealth of experience could protect them from the risks of automation – at least those workers in strategic jobs requiring skills that AI would not be able to replace. On the other hand, a U.S. survey indicates that employers apparently tend to hire younger applicants for AI-supported jobs, with 90% giving greater consideration to applicants under the age of 35 and only 32% hiring people over 60 for such jobs. This means that experienced workers may not benefit as much from AI-related job creation as young people.

Young people

Although workers aged 15 to 24 represent only 13% of Quebec's active workforce, they nevertheless make up 24% of workers vulnerable to automation. Young people are over-represented in some occupations, such as cashiers, waiters and waitresses.

A high automation risk for young people... who are not pursuing their education

We also learn from the analysis that the impact of automation on young people may be only a transitory phase in their working lives. In fact, many hold jobs that are more at risk of automation only during the time they are students working to pay for their living expenses, or while waiting to find a job more related to their field of study and skill levels. In these cases, the elimination of such jobs could have only a one-time effect on their incomes.

However, young people who are not in school and who have permanent high automation risk jobs or who are just starting their careers face quite a different reality. Depending on their experience and skills, some could be hired to work at entities with a lower risk of automation. For example, young waiters and waitresses might opt for a restaurant where social intelligence is a more sought-after skill. If they are unable to capitalize on this skill, however, the risks of automation would become very real for them. This possibility therefore calls for skills development policies that reach out to young people who are out of school.

The impact of AI on youth employment could, however, go far beyond automating certain student jobs. Entry-level positions usually held by young professionals might not be completely eliminated but could well become scarcer. For instance, some companies are already planning to slow down the recruitment of data entry employees, copywriters and apprentice designers and developers.

Paradoxically, this technological transformation could also benefit some of the young people obtaining these entry-level positions. Their knowledge of AI, often acquired during their training, could well enable these youth to differentiate themselves and accelerate the closing of the productivity gap with experienced workers.

A post-secondary degree provides substantial protection against automation risks

The degree of automation vulnerability for people over 25 will be determined to a greater extent by their levels of education. The reason for this is that most of them have already left school and are facing financial constraints that make a return to school difficult, even though further studies are sometimes necessary for an appropriate career transition.

Not surprisingly, however, the most vulnerable workers are those who lack qualifications (Chart 8). For example, these people may occupy jobs that can be automated by robotizing physical tasks, such as those carried out by certain manual labourers, or through artificial intelligence, such as customer service jobs.

Although these workers are exposed in part because of the nature of their work, their vulnerability is primarily attributable to the greater difficulty they face in quickly relocating to other jobs less at risk of automation.

Conversely, college and university graduates are less likely than the Quebec average to hold vulnerable jobs.

Chart 8

Proportion of the vulnerable workforce over 25 years of age in Quebec by highest level of education
Share of the workforce by highest level of education attained
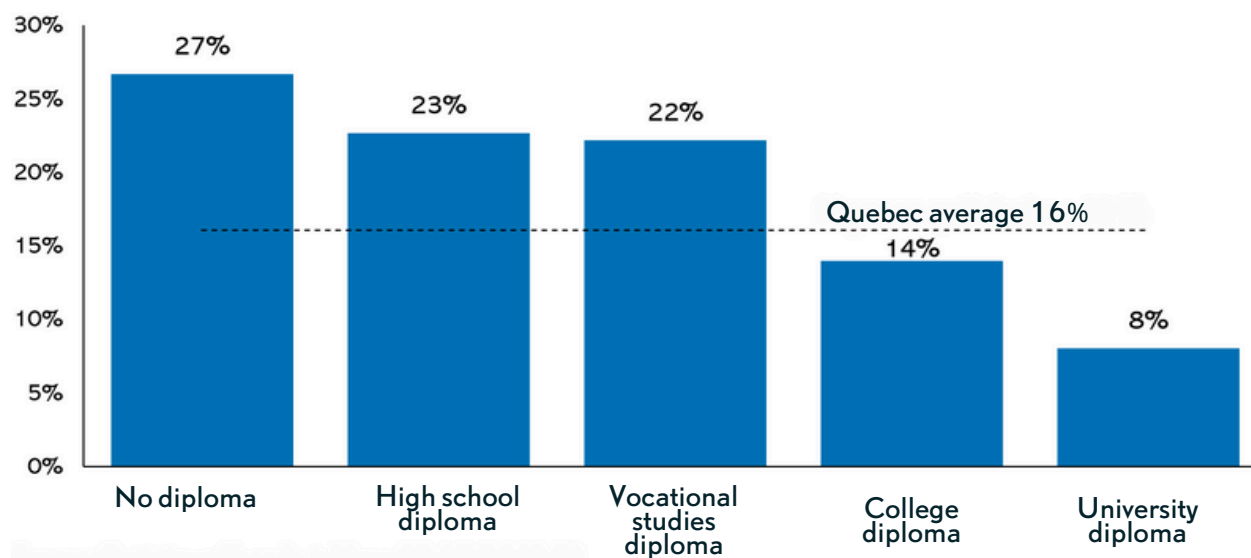
Source: Statistics Canada, Table 98-10-0449-01

Post-secondary graduates are not entirely immune

When we take into consideration only adults aged 25 and over, the analysis reveals that those employed in sales and services are no longer the most vulnerable workers in Quebec. Now it is people working in the business, finance and administration sector (Chart 9) who are the most exposed, with administrative assistants and auditors at the top of the list.

Administrative assistants are thus vulnerable to automation even though they have a vocational or college diploma. The same is true for auditors, a third of whom hold a university degree. This is proof that a post-secondary degree no longer completely shelters people from the risks of automation.
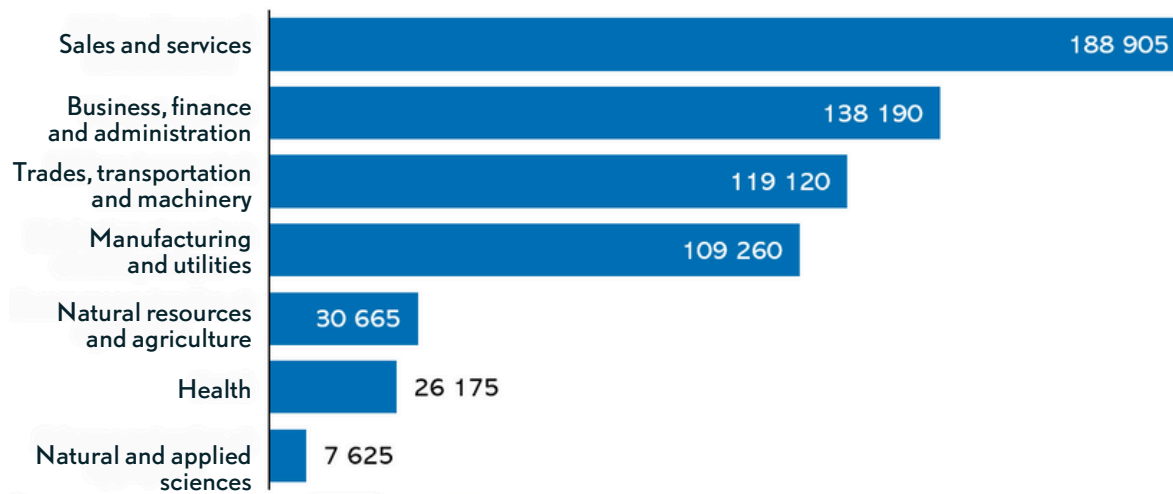
Most importantly, considering the newer forms of generative AI with their capacity to create original content such as text, images or code, we can say that the impact of automation might be more keenly felt by more educated workers.

However, while many occupations held by post-secondary graduates are now exposed to AI, a good number of these occupations remain "complementary" with the technology, according to the authors of a Statistics Canada study. Human supervision is thus still required for these occupations, in particular because of the important decisions involved or the consequences of a potential error. This is the case, for example, with judges or doctors, for whom AI is seen more as a decision-making tool than as a threat of possible replacement.

AI technology would therefore have the effect of adding value to their professions rather than eliminating them. Finally, the Statistics Canada study points out that it is also academics who would adjust more easily by transitioning to positions with a lower automation risk or with greater complementarity. For instance, translators could leverage their language expertise to move into high school or college teaching, thus lowering their vulnerability to technology.

Chart 9

Vulnerable workforce in Quebec among those aged 25 and over by major professional category

Category	Value
Sales and services	188 905
Business, finance and administration	138 190
Trades, transportation and machinery	119 120
Manufacturing and utilities	109 260
Natural resources and agriculture	30 665
Health	26 175
Natural and applied sciences	7 625

Source: Statistics Canada, Table 98-10-0449-01

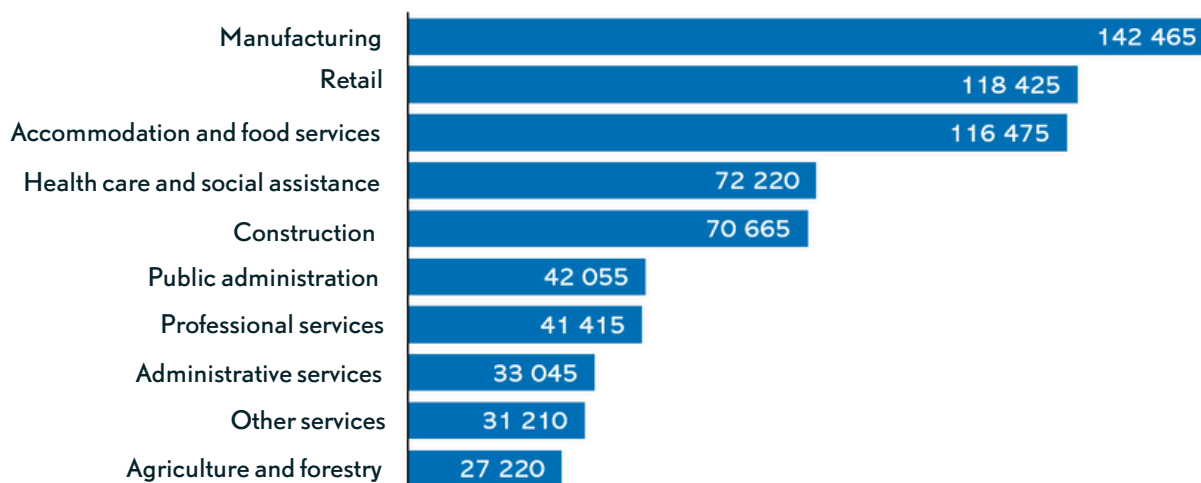## Employers also need to prepare for the transformations to come...

Studying vulnerability by industry rather than by occupation also allowed the Institut du Québec to identify those sectors whose processes are the most likely candidates for transformation as automation is deployed.

Using this perspective, the analysis points to manufacturing as the Quebec sector with the largest number of workers exposed to automation (Chart 10). This is because robotization threatens many jobs specific to this industry, such as machining and tooling inspectors. In addition to these jobs, there are other vulnerable jobs, such as administrative assistants or auditors, which can be found in all industries.

Chart 10

Sectors with the highest workforce vulnerability to automation in Quebec
Number of workers

Sector	Value
Manufacturing	142 465
Retail	118 425
Accommodation and food services	116 475
Health care and social assistance	72 220
Construction	70 665
Public administration	42 055
Professional services	41 415
Administrative services	33 045
Other services	31 210
Agriculture and forestry	27 220

Source: Statistics Canada, 2021 Census of Canada (special compilation)

ARTIFICIAL INTELLIGENCE WILL ENHANCE QUEBEC'S PRODUCTIVITY... UNDER CERTAIN CONDITIONS

Key points

- Artificial intelligence has the potential to improve Quebec's productivity. On the one hand, it can increase individual productivity by assisting humans in their tasks, such as helping them summarize long reports. On the other hand, AI also makes it possible to automate certain tasks and reallocate workers to higher value-added tasks.
- Such an increase in productivity would be timely for Quebec, which needs to be more productive in order to support its growth and reduce recruitment difficulties in a number of sectors.
- However, AI will not lead to increased productivity if it is adopted merely to replace humans and therefore maintain low value-added economic activities. Worse still, if AI does not re-skill vulnerable workers, such applications of this technology could potentially produce even more losers.
- The general public has been very quick to embrace some AI applications, such as ChatGPT. Quebec organizations, however, may take longer to transform their processes through the use of AI. For example, only 12% of Quebec companies are planning to use AI to produce goods or deliver services in the coming year.

What is the great appeal of productivity promises?

In Quebec, AI task automation is attracting substantial interest because of its potential to increase organizational efficiency – a particularly crucial issue in a context of aging populations, labour shortages and stagnant productivity. Higher productivity would enable businesses to produce more with fewer resources, thus helping to improve people's living standards.

On the workers' side, the benefits of automation are already being felt. AI promises to lighten certain repetitive or more difficult tasks, such as literature searches or data entry. It can also improve working conditions through error reduction and by enabling employees to focus on more rewarding tasks requiring judgment and creativity.

There is no question, however, that it will take some time for these productivity gains to be reflected in macroeconomic data. Therefore, as has been seen with other major technological innovations, many years or even decades may elapse before the benefits of AI appear significantly in productivity indicators. This sought-after productivity increase could be delayed by constraints such as the uneven adoption of AI technologies, the concentration of benefits in a small number of large companies and a certain slowness in carrying out this necessary reorganization of business processes.

How will AI improve business and workforce productivity?

Artificial intelligence offers a host of solutions to help employees perform their daily tasks more productively. For example, the use of AI enables them to write better and higher quality emails or reports and thus allows them a greater amount of time to spend on more productive tasks.

A recent study by The Conference Board of Canada cites promising experiences of businesses that have turned to AI-powered solutions to improve their productivity. One company uses artificial intelligence to adapt its marketing content to various social networks while another relies on an AI-supported conversational system to speed up regulatory information searches.

The Vitrine AI Québec also features a host of case studies demonstrating the technology's immense productivity potential. One example describes a tool offered by a Quebec company to more efficiently select patients for Alzheimer's and cardiology clinical trials, thus avoiding unnecessary costs for research teams. Another company specializes in travel price forecasting, such as for airline tickets and hotel rooms, and relies on AI to improve its forecasting models and stand out from its competitors.

AI can also be used to optimize corporate business processes. Machine learning algorithms now have the ability to analyze large quantities of data to quickly identify inefficiencies and recommend improvements. In the logistics sector, AI can be used, for example, to optimize delivery routes, thus reducing costs and transport time. AI also fosters better decision-making by providing accurate forecasts and pointing to new data trends. Thanks to these advances, retail sector companies are better able to manage their inventories, and companies in the finance sector are able to gain a competitive edge on the financial markets.

The AI productivity promise

Generative AI has the potential to increase Canada's GDP by 2% according to a recent Conference Board of Canada study; however, these forecasts are likely to take some time before they become reality. In this same vein, an OECD report points out that AI's effects on productivity might be slow to fully materialize at the macroeconomic level. This is because of the uneven adoption of technologies by various business sectors, and consequently the need for them to make additional investments in reorganizing their business processes and training their workers.

For its part, the Canadian Chamber of Commerce stresses that AI could help increase labour productivity by 1% to 6% over the next decade; it fears, however, that not all businesses will benefit equally from the technology. Once again, larger, well-financed companies might be able to take better advantage of these improvements. With fewer resources, SMEs could find themselves lagging behind, facing difficulties in accessing the tools and skills they need to reap the full benefits of AI.

Two possible paths for AI deployment and its impact on productivity

A number of conditions still need to be met if the promises of AI productivity are to be realized. First, the consequences of AI deployment are still uncertain and can take two distinct paths (Chart 11):

Complementary AI: In this first scenario, AI creates new tasks and activities in which humans intervene productively. It also helps to boost labour productivity. We can then come up with AI tools that support workers by executing their tasks more quickly or by improving the value of the service offered.

AI substitution: In this second scenario, AI is used strictly to automate tasks previously performed by human beings.

In a labour scarcity context, AI substitution can positively impact productivity by automating certain less rewarding tasks and reallocating workers to higher value-added tasks. The concern among some experts, however, is that AI might be used more as a way to replace humans. The potentially harmful consequences of this scenario could lead to significant employment disruptions – or disruptions that come too quickly – because it fails to offer retraining solutions to the people affected or ways for them to integrate into a more productive occupation that has less exposure to automation.

Chart 11   Possible paths for AI deployment in Quebec
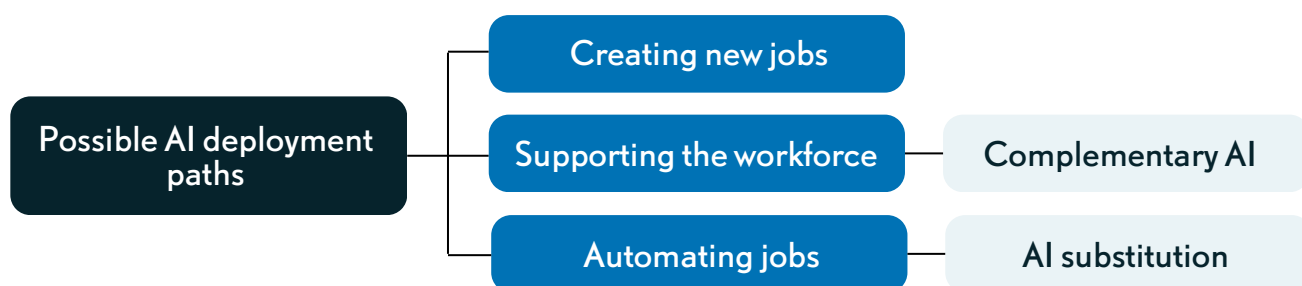
Source : Institut du Québec

Barriers to adopting productivity-enhancing AI

There are a number of barriers to the deployment of AI for productivity growth. Table 2 provides several examples and describes some conditions that could result in AI worker replacement. In short, company inertia, regulatory frameworks and education systems are the primary obstacles that might considerably limit the potential benefits of productivity.

Table 2 Barriers to adopting productivity-enhancing AI

Major risks	Examples
Slow business adoption of AI	AI deployment is limited to large businesses or a few industries.
	Businesses are unable to create new work processes that would allow them to take full advantage of AI.
	Workers resist AI deployment for fear of losing their jobs.
Technical and regulatory difficulties	AI and AI applications are not developing as quickly as anticipated, thus limiting productivity gains.
	AI deployment is being slowed down in some sectors, such as health or transportation, by the legal and regulatory framework.
	AI models are becoming increasingly complex, making development costs prohibitive for many businesses that would like to develop competitive models. This, in turn, limits competition.
AI development overly focused on automation	AI is still used primarily to replace workers but it creates few new productive tasks.
	Workers are offered few opportunities for on-the-job training in other, more productive occupations that are less exposed to automation.

Source : Institut du Québec et FMI, Artificial intelligence – What AI means for economics, Available here.

AI will also inevitably create new jobs

Artificial intelligence sometimes allows businesses to increase their service offering without needing to hire additional staff. Such a possibility has led 67% of Quebec businesses to believe that AI will have a neutral impact on employment. Some 14% even believe that this technology will contribute to an increase – rather than a decrease – in the number of jobs (10%).

Another avenue to consider: AI also enhances the employment prospects of digital transformation professionals who provide digital transformation services. These new AI-powered services require in-depth expertise to help businesses take full advantage of this technology. For example, software development engineers and designers will now be called upon to create customized applications for companies wishing to provide automated customer service that reflects their brand image. Job creation in these highly productive fields could also boost Quebec's productivity.

It should be noted, however, that even in the IT field, some support jobs could be partially or fully automated since AI is able to facilitate interactions with technologies.

Finally, some authors argue that the effects of productivity can offset the impact of automation on employment and thus limit potential job losses, or even cancel out these effects entirely. More tangibly, since AI-related technologies offer a cheaper solution for carrying out some tasks, businesses would be able to offer more services at lower costs. This increased production could then lead to a greater demand for staff to complete tasks that cannot yet be automated.

Mechanisms that limit AI substitution

When surveyed about the risks of AI job automation, academic researchers interested in the phenomenon predicted that such risks will be generally lower than feared by the public. More importantly, they anticipate a longer deployment time for such automation than the general public. In practice, it is therefore a safe bet that these jobs will be replaced by attrition, e.g., when incumbents retire, and that AI technology will be used first to fill vacant positions.

In this regard, the MIT-IBM Watson AI Lab believes that very few jobs will be entirely replaced by AI because many involve tasks that AI will not be able to automate. Moreover, the authors who inspired our study on identifying high automation risk occupations recently stated that AI automation faces basically the same barriers as earlier digital technologies.

Finally, we need to understand that AI mainly automates specific tasks and not jobs in their entirety. The impact of AI on jobs is therefore not an all-or-nothing issue, and the fact that a job may be somewhat affected by AI does not necessarily mean that it will disappear. The reality is that new technologies are gradually reducing the need for staff to perform certain tasks within an occupation. For example, although a number of cashiers have already seen their jobs replaced by automated checkouts, stores still make at least one person available to solve machine errors or help customers adapt to the new procedure and facilitate the transition. In other words, while AI can automate the vast majority of cashier tasks, it has not completely eliminated this occupation. Instead, it has had the effect of shifting needs and calling for the development of other skills.

Generally speaking, a job is not limited to a single task or skill but encompasses a variety of different activities. When this task diversity within the same occupation was taken into account, researchers found that the impact of automation on employment would be approximately four times less than generally anticipated.

Moreover, as AI evolves, it is transforming the nature of work in unexpected ways. While this technology takes on more and more analytical tasks, it paradoxically elevates the value of other skills. For example, in the services sector, such qualities as intuition and empathy are becoming increasingly important for employees.

Supporting workers to ensure productivity gains

Digital technologies will not be able to fully automate the jobs of the vast majority of workers. It is therefore a safe bet that AI will be most transformative in helping them perform their tasks better. In other words, technology is usually more about enhancing job quality than about actually eliminating jobs.

Nevertheless, we will need policies and regulations to guide the development of complementary AI, rather than allowing market forces alone to dictate an uncertain trajectory. Will businesses and universities also have the power and a role to play in this shift? Table 3 summarizes the conditions that decision-makers will need to meet if AI is to develop along a desirable trajectory.

Table 3 Key conditions to ensure that productivity-enhancing AI becomes a reality

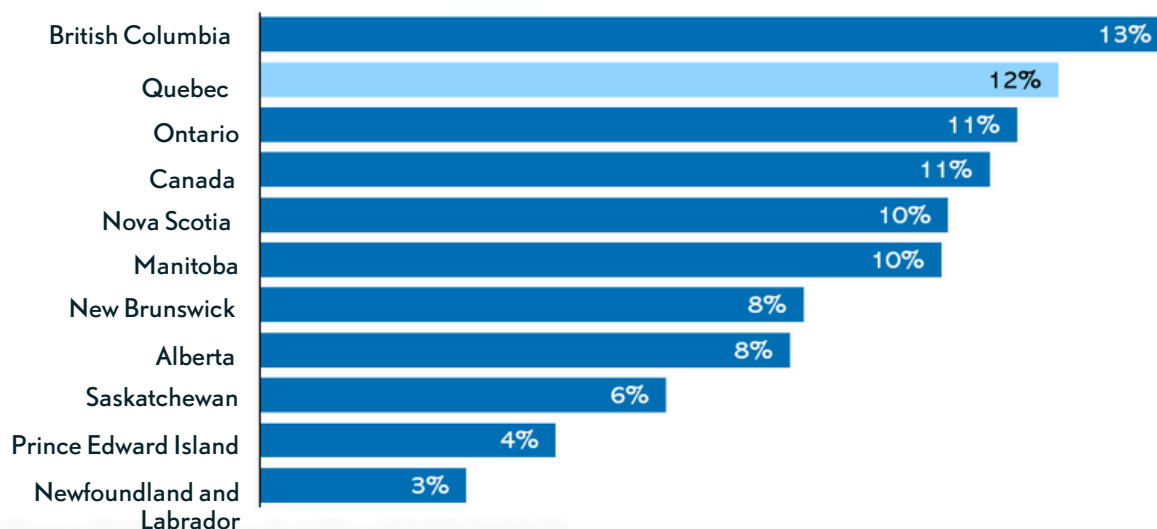| Key conditions	Examples of practices
Adopt policies and regulations promoting AI development that will complement workers' jobs.	Introduce risk-mitigating measures to ensure that AI models used by businesses produce unbiased results and prohibit certain AI practices that may cause serious harm to individuals.
	Promote staff participation in developing new work processes to better identify opportunities for productivity through complementarity.
	Develop AI expertise within governments by setting up in-house teams of experienced consultants.
Develop workers' skills and the training programs required to impart these skills.	Develop and design science, technology, engineering and mathematics curricula in anticipation of transformation and growing needs.
	Provide training to managers and staff to support them in deploying AI and promoting its use.

Source: Institut du Québec and IMF, Artificial intelligence – What AI means for economics. Available here.

Some businesses have already taken the plunge

Although very few businesses in Canada have yet begun capitalizing on AI to produce goods and provide services, Quebec looks set to become a leader in this area (Chart 12), with the technology and professional services sectors leading the way. When asked about their intentions to adopt artificial intelligence applications over the next year, Quebec companies ranked second in Canada. In this regard, however, it should be noted that, according to a BDC study, many Canadian businesses are actually using AI-powered tools already – but without necessarily realizing it. The primary barrier to AI adoption in Quebec companies would seem to be their failure to identify the operational needs that could be met by AI.

Chart 12

Companies planning to use AI to produce goods or provide services in the next 12 months
Proportion of companies surveyed, third quarter of 2024

Region	%
British Columbia	13%
Quebec	12%
Ontario	11%
Canada	11%
Nova Scotia	10%
Manitoba	10%
New Brunswick	8%
Alberta	8%
Saskatchewan	6%
Prince Edward Island	4%
Newfoundland and Labrador	3%

Source: Statistics Canada, Table 33-10-0878-01

The vast majority (73%) of Canadian businesses that are not planning to use AI in the next year believe that the technology is not relevant to the goods they produce or the services they offer. However, this belief flies in the face of the scientific literature or the forecasts of AI experts.

We therefore have every reason to think that a number of steps are still required before Canadian businesses and employees will be convinced of AI's full potential to increase their productivity. This a conviction is also directly linked to skills development: two thirds of Quebec businesses recognize the need to train current employees in the use of AI in order to integrate this technology into their production, while more than half say they need to develop new work processes.

PROMISING TRAINING AND RETRAINING PRACTICES

Key points

- Unlike other technologies that often call for specific technical knowledge, the latest artificial intelligence applications provide democratized access because they are so easy to use. We can now simply speak to a computer and it will carry out our commands.
- Such accessibility calls for a shift – rather than a reduction – in training needs. What is important now is that we train experts to create AI software solutions, train managers to integrate these solutions into their organizations and provide support to the most vulnerable employees in developing transversal skills to ensure their occupational adaptability.
- Recent practices implemented in Canada by the Future Skills Centre (as can be seen in a few examples in this report) include creating a mentorship centre that pairs some 5,000 healthcare workers with technology experts to promote the integration of AI into their innovation projects, or reskilling vulnerable retail employees for sales positions focused on customer interaction or on skills training for digital technology jobs in SMEs.

Training to ensure full benefit from AI and workforce resilience

Many applications now allow for natural interactions with generative AI through speech or text; this makes such applications much more accessible and user-friendly than traditional technologies that more often require technical expertise. Such ease of use does not, however, diminish the importance of training but simply calls for a different type of training: while it is indeed essential to train experts to create these tools, there is also a need to train managers in how to maximize the tools' strategic potential and to help employees with the greatest exposure to change become more occupationally adaptable.
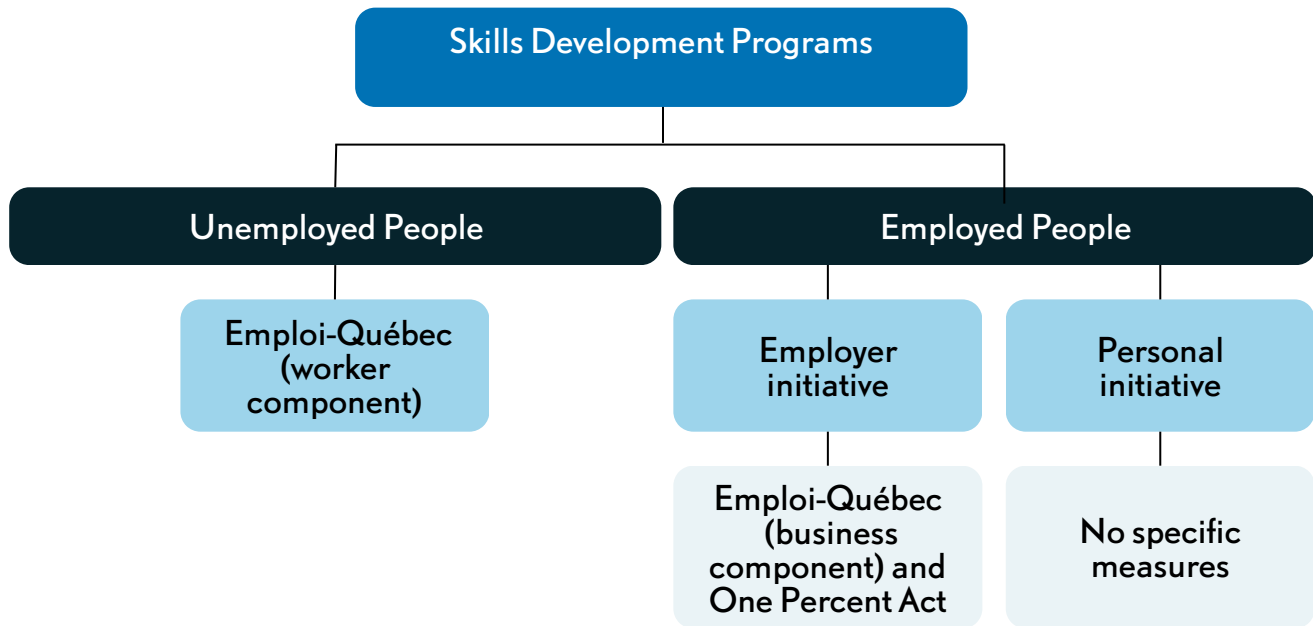
A trained workforce is in a better position to take advantage of changing job opportunities over time because enhancing workers' skill levels makes them more resilient to labour market changes, particularly to technological advances. Pre-service training plays a key role in ensuring that young graduates have the skills the labour market is looking for and that they can adapt if these skills change.

While post-secondary graduates are also exposed to automation, they are better protected than other workers. On the one hand, the nature of their work does not often lend itself to full automation and, on the other hand, these graduates are also better positioned to hold other jobs because they possess more transversal skills.

It's also worth noting that more highly skilled workers <u>are more likely</u> to undergo training over the course of their careers. And it is precisely this willingness to retrain throughout their working lives that enables these workers to adapt to job market changes – which, in turn, enables organizations to take better advantage of emerging technologies and innovations. Thus, not only does training increase labour mobility, but it is also becoming more than ever a real tool for economic development.

Promoting training throughout employees' working lives

Quebec has a rich skills development ecosystem, with many programs available to fund and foster it. Not only are there a number of measures designed to promote training and support for unemployed people, but employers can also train their workers in ways that meet business priorities. Unfortunately, however, there are few measures in place in Quebec to encourage and fund training for workers wishing to take continuous training programs other than those offered by their employers (Charter 13). Moreover, since automation is likely to cause a part of the workforce to shift towards other occupations, workers need to have greater control over their skills development.

Chart 13 Overview of the main skills development programs offered in Quebec

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                    ┌─────────────────────────────────────┐
                    │     Skills Development Programs      │
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              ┌────────────────────┴────────────────────┐
    ┌───────────────────────┐              ┌───────────────────────┐
    │   Unemployed People   │              │    Employed People    │
    └───────────────────────┘              └───────────────────────┘
                │                        ┌──────────┴──────────┐
    ┌───────────────────────┐  ┌──────────────────┐  ┌──────────────────┐
    │    Emploi-Québec      │  │     Employer     │  │     Personal     │
    │      (worker          │  │    initiative    │  │    initiative    │
    │     component)        │  └──────────────────┘  └──────────────────┘
    └───────────────────────┘          │                    │
                              ┌──────────────────┐  ┌──────────────────┐
                              │   Emploi-Québec  │  │                  │
                              │    (business     │  │   No specific    │
                              │  component) and  │  │    measures      │
                              │  One Percent Act │  │                  │
                              └──────────────────┘  └──────────────────┘
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Source : Institut du Québec

The Future Skills Centre has supported a number of training initiatives for which certain success factors have been identified, notably those factors that can help workers take full advantage of AI, or re-skill when faced with the risks of automation. It should be noted, however, that many of these initiatives have not yet been formally assessed because they are still ongoing.

Promising practices to help workers take full advantage of AI

Example 1 : Accelerating the adoption of artificial intelligence in healthcare
Project scope: Across Canada ($1,520,000)

Context

AI-based clinical decisions are multiplying in the field of medicine and clinical care, from dermatology, radiology and pathology to health management and symptom monitoring. However, AI best practices in healthcare may remain misunderstood for a long time in some health facilities where professionals have yet to receive adequate training in the effective and safe use of this technology. The apprehension these workers have towards AI technology is twofold: they fear its impact both on their jobs and on the quality of patient care. The first step in overcoming this barrier will be to persuade staff that they will now have access to a range of technical tools enabling them to make better clinical judgments and, ultimately, achieve better patient outcomes.

The Future Skills Centre recently funded upgrade training for healthcare workers. The strategy is to build on the assumption that workers with AI literacy skills will be more likely to embrace technological change, thereby fostering a more dynamic culture of adoption within institutions. The purpose is to ensure that these organizational changes will facilitate the adoption of digital technology.

An educational component designed to change both the professional culture and the skills of healthcare workers is included in the implementation plan, and a mentoring/coaching centre has been set up for this purpose. Some 5,000 healthcare workers across Canada were paired with technology experts to explore the potential of AI in their healthcare innovation projects and ease their concerns. A training plan and mentoring pathway have also been developed for each pairing. The goal is to empower healthcare professionals and help them quickly take charge of AI-initiated transformations in their organizations. In particular, these plans seek to alleviate practitioners' uncertainties about how AI can transform the healthcare professions and improve patient care.

The project also includes AI training for healthcare leaders aimed at accelerating deployment of this technology. This training seeks to ensure a smooth and easy organizational transformation incorporating a number of key dimensions, i.e., equity, data governance, transparency in AI use, change management and technological innovation.

Evaluation

The project is still ongoing.

> **Example 2:** Building the skills of the trucking industry for the future
> **Project scope: New Brunswick ($780,000)**

Context

For several years now, the trucking industry has been facing a driver shortage. According to the Future Skills Centre, nearly 50% of older, experienced workers in this sector have low levels of technology and computer skills and are resistant to technology adoption. Some truckers actually opt to retire rather than develop computer skills or upgrade their other skills. Innovative solutions are therefore required to attract new workers, retain the existing workforce and increase the productivity of trucking companies facing persistent labour shortages.

The Future Skills Centre funded a virtual reality pilot project to provide skills enhancement training for experienced professional truck drivers and train new drivers. The primary goal of this project was specifically to assess the effectiveness of a portable virtual reality simulator in improving driver skills through pre- and post-training road assessments. A secondary goal was to explore the adoption of this promising technology by trucking companies.

Evaluation

Virtual reality simulation has proven to be particularly effective in training both young drivers and newcomers with limited language skills. Young drivers quickly become comfortable with this format because of its similarity to video games, and newcomers are able to experience driving in Canada without incurring risks. Participating companies have recognized the usefulness of the handheld virtual reality simulator in assessing skills and developing training programs and have indicated that they would continue to use this tool.

Problems of motion sickness were observed among participants, however, particularly among older drivers less familiar with immersive environments. The COVID-19 pandemic also severely disrupted the initial project, significantly reducing the sample size and making it impossible to conduct a longitudinal study on learning transfer.

Example 3: From Data to Decision: AI Training and Professional Certification
Project scope: Across Canada ($1,055,000)

Context

A good many large and medium-sized Canadian businesses are considering investing in AI to increase productivity, improve customer experience or reduce operating costs. Despite their enthusiasm, however, quite a few of these companies are hampered by a certain lack of comfort and familiarity with AI technology.

To meet these challenges, the Future Skills Centre created a partnership with the Université de Montréal and the IVADO group to offer a short online program on organizational AI integration. This training is intended for mid-career professionals and managers.

The project has four components:

1. A self-assessment for professionals to measure their AI skills, identify gaps and determine their organizations' needs; this exercise will then help them choose a range of course offerings.
2. The training path includes basic courses on the steps required to adopt AI in an organization as well as other specialized training to address more specific needs.
3. For each course, there is an assessment that professionals can take. If successful, they will receive professional certification from IVADO and the Université de Montréal.
4. To validate this project's relevance and effectiveness, a mechanism needs to be set up to analyze what the professionals have learned and the assessment method as a whole.

Evaluation

The project is still ongoing.

Example 4: Skills Development in SMEs for Faster Adaptation to Job Market Changes
Project scope: Quebec ($100,000)

Context

Quebec SMEs are facing a significant talent shortage and are having difficulty assessing their training needs and accessing appropriate resources. This is a particularly worrisome situation in Quebec where basic skill levels are below the Canadian average, corporate investment in training is among the lowest in the country and workforce adaptation to job market changes is elusive in spite of a number of public initiatives aimed at developing a culture of continuous corporate training.

The Future Skills Centre awarded a start-up grant to the Fédération des chambres de commerce du Québec (FCCQ) to deploy a national initiative to:

- Identify core competencies required at the regional level;
- Raise corporate awareness of the importance of skills development;
- Develop skills development plans;
- Collect data on needs in order to guide public policies.

Inspired by a dual-purpose training model implemented in Europe, this project will be deployed in eight Quebec regions by the FCCQ network.

Evaluation

The project is still ongoing.

Promising training practices to support workers threatened by automation

Example 5: Reskilling Displaced Retail Workers
Project Scope: Ontario ($280,000)

Context

A number of retail jobs are at risk of being automated as the growing popularity of e-commerce slows in-store demand. As a result, workers in this sector do not always have clear options for transitioning to occupations less threatened by automation – unless they are willing to embark on new training programs that might extend over several years.

The Future Skills Centre funded a project to develop a two-pronged skills training program for retail workers:

1. Retraining to sales positions prioritizing face-to-face interaction with customers.
2. Skills development for SME jobs in the technology and digital sector, including e-commerce skills.

The project created training models tailored to retail employees' needs and giving participants the opportunity to learn while being paid in their workplace. Thanks to an analysis of international best practices and close collaboration with industry partners, such as the Retail Council of Canada, it was possible to identify the basic elements required to ensure the success of the training programs.

Evaluation

Eighteen contributors and 13 different organizations collaborated on developing the training programs, and this project generated 108 concepts to be integrated into the programs. Budgetary and time constraints prevented holding an open call for participation, and this potentially limited the diversity of perspectives. Since the initial data and research were limited, the project pivoted towards short-term intervention programming, rather than longer-term impact programming with more comprehensive primary data.

Example 6: <u>Facing the challenge of digital transformation in the insurance sector: women at work</u>
Project scope: Quebec ($1,010,000)

Context

Low-education occupations – predominantly held by women – are particularly affected by task automation and job restructuring resulting from the adoption of new digital technologies such as AI. Among the jobs most likely to be affected by this digital transformation are those held by insurance technicians, customer service representatives, administrative assistants, employee representatives and accounting technicians. Many of these jobs are in the insurance sector, with a heavy concentration in the Chaudière-Appalaches region.

This is the context in which a consortium of Université Laval researchers and their partners launched a project to analyze the skills development needs of these workers, their organizations and the insurance sector. The goals were to diagnose current and potential changes in the industry, create training pathways and provide career support for female workers whose jobs may be exposed to automation.

The study aims to:

1. 1.Assess the nature and extent of digital transformation for jobs held by women and in socio-occupational categories at risk of automation, and identify the needs of female workers and employers;
2. 1.Develop innovative approaches to skills management, training and support, as well as retraining, skills upgrading and career shift models for these workers;
3. 1.Assess the effectiveness of these training and support models from the vantage point of the workers and their employers, with a view to continuous improvement.

Evaluation

The project is still ongoing.

Conclusion

Approximately 18% of the Quebec workforce, or some 810,000 people, currently hold or are looking for jobs that are vulnerable to automation due to the integration of digital technologies such as AI. In other words, these people are in high automation risk jobs with no opportunities for rapid occupational retraining. The impacts vary greatly across industries, occupations and demographics. In particular, young people aged 15 to 24 and workers without qualifications are most at risk. Moreover, the manufacturing sector has the highest number of vulnerable workers.

It should be noted, however, that automation deployment across all industries and organizations will take some time. A number of experts are forecasting that machine replacement of humans will often be done through attrition – retirements, for example – and may initially help to fill positions that are often vacant because of labour shortages.

It should also be noted that AI deployment can take two distinct paths. The first path relies on complementary AI to help workers increase their productivity by improving the quality of their services or enabling faster delivery of these services. The second path relies on the AI substitution adopted to replace the workers who previously performed these tasks. While this approach can alleviate some labour shortages, it also calls for a societal rethink. In particular, it is important to offer new avenues to workers impacted by these major transformations and to help them upgrade their skills so that they can perform more productive tasks.

This transition calls for concerted and strategic action. Here are three key areas of recommendations for maximizing AI benefits while also minimizing the negative impacts of this technology.

To ensure that AI contributes to increasing Quebec's productivity, organizations should:

- Accelerate their investments in digital technologies and AI, in particular to alleviate labour shortages by automating certain tasks and reallocating employees to more rewarding, higher value-added tasks;
- Set up a structured technology watch to anticipate changes for each business sector and the occupational impact of these changes;
- Develop change management programs to facilitate employee adoption of new technologies;
- Foster a culture of continuous learning and innovation.

In order to make workers more resilient, governments and their education and training partners should:

- Think differently about training support measures so as to better factor in the retraining needs of working people (and not just the needs of the unemployed);
- Develop agile and accessible continuous training programs, particularly for employed workers;
- Experiment with new teaching approaches that combine both on-the-job training and transversal skills development;
- Establish prior learning recognition mechanisms to facilitate occupational transitions.

To better anticipate future needs, the impact of new technologies should be systematically integrated into the labour requirement forecasts that are frequently used to plan vocational/college training and immigration policies.

Appendix

Researchers Frey and Osborne (2013), who developed the methodology on which our study is based, first carefully reviewed 70 occupations with the help of machine learning experts and with the goal of assessing the likelihood of job automation. In each case they asked a basic question: considering the possible access to big data, can this occupation's tasks be sufficiently defined for them to be carried out by machines? This initial assessment produced a classification under which an occupation either can be automated in the foreseeable future or it cannot.

Next, the researchers used the U.S. Department of Labor's O*NET database to determine the extent to which these occupations require different skills. This initial database was then used to train a probabilistic classification algorithm (the Gaussian Process Classifier). This algorithm used nine key variables from the O*NET database to measure three types of skills considered as potential barriers to automation: perception and manipulation, creative intelligence and social intelligence. Focusing on the trends identified in the 70 occupations annotated by machine learning experts, the algorithm learned to recognize the characteristics that make a job more or less automatable. When their database was expanded to a total of 702 occupations, the algorithm was able to estimate a job's automation probability in the foreseeable future.

For our study, the Institut du Québec was concerned only with occupations having an automation probability of more than 70%, as determined by the methodology developed by Frey and Osborne. This is an approach that has subsequently been widely used internationally, including by the OECD, whose work also provided inspiration for our study. The OECD researchers took this a step further by considering which high automation probability occupations offer few opportunities for affected workers to redirect themselves to other jobs through a so-called "acceptable" transition.

More specifically, for a career change to be deemed acceptable by the OECD, it must require:

1. No more than six months of training to enable a worker to fill a job that is not at high risk of automation
2. A modest increase in literacy and numeracy skills
3. Similarities in the skills required (e.g., technology or management and communication skills)
4. At least one field of study also required for the current job
5. A salary reduction of less than 10%
6. Limited over-qualification in literacy and numeracy skills

The authors were able to identify 27 subgroups of occupations vulnerable to automation in the 2008 International Standard Classification of Occupations (ISCO). The definitional level of these occupations is much broader than the level found in Statistics Canada's National Occupational Classification (NOC 2021), which uses 2021 Census data. In order to capitalize on the wealth of this data, the Institut du Québec then translated the vulnerable occupations identified by the OECD into core occupational groups as defined by the NOC 2021. In this way, 96 core groups of occupations vulnerable to automation were identified for Quebec. This identification of vulnerable occupations was subsequently corroborated by work carried out by The Conference Board of Canada using the now outdated, but similar, NOC 2011 classification.

To analyze the demographic groups most vulnerable to automation in Quebec, the Institut du Québec cross-referenced employment data by occupation with working population characteristics using publicly available data from the 2021 Census. Finally, the authors wanted to paint a picture of vulnerable employment by industry. However, in the absence of the publicly available data they needed to carry out such an analysis with similarly precise occupational definitions, the authors relied on a special Census data compilation.