

PERSPECTIVE



New Technologies: Hardly a Quiet Revolution

Day in and day out, dozens, if not hundreds, of articles are published around the world reporting on the arrival of new technologies. Whether they're touted for their benefits or reviled for their dreaded impact on jobs and privacy, new technologies are making waves. Defining them is a challenge in and of itself, to say nothing of the challenges facing individuals, organizations and governments compelled to adapt to them. Where should we draw the lines? Beyond the enthusiasm they generate, new technologies create two obligations for governments. First, they must ensure that their citizens benefit from them. Second, they must enable workers (both current and future) to adapt to them in order to avoid creating an excluded class and increasing inequalities.

Welcome to the 21st century

What should we call the flood of new technologies that has swept up individuals, businesses and governments alike? There's no shortage of names for this phenomenon: Industry 4.0, disruptive technologies, the postmodern renaissance, the digital transformation, the digital revolution, and disruptive innovation are just a few. Regardless of the name we choose, each conveys the idea of a profound change (box 1).

What comes under the umbrella of new technologies? It depends on who you talk to as there is no exhaustive, definitive list. However, a brief comparative analysis enabled us to group together a number of technologies that could be considered

BOX 1

What are disruptive technologies?

According to Statistics Canada, a disruptive technology is one that displaces an established technology and shakes up the industry, or a revolutionary product that creates a brand-new industry.

It is characterized by the speed at which it spreads and the fact that it exceeds the limits of the traditional economy.

Disruptive technologies have an impact on the behaviours of individuals, businesses and governments.

Source: Statistics Canada, at the [convention](#) of the Association des économistes québécois, May 2017, Gatineau.

disruptive: Internet (mobile and desktop), cloud computing, big data (or metadata), blockchain (box 2), robotics, machine learning, artificial intelligence, next-generation genomics (such as low-cost gene sequencing), new materials, energy storage, renewable energy, self-driving vehicles, 3D printing and the Internet of Things are among those most frequently discussed.

Energy, which was more or less the Holy Grail of governments and organizations in the 20th century, has been replaced in the 21st century by data and the information it contains. This is the new paradigm and the quest for data isn't about to run out of steam. For example, graph 1 on page 2 shows the growth in cross-border data flows anticipated between Canada and the United States by the McKinsey Global Institute between now and 2020. They're clearly on an upward trend.

BOX 2

What is blockchain?

Blockchain is a decentralized online accounting system or register that is maintained by a computer network that checks and records transactions using established cryptographic techniques.

Blockchain technology solves the problem of transferring funds between Internet users without having to go through a third party.

Source: Mark Mueller-Eberstein, CEO and founder of Adgetec Corporation, Infopresse, May 2017.

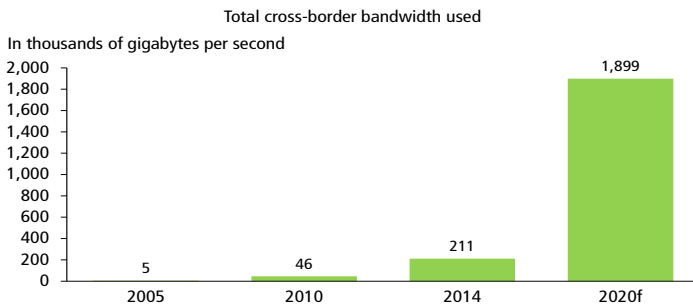
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NOTE TO READERS: The letters k, M and B are used in texts and tables to refer to thousands, millions and billions respectively.

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GRAPH 1
The volume of data flowing between the United States and Canada will increase tenfold by 2020



f. McKinsey forecast
 Sources: McKinsey Global Institute, Conference Board of Canada and Desjardins, Economic Studies

When did this new perspective take hold? Some view the 2010s as the turning point, or even the breaking point. According to them, the most significant gains in cost reduction and productivity, in particular, are yet to come. They believe that we have only begun to grasp the scope of this phenomenon and that other major upheavals are on the horizon. Hence, we should curb our enthusiasm over the expected benefits. Still others think that we're in the eye of a storm. In each case, the underlying message is that we don't fully realize the repercussions of the major changes occurring and that we know very little about the limits of these technologies.

From a production standpoint, some analysts are talking about an outright fourth Industrial Revolution, the first having been ushered in by the steam engine, the second by the internal combustion engine, and the third by information and communications technology (ICT) and microelectronics, which allowed for production to be automated. This new era, which is marked by connectivity, will change production methods as well as factories and products.

How is the current wave of new technologies different from those of other eras? The sense is that this transformation will be much quicker than those we may have witnessed in the past, leaving us little time to adapt. In addition, the changes will not merely impact a few specific sectors, but rather all economic and human activities. This has fuelled fears that the gains and wealth generated will be even more unevenly distributed than they currently are, as some businesses and countries already have a head start. The speed at which these changes are expected to occur leave little time for workers to adapt and some believe this will result in "technology castaways" in the workplace.

However, it's clear that new technologies have already pushed the limits known up until now. Just think of the borders that have been erased due to e-commerce. Tasks that were previously reserved for humans, such as reading and sorting documents, are now accomplished by computers. Information storage capacity is

reaching stratospheric levels as compared to recent standards. At the very least, our frame of reference is shifting.

New technologies are transforming businesses. Manufacturers, in particular, are moving from offshoring to automation. Industry observers have suggested that standardized production is likely to migrate toward more specialized production as we enter the era of customization.

What does this mean in concrete terms?

These new technologies aren't merely conceptual; we're already seeing them being applied in our daily lives. To help illustrate this, here are a few examples related to big data: Call centre employees can now solve problems more quickly and customize their client offers thanks to immediate access to information. In the manufacturing sector, product development improvements have reduced the need for raw materials and minimized rejected products and waste. In the insurance industry, information at employees' fingertips has sped up claims processing times and made it easier to detect fraud.

On construction sites, robots now provide assistance, particularly with monitoring. In Japan, dump trucks and bulldozers are controlled remotely via GPS-linked systems. In food manufacturing, shelves equipped with sensors provide 3D temperature and hydrometric data, which is used for cheese ripening and other activities. The data can be consulted remotely via computer, tablet or smartphone and ripening parameters can be adjusted accordingly. In the real estate sector, structures can be monitored by drones, and lighting, ventilation and heating are often now managed by intelligent systems. In the farming sector, robots are being used to milk dairy cows and clean pigsties. Along the same lines, hydrometric monitoring of crops, spraying and irrigation can all be managed by intelligent systems.

In some Quebec towns, mobile applications are already available to citizens to pay traffic tickets, send applications to their municipalities, consult the property assessment roll or sign up for recreational activities using their smartphones. Similarly, Toronto residents who drive on toll roads can receive a single bill detailing all of their travel with rates based on the times of day they drove. These are just a few applications that demonstrate how new technologies have been woven into every aspect of the lives of individuals, businesses and governments.

Quebec vs. new technologies

How is Quebec faring with all of this? In February 2016, Montréal International partnered with Québec International to create a profile with regard to big data.¹ Quebec's strengths lie primarily in its specialized research expertise, the complementary

¹ This profile was also created in partnership with the Communauté métropolitaine de Montréal, Canada Economic Development, Innovation, Science and Economic Development Canada, the Institute for Data Valorization (IVADO), the Ministère de l'Économie, de la Science et de l'Innovation and the city of Montreal.

relationship between Quebec City and Montreal, the quality and stability of its workforce, its level of culture and creativity, its capacity to house data, the high level of protection of its data, the cost-benefit analysis and its quality of life.

However, the threats it faces are related to recruiting a qualified workforce, the brain drain, the attractiveness of other expertise hubs such as San Francisco, Boston, New York City or France, the lack of awareness of company officers regarding the value of data for growing their businesses and the appeal of U.S. funds for Montreal companies.

When it comes to the presence of robots, Quebec appears to be lagging in automation. That was the conclusion drawn by the Canadian Advanced Technology Alliance (CATA Alliance) in a study conducted and published in April 2017 by ScienceTech Communications.² The study revealed that there are approximately 7,300 robots in Quebec and the level of automation is very unevenly distributed. In fact, just over half of Quebec companies are somewhat or marginally automated.

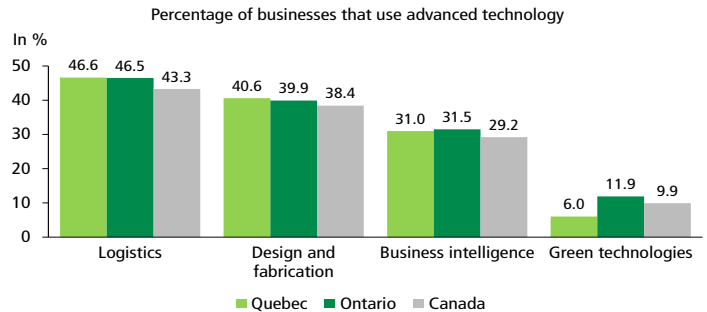
For its part, the Institut de la statistique du Québec published an [analysis](#) in December 2016 on the use of advanced technologies in Quebec businesses. The results were taken from the [Survey of Advanced Technology](#), by Statistics Canada. For the purposes of the survey, 41 advanced technologies were considered and grouped into four major categories. In addition, only companies with 10 or more employees were surveyed. The following key conclusions were drawn: Businesses in Quebec, Ontario and across Canada use advanced technologies in comparable proportions. Like the rest of Canada, a greater proportion of the technologies used in Quebec are related to logistics³ (graph 2). The survey estimates that 64.2% of businesses with 10 employees or more use at least one advanced technology.

Lastly, how does Canada stack up against other countries? There are many different types of rankings available, but the World Economic Forum's Networked Readiness Index is particularly interesting. It takes into account 53 indicators ranging from academic training and the quality of science and math education to the time required to start a company. Out of the 139 economies considered, Canada ranked 14th in the most recent edition of the index, which was published in 2016. Neither leading the pack nor trailing behind, Canada's conditions appear favourable for adopting new technologies. The challenge, which is monumental, lies in learning to work with these new tools to

² Canadian Advanced Technology Alliance (CATA Alliance), ScienceTech Communications, "Le secteur manufacturier avancé – Québec 2017," *Enquête sur l'automatisation du secteur manufacturier au Québec*, April 2017, 140 pages. Access to the document is granted on request via the CATA Alliance website.

³ For example: automated products and parts identification, warehouse management systems, customer relationship managers, and demand planning or forecasting systems.

GRAPH 2
The most highly used advanced technology in Quebec, Ontario and across Canada is advanced logistics



Sources: Statistics Canada and Desjardins, Economic Studies

ensure that citizens and the economy benefit from them while avoiding the creation of excluded classes.

Shaking things up

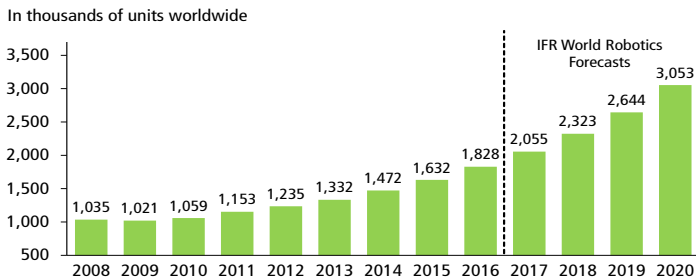
While new technologies are far from having delivered their full potential, their effects are already being felt. Opening up national and regulatory borders is just one such effect. E-commerce, Uber and Airbnb are a few concrete examples that have expanded the options available to individuals and businesses, whether in trade, transportation or traveller accommodations. At the same time, they are imposing changes to the rules of the game in each of these industries.

The issue of employment is a key concern. Will there be net gains or losses? No one can say for sure. Automation is at the centre of these debates, although only one of the new technologies emerging right now. Without a doubt, certain tasks previously performed by humans are being carried out by robots instead. How many? Everyone has a different estimate. Opinions vary according to the technologies analyzed, the job categories considered, the countries affected and the sectors concerned.

We already know that routine jobs that entail repetitive and sometimes dangerous tasks are more vulnerable to automation. Robots are also associated with jobs that require little training. Until recently, they were associated with the manufacturing sector (graph 3 on page 4). However, we would be significantly underestimating the scope of technological developments if we were to limit their application to the production of material goods. There is already talk of threats to retail trade (cashier positions at grocery stores, etc.). In the coming years, the service industry will be impacted in various sectors, which would have been difficult to associate with automation just a few years ago (graph 4 on page 4).

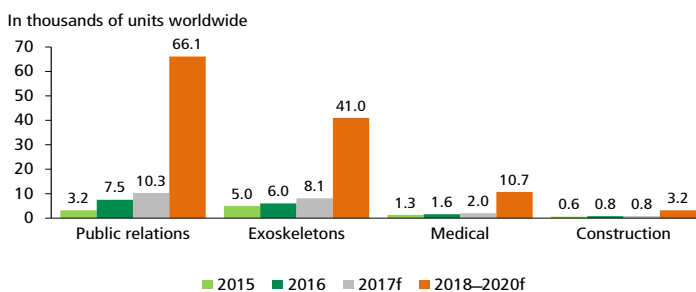
In June 2017, the Brookfield Institute published a [study](#) in which it identified the Quebec regions with the highest potential for automation. After carrying out simulations, manufacturing towns in southern Quebec, in particular, Drummondville, Granby,

GRAPH 3
Industrial robots are already here, but their numbers are expected to rise



Sources: IFR World Robotics 2017 and Desjardins, Economic Studies

GRAPH 4
The use of service robots is expected to skyrocket



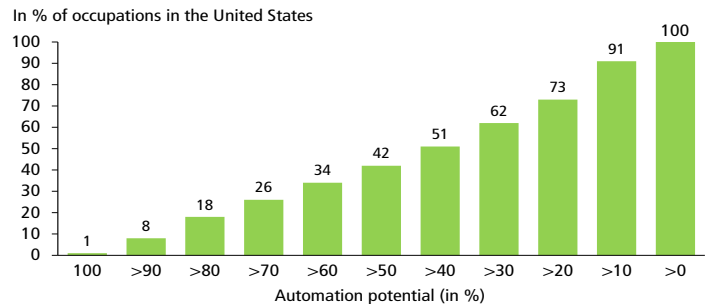
f: IFR World Robotics Forecast
Sources: IFR World Robotics 2017 and Desjardins, Economic Studies

Lachute, Cowansville and Saint-Georges de Beauce, were identified. The relative significance of jobs in the manufacturing and retail sectors throughout the economies of these municipalities could make them more vulnerable.

Between the catastrophic scenarios and those that tend to minimize the effects, certain analyses are worth noting. A [study](#) by the McKinsey Global Institute, published in January 2017, is interesting in several respects. It analyzed some 2,000 activities within approximately 800 occupations, and the scope of the study extended beyond the United States. According to the study, approximately 60% of occupations had at least 30% technically automatable activities (graph 5). While we cannot conclude that these jobs will disappear overnight, how many lost jobs will be replaced with those created as a result of new technologies? That's the key question. No one can answer it with any certainty because the parameters used to carry out estimates are only applicable today, and we cannot predict future developments.

Putting aside uncertainties related to the labour market, the promise of productivity gains is central to adopting these innovations. The reduced cost of labour in a manufacturing plant,

GRAPH 5
Some 60% of occupations have at least 30% technically automatable activities



Sources: McKinsey Global Institute and Desjardins, Economic Studies

the option to order electronically in a fast food restaurant, or the possibility of penetrating the global markets at a low cost thanks to the Internet are indicators of real benefits. Some believe that current industry insights are underestimated as the effects of synergy between new technologies are not yet fully known. That remains to be seen.

Multiple challenges

Some are studying the technical aspect of new technologies, while others are trying to estimate their effects. Still others are assessing the challenges they pose for individuals, organizations (private and public) and governments. In addition to concern over the growing number of workers left behind in the labour market, there is the issue of redistributing the expected benefits and gains in productivity. Will they be privatized or spread throughout the community? As intelligent systems become a hot topic, the issue of organizational control also becomes critical.

Given the head start of some companies with regard to data management (particularly in e-commerce, accommodations and transportation) and the enormous advantages these companies have enjoyed, some are calling for stricter regulations. Smaller players have less room to expand and fewer means with which to do so. Some companies are quasi-monopolies. How do we give access to new industry players? The challenge of minimizing unequal access is already being felt in some markets. How can we loosen the grip of the service providers currently dominating the market?

Furthermore, the way in which mergers and acquisitions are viewed will need to be adjusted given the information at their disposal. How can we assess the concentration of data as compared to the markets that companies serve and with regard to privacy? How can these factors be evaluated? What tools will we need to detect potential cartels?

With the arrival of artificial intelligence, some are calling on governments to take action regarding intellectual property. Are new parameters necessary? If so, where do we begin?

Controlling the use of data is also a growing concern. Can third parties be tasked with managing data? How far should the powers of delegation go?

Setting limits

Right now, the possibilities seem endless. The rollout of new technologies is far from over and many believe that more surprises are in store. However, beyond the enthusiasm they may generate, we must assess their benefits and consider the limits that should be placed on them. Governments are facing two obligations. First, they must modernize their economies to ensure that their respective citizens benefit from these advances that are occurring at lightening speed. The goal is to avoid being in constant reactive mode with trading counterparts, scientific partners and allies in any type of agreement. Second, they must enable workers (both current and future) to adapt to them in order to avoid creating an excluded class and increasing inequalities. Now more than ever, we must strengthen the role of education in a society in which knowledge has become the cornerstone of participation.

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