

New technologies: progress in robotization An economic look at a global phenomenon

Major analysis firms and some academics have, in recent years, published studies promising a true revolution. There has been so much technological progress that robots are in the process of turning manufacturing production and service delivery inside out. The impression given by these studies, and their echoes in the media, is that humans only have to hang in there because, sooner or later, their tasks will be automated. Clearly, the nature of the tasks will change, but does this mean that a leisure society is at hand? The studies do not agree on the scope of the expected changes. They do, however, converge on certain points: the changes will be rapid and broad, in both manufacturing and services. The purpose of this article is not to cover all aspects of robotization, but rather to take a closer look at what's being said, and put the Quebec situation in perspective.

PROMISES OF A MANUFACTURING REVOLUTION

The studies are full of shocking figures. Boston Consulting Group (BCG¹) estimated there were 1.4 million industrial robots in operation worldwide in 2015. 200,000 robots were shipped annually in 2014, a number that could hit 500,000 in 2025, or even 700,000, according to their most daring scenario. Within about 10 years, the proportion of tasks done by robots would rise from a global average of about 10% now to 25% in the manufacturing sector. It is thought that the increasing adoption of robots could cut labour costs by 33% in South Korea, and 18% to 25% in China, Germany, the United States and Japan, over a situation in which nothing was done to further automate manufacturing.

Plant operations were not just automated yesterday, but the pace at which robots are being introduced is expected to accelerate so much that the BCG refers to these years as a inflection point. According to BCG, a combination of factors will speed up adoption. If the trend persists, hardware and software prices would drop 20% in the next decade, while robot performance would keep improving and programming would become even easier, fostering acquisition by SMEs. Increasingly, the watchword is advanced robotics, due to the opportunities now offered by technological progress. Moreover, the shortage of labour and workforce ageing in developed countries, and the drive for productivity gains favour an expansion by robotics.

We can easily imagine that robot adoption varies, and will vary from sector to sector and even country to country. At this time, it is concentrated in a few domains, such as computers and electronics, electrical equipment, transportation equipment (automotive, aerospace, etc.), and machinery; according to BCG, about three quarters of robots are focused in these areas. BCG also estimates that 80% of the robots sold each year are deployed in China, Germany, Japan, South Korea and the United States. As they are generally still very expensive, they are mostly owned by major corporations.

It is thought that industries for which labour constitutes the lion's share of production costs will be the most affected. Industries with repetitive tasks are the most vulnerable, but sectors that are now ahead will continue to lead in 2025 (table 1 on page 2). BCG put manufacturing into three broad categories based on the eventual adoption of advanced industrial robotics. Ranked first are the four sectors in which automation is already well underway, and they will maintain their lead. They are followed by industries that will come to robotics more slowly, such as plastics and rubber, oil, and primary metals. After that are other fields in which materials are harder to manipulate, given the current technological limitations and fields in which labour is less of a weight in production costs than those that are already engaged in robotic manufacturing.

¹ BCG, "How Robots Will Redefine Competitiveness", September 2015.
<https://www.bcgperspectives.com/content/articles/lean-manufacturing-innovation-robots-define-competitiveness/>

Table 1 – Four industries will lead the adoption of advanced industrial robots

Industry	Rationale and implications
Computers and electronic products Electrical equipment, appliances and components Transportation equipment Machinery	<ul style="list-style-type: none"> • More than 85 percent of production tasks within the industry are identified as potentially automatable. • High manufacturing wages in the industry will lead to economical adoption in most economies. • Will reach near saturation in the late 2020s.
Plastics and rubber products Miscellaneous Petroleum and coal products Primary metals	<ul style="list-style-type: none"> • Limited penetration today; high percentage of automatable tasks. • Moderate factory wages. • Likely to be adopted only in high-wage economies in the near term; future decreases in the cost of robotics will drive further adoption.
Chemicals Nonmetallic mineral products Wood products Paper Fabricated metals Food Textile mill products	<ul style="list-style-type: none"> • Materials are typically ill suited for manipulation by robots; current technology limits robots to a few tasks. • Low manufacturing wages. • Significant future adoption will require low-cost solutions or technological breakthroughs.

Sources: The Organisation for Economic Co-operation and Development, Boston Consulting Group

A LOOK AT QUEBEC

In the early 2000s, it took huge amounts of money to buy robots. Prices have come down since then and, as we have seen elsewhere in the world, robots have gotten faster, applications have proliferated, they are now more accurate and easier to program than they were. In Quebec, major aerospace, food and plastics manufacturers are already familiar with these tools. According to the Centre de Robotique et de Vision Industrielles (CRVI), Canada was behind. For example, in the early part of this decade, Germany had 1 robot for every 505 people, while Canada had 1 for every 2,325. In Quebec, automation has expanded more in sectors with high production volumes.

According to Statistics Canada’s calculations, which were published in *Les Affaires* in 2015², automation by Quebec manufacturers is below the Canadian average, and lower than in Ontario. This observation is based on a ratio that measures “the value (in 2007 dollars) of the machinery and equipment available to an employee for one hour of work”. A high ratio is construed as a sign of automation. In 2013, it was estimated to be \$13,900/hour in Quebec, \$14,700/hour in Ontario and \$15,500/hour in Canada. Given the huge investments required for oil operations in western Canada (excluding infrastructure), it is not surprising to find that Quebec is below the average for Canada.

However, Quebec narrowed the gap with Ontario between 1997 and 2013. Although this is an interesting observation, it comes from a 1% increase in the ratio of capital invested to hours worked in Quebec, with a decline of 3.7% in Ontario...

² “Le Québec rattrape l’Ontario, mais se fait devancer par l’ensemble du Canada,” in *Les Affaires*, June 13, 2015 issue.

WHY INVEST IN ROBOTICS?

Those who promote robotization have lots of arguments for showing off its merits. They include low maintenance, and the fact that robots do the repetitive, dirty, dangerous jobs that are sometimes hard to fill, and do them without complaining. The claim is that robots can increase corporate productivity, and move workers to jobs with “more value added.” Robots are also thought to save time in operations such as cutting and grinding on large parts, as well as deflashing.³ They make it possible to optimize the use of raw materials, and therefore reduce waste. Proponents even go so far as to invoke the potential for energy savings, due to the precision of each operation, and the fact that the devices do not require lighting. For all of the above reasons, robots are believed to generate savings. BCG, for its part, asserts that they are cheaper to use than humans. According to BCG, a welder earns about US\$25/hour at a plant in the United States. The estimated cost for a robot doing the same job is approximately US\$8/hour, once the purchase, installation, maintenance, software and peripherals have been factored in, amortized over five years.

Quebec is not a leader in the area of productivity, as those who try to measure it discover. Although not all of the calculations yield the same results, the final observation is the same: we have to do more than we are now, and automation is one way to improve productivity.

In another vein, Quebec manufacturers are lagging behind when it comes to automation, putting them in an increasingly precarious position vis-a-vis their Canadian and foreign competitors. This is especially important given that Canada has entered into more and more commercial and free trade agreements with other nations in the last few years. Moreover, the manufacturing powerhouses like China, the United States, South Korea and Germany, to name just a few, have already jumped onto the robotics bandwagon. According to BCG's studies, they are the biggest buyers of robots at this time, and will remain so until the end of this decade.

Why is Quebec's manufacturing industry behind? There is no formal answer. One reason given is the larger proportion of SMEs in Quebec. As we said earlier, robots are introduced

much more rapidly in large corporations. According to the Association pour le développement de la recherche et de l'innovation du Québec (ADRIQ), it is a cultural issue; the association asserts that the importance of automation has not gotten enough attention.⁴

Before investing, it is a good idea to look at the environment in which the business is operating. Identifying competitors and understanding their processes can enable more informed decisions, if a business wants to stand out, produce more than competitors, or even have a level playing field. Lastly, workforce preparation is essential to success.

The impact on employment has not yet been clearly established. Those who are against the introduction of robots argue that they decrease the number of plant workers and help increase unemployment. A majority of those who want to pick up the pace on robot introduction recognize that jobs that are unskilled, repetitive, dangerous and hard to fill are slowly disappearing. However, in their eyes, robots make it possible to create more complex, skilled and better-paid jobs. Many think that the growth created by introducing robots generates so much activity that more workers have to be hired. A Swiss study conducted by Deloitte⁵ in 2015 concluded that “jobs with a low risk of being replaced by automation have grown significantly in the last 25 years, while jobs with a high risk have grown less vigorously or have even decreased... However, more jobs have been created in the past 25 years than have been lost.” A survey cannot tell us everything and cannot be conclusive. It would be interesting to repeat the exercise where automation has made more progress in the last few years. Moreover, the issue of labour remains a concern in a context of population ageing and recruitment problems.

GOING INTO ACTION

Quebec has no shortage of people to promote automation. For example, the Centre de recherche industrielle du Québec (CRIQ) has, for decades, had a team of specialists dedicated industrial automation to support businesses. The mission of the Centre de Robotique et de Vision industrielles (CRVI) is to work to increase manufacturer productivity. The Regroupement des équipementiers en automatisation industrielle (RÉAI) includes a hundred businesses that

³ Deflashing: “In manufacturing, the flash is unwanted excess material that is often thin, as if the material had grown. It is an aesthetic issue, can be sharp, and can create problems in later assembly operations.” Source: Wikipedia

⁴ “L'Automatisation, une question de survie,” in *Les Affaires*, June 13, 2015 issue.

⁵ Deloitte, “Man and Machine: Robots on the rise? The impact of automation on the Swiss job market”, 2015, 8 pages. <http://www2.deloitte.com/ch/en/pages/innovation/articles/automation-report.html>

offer Quebec industrial automation solutions. These firms alone account for about 5,000 jobs, and have more than half a billion dollars in sales. For its part, the Association pour le développement de la recherche et de l'innovation du Québec (ADRIQ) supports technological innovation. Very recently, it added an "innovation/automation" prize for the 2016 edition of its "Gala des Prix Innovation". And we can't forget about the work being done by the Manufacturiers et Exportateurs du Québec (MEQ). These are just a few examples of the organizations and associations working to make robotization a reality here.

The idea of automation is also being transmitted through the events that are organized week by week and month by month.⁶ There is also training on automation given in collaboration with the Ministère de l'Économie, de la Science et de l'Innovation (MESI).

Lastly, the Quebec government is earmarking \$500 million for manufacturing innovation in its "2016-2019 Strategic Plan." The focus is on businesses that innovate, automate and promote the technology boom. The message is being proclaimed far and wide, by many speakers, in every guise. What remains to be seen is whether the industrial firms will do anything about it.

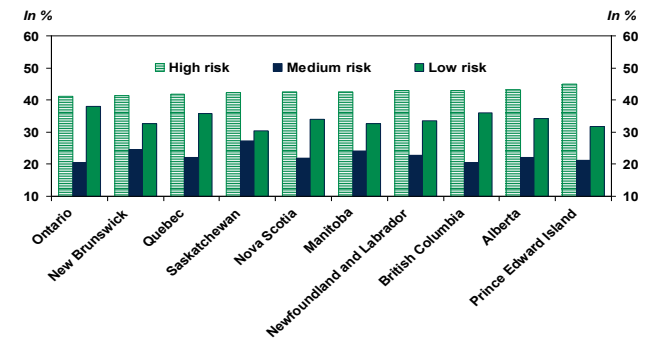
BEYOND MANUFACTURING

Robotization is not the sole purview of the manufacturing sector. There has been no shortage of studies on automating the entire economy in recent years. Canada's Brookfield Institute for Innovation + Entrepreneurship⁷ thinks that, in the next 10 to 20 years, 42% of Canada's workforce will be at a high risk (70% or more) of being affected by automation. On the other hand, the researchers estimate that 36% would be at a low risk. They did a province-by-province breakdown (graph 1). Note that the proportion of jobs at high risk ranges from 41.1% in Ontario to 45.0% in

Prince Edward Island. The percentage of jobs at low risk is larger in Ontario (38.0%) than elsewhere in Canada. Quebec ranks third (at 35.7%), after British Columbia. According to the estimates created by the Institute's researchers, jobs that are more at risk of being automated have lower average incomes (graph 2).

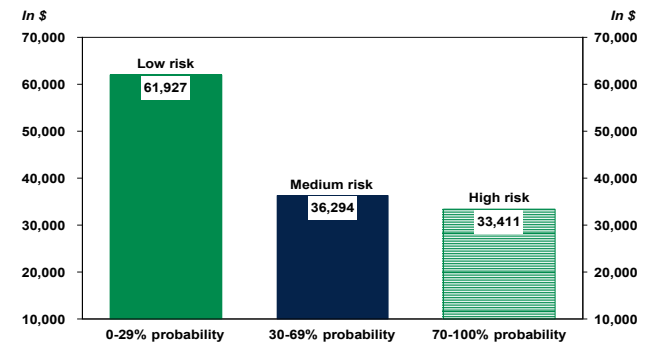
Brookfield Institute went so far as to identify jobs that were at high risk based on rapid technological development. The following jobs lead the way: retail sales, administrative assistant, fast food cook and sales and truck driver. The study concludes that 42% of paid job duties could be automated using current technology. Note that these are duties, not jobs.

Graph 1 – Breakdown of labour by risk of being affected by automation



Source: Brookfield Institute for Innovation + Entrepreneurship

Graph 2 – Canada: Breakdown of automation risk by average income



Source: Brookfield Institute for Innovation + Entrepreneurship

⁶ Some examples: June 2016 (Montreal): Colloque Automatisation industrielle, May 2016, (Montreal): Colloque Action automatiser, November 2015 (Montreal): Colloque Automatisation industrielle, October 2015 (Quebec): Séminaire sur la compétitivité des entreprises: l'Automatisation avancée, September 2015 (Magog): Mardi de l'innovation : L'automatisation.

⁷ Brookfield Institute for Innovation + Entrepreneurship, "The Talented Mr. Robot, The impact of automation on Canada's workforce", June 2016, 48 pages.

For its part, McKinsey released a research report in 2015⁸ that focused on tasks, not jobs. One of the findings was that very few jobs would be fully automated, but that many jobs would undergo substantial changes. McKinsey thinks that, given the current technology, 45% of the work activities for which U.S. workers are paid could be automated. In light of this work, at least one position out of five could be fully automated.

Robots are also very much present in various service sectors. The finance industry already has robo-advisors. Not as well known in Canada, they are seeing some popularity in the United States. Big organizations like Charles Schwab and Vanguard Group have adopted them. They are managing billions in assets in the form of negotiated funds. The law sector has also been affected. British Columbia now has the Civil Resolution Tribunal⁹, a website that uses algorithms to resolve disputes between individuals. Initially, the CRT's mission was to settle disagreements between condo co-owners. Recently, its mandate was expanded. Other, similar experiments are underway elsewhere in the world, for example, in the Netherlands and Australia.¹⁰ In the private sphere, we now have "social robots" that can interact and get in contact with humans. Some of them have an animal (robot dog) or humanoid form. They can recognize faces, remind people of appointments, read emails, etc. These applications are still in development, but they are very present, particularly in Japan.

ROBOTS, A PRESENCE TO GET USED TO

Development has been lightning fast in the last few years, and everything suggests this will continue. We are now talking about "robotic intelligence." From a device programmed to do a task (painting, bolting, assembly, etc.), we are transitioning to a versatile work unit that can make decisions based on the parameters it is dealing with. Those who are designing these tools are also developing approaches to make them easier to program. Technological development is slowly eradicating the boundaries between human and machine. The potential for applications is huge and increasingly going beyond routine, predictable tasks.

For now, it is easier to picture robots in manufacturing. However, the functions they can and will be able to do go well beyond this area. In a context of workforce ageing and labour shortage, some tasks may have to be done by robots. But, to what extent? Here, that decision remains up to humans.

Simultaneously, however, the productivity gap in manufacturing will have to be closed if Quebec businesses want to maintain their place in Quebec and Canada, and carve out a share of international markets. Regardless of the role we have robots play, we cannot deny that they are increasingly important in all spheres of activity. It is best to stay informed, starting now, to learn how they are and can be useful, what their limits are, and what role we intend to have them play.

⁸ Chui, M., Maniyka J., and Miremadi, M. "Four fundamentals of workplace automation", McKinsey, 2015.

⁹ <https://www.civilresolutionbc.ca/>

¹⁰ <http://www.abc.net.au/news/2016-07-06/robot-lawyers-dutch-conflict-resolution-technology-on-its-way/7572488>