



Study

Industry 4.0: The New Industrial Revolution

Are Canadian manufacturers ready?

May 2017

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Acknowledgements

Thanks to Isabelle Simard, Marco Santos Pires and Gariné Tcholakian for their comments on this study at an earlier stage; to Rayhan Abdulmughnee, whose insights are reflected in the advice included in this report; and to Don Macdonald for his invaluable comments and editing.

This research was prepared by the Economic Analysis team from Marketing and Public Affairs at the Business Development Bank of Canada (BDC). It is based on public and proprietary data that were analyzed and interpreted by BDC. Any error or omission is BDC's sole responsibility. Reliance on and use of the information herein is the reader's responsibility.

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Introduction

“The technology is more affordable, user-friendly and robust.”

—Joe Loparco,
Co-President of AGS Automotive Systems,
an auto parts manufacturer

A new revolution

Breakthroughs in information technology, mobile communications and robotics have led to the growing use of digital technologies in factories around the world. This transformation has come to be known as Industry 4.0—or the Fourth Industrial Revolution—after those sparked by the steam engine, the assembly line and electronic automation.

The impact on manufacturing promises to be remarkable. We are already witnessing the impact digital transformation is having in Europe and the U.S., where highly automated and flexible factories can now compete against low-cost factories in Asia.

If you're like many Canadian manufacturers, you may be wary of the cost and complexity of introducing digital technologies into your business. However, our study suggests these tools dramatically improve productivity, growth and customer satisfaction. What's more, it's now possible for almost any company to get involved.

This report gives an overview of Industry 4.0, including a snapshot of the current level of adoption by small and mid-sized manufacturers in Canada, based on a national survey. It also explains why investing in this area is so important for your business and offers tips on how to do it right. Along the way, you will meet entrepreneurs just like you who are already reaping the benefits of Industry 4.0 technologies in their companies.

The revolution is underway. Are you ready to take the plunge?

Highlights

Our study indicates that manufacturers that have begun embracing digital technologies are experiencing exciting benefits.

This report is based on the findings of a recent BDC survey of close to 1,000 entrepreneurs on how Canadian small and mid-sized manufacturers are incorporating digital technologies into their businesses.

Here are the highlights.

-
- Almost 40% of Canadian small and mid-sized manufacturers have **implemented** Industry 4.0 projects, including 3% that have fully digitized their production, while another 17% are in the planning phase.
-
- Taking the plunge pays. Digital adopters are enjoying **increased productivity, lower costs** and **improved product quality**. In fact, they're almost twice as likely as non-adopters to forecast annual revenue growth of 10% or more over the next three years.
-
- On average, digital adopters have **invested** over \$250,000 in their projects over the past two years. Companies that have invested the most say it is easier to implement technology in their business. They also say they're more ready to face the coming digital revolution and have better growth prospects.
-
- A third of adopters found the implementation process **challenging**. They ranked a lack of skilled personnel, excessive costs and unclear benefits as the top barriers to implementing digital technologies.
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- We offer the following tips for getting your business started in adopting digital technologies.
 1. Focus on customer needs.
 2. Be strategic.
 3. Empower your employees.
 4. Walk before you run.
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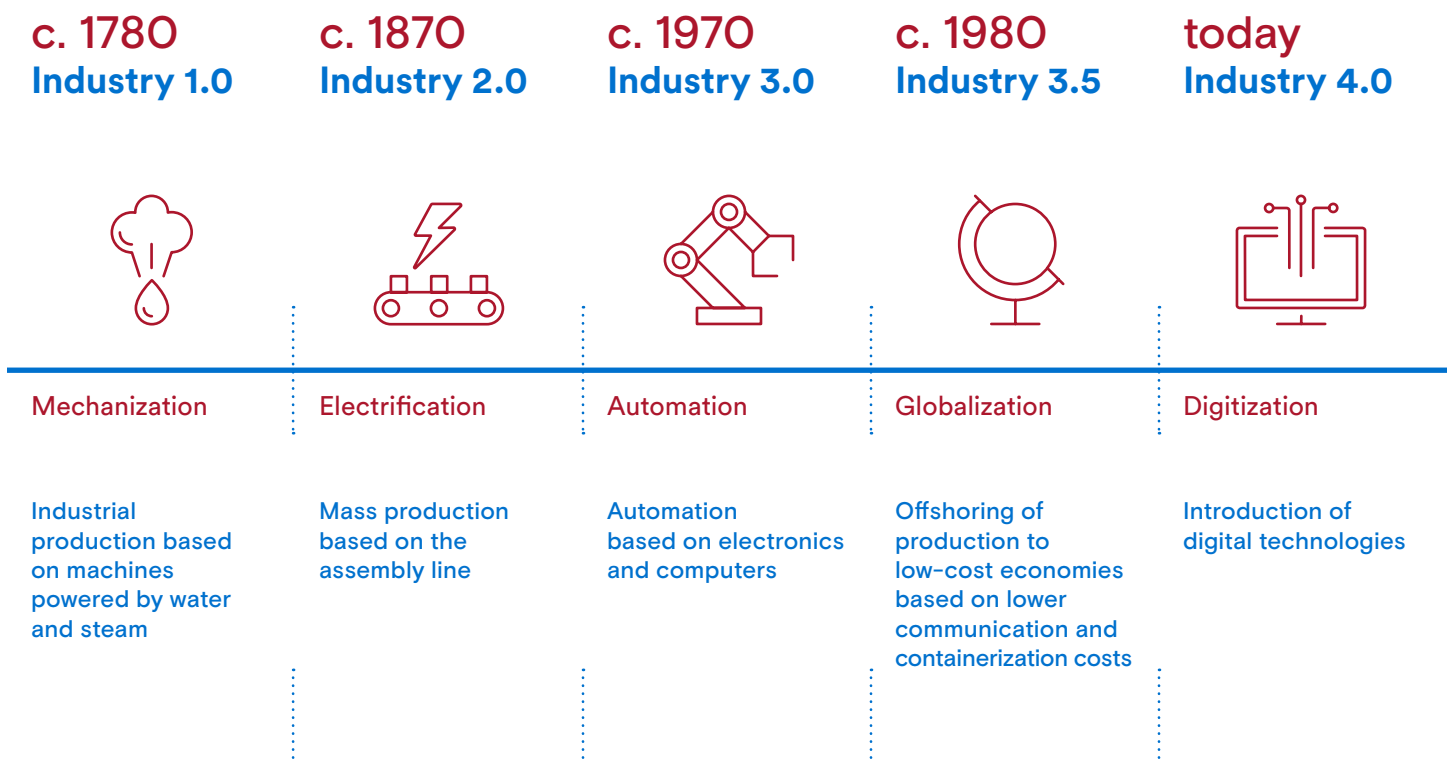
1

What is Industry 4.0?

Industry 4.0 refers to the use of digital technologies to make manufacturing more agile, flexible and responsive to customers.

It's now possible to create a **smart factory** where the Internet, wireless sensors, software and other advanced technologies work together to optimize the production process and improve customer satisfaction. These tools allow a business to react more rapidly to market changes, offer more personalized products and increase operational efficiency in a cycle of continuous improvement.

Figure 1 – Industrial Revolutions over the ages



Industry 4.0 uses digital technologies to react more rapidly to market changes, offer more personalized products and increase operational efficiency.

Three ways to introduce digital technologies into a manufacturing business

1

Build a digital factory

You can use powerful manufacturing technologies to monitor and guide production, and mine data for insights to increase output and decrease downtime. You also can use sensors to monitor and improve quality continuously.

2

Create digital products

You can add Internet-connected sensors to your products that allow you to monitor their performance and provide information to your customers, such as when parts need to be replaced. Connected products differentiate you from competitors and allow you to generate revenue by shifting to a product-as-a-service business model.¹

3

Provide a digital customer experience

You can use the Internet and other advanced technologies to get closer to your customers. For instance, you can offer them the ability to customize their orders online and see the progress of an order in real time. You can even predict their needs before they're aware of them.

¹ For example, a machinery manufacturer could install, monitor and maintain machines in exchange for a monthly fee instead of making a one-time sale.

Figure 2 – Applications of Industry 4.0 in Canadian small and mid-sized businesses





AGS Automotive Systems

Using technology to generate powerful “a-ha” insights

Joe Loparco says the time is right to introduce digital manufacturing technologies at AGS Automotive Systems.

The auto parts maker has been ramping up its use of manufacturing execution systems (MES) software to monitor and manage production, reduce downtime, and improve quality in its factories.

“The auto industry has done better, and that’s allowed us to focus and invest in this area right now,” says Loparco, AGS’s Co-President. “The technology is more affordable, user-friendly and robust.”

With factories in Canada and the U.S., AGS designs and manufactures such parts as bumper assemblies, running boards, side mouldings, spoilers and structural components. Key customers include large auto manufacturers, as well as several Tier 1 parts suppliers.

The auto industry is one of the most competitive sectors in the world, and AGS has long used sophisticated technologies such as robotics to boost productivity and improve quality. The use of digital manufacturing technology is the next leg on that journey, Loparco says.

“It’s a whole other level of not only gathering data, but also being able to manage that data in a more holistic way.”

A manufacturing execution system provides accurate, real-time production information, producing huge benefits in such areas as hitting production targets, and optimizing equipment performance and preventative maintenance. But Loparco, a former IBM executive, believes other, less obvious benefits are the most powerful.

These include the ability to get at the root causes of production stoppages and part defects. Data can be mined and correlated to produce “a-ha moments”—insights into why a certain stoppage or defect has occurred at a given time, he says.

The cost savings and productivity gains can be enormous, Loparco says.

“Automotive is a high-volume business. So every time you can flush out an issue an hour earlier than before, you’re saving big money. And if you can flush it out days earlier, you’re saving really big money.”

AGS is also using other digital technologies to gain a competitive edge. For example, it uses sensors and measuring devices to monitor the appearance of chrome-plated parts—a key product. It also uses a 3-D printing technology to create new product prototypes and plans to use 3-D printers for low-volume, custom manufacturing.

2

What's happening in Canada?

39%
of Canadian small and mid-sized manufacturers have implemented Industry 4.0 projects.

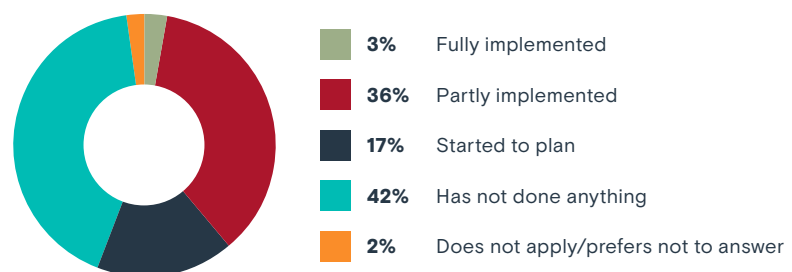
A good start

Our survey indicates digital technologies are gaining traction in many Canadian factories. Almost 40% of Canadian small and mid-sized manufacturers have implemented Industry 4.0 projects, including 3% that have fully digitized their production. Another 17% are in the planning phase.

Taken together, these data are encouraging, but Canadian manufacturers still have a long way to go in their digital transformation. This is underscored by the worrisome finding that 42% have yet to get started at a time when competitors in the U.S., Europe and Asia are moving full steam ahead.²

Figure 3 – Manufacturers are in the early stages of digital adoption

To what extent have you implemented digital technologies (Industry 4.0 projects) in your company?



Source: Ad Hoc Research, Survey on Industry 4.0 in the Canadian manufacturing sector, 2017.
Base: All respondents (n=960).

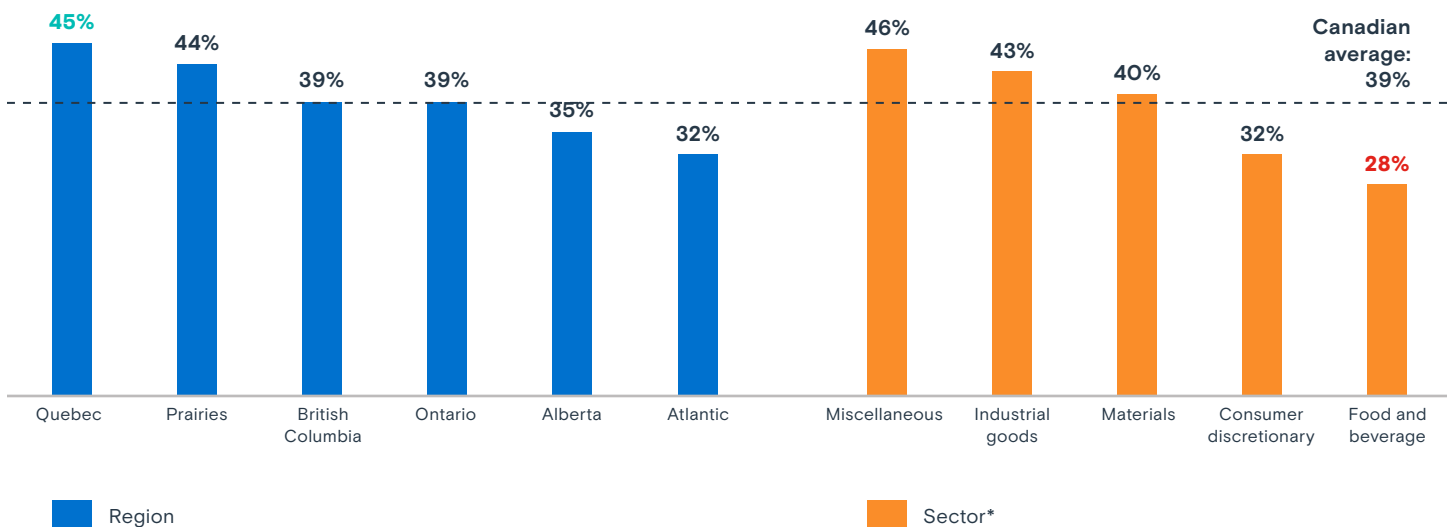
² Data from the Centre for the Study of Living Standards show that Canadian businesses lag their U.S. peers in terms of productivity and investment in information and communications technology. As well, data from the OECD and the International Federation of Robotics indicate that Canada lags most developed nations on machinery and equipment investment and use of industrial robots.

Varying adoption rates across regions and sectors

Proportionally, more businesses in Quebec than in other provinces have begun their digital transformation, while manufacturers in Atlantic Canada are lagging behind. This may be because Atlantic Canada relies more heavily on food and beverage manufacturing, where businesses have been slower to adopt digital technologies (Figure 4). On the other hand, manufacturers of miscellaneous products appear to have found much value in digital manufacturing technologies, notably 3-D printing. This category includes makers of simple customizable products, such as signs, toys and jewellery, as well as more complex goods tailored to the user, such as medical devices.

Figure 4 – Quebec leads the way to Industry 4.0

Percentage of businesses that have implemented digital technologies



Source: Ad Hoc Research, Survey on Industry 4.0 in the Canadian manufacturing sector, 2017.

Base: All respondents (n=960). A number in blue (red) represents a result that is statistically significantly higher (lower) than those for other groups, with a confidence level of 95%.

* See the Survey methodology for definitions of these manufacturing sectors.

\$261,000

Average investment in Industry 4.0 over the last two years

Investments pay dividends

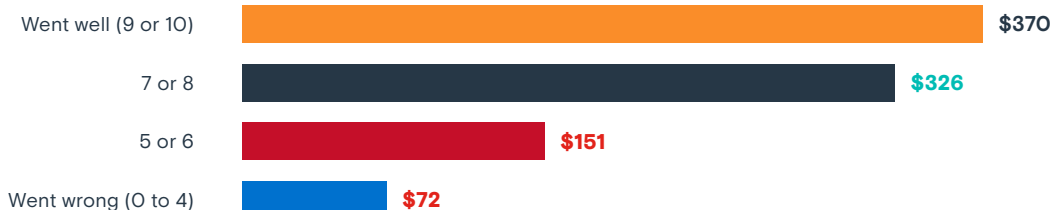
Our survey also indicates that businesses that invest the most have a better growth outlook, find it easier to implement digital technologies and are more prepared to adopt new technologies.

We asked survey participants to rate, on a scale of 0 to 10, how well implementing Industry 4.0 went for them and how ready they were to adopt new Industry 4.0 technologies. Those that gave a 9 or 10 score on these two questions invested more, on average, than those with a lower score (Figure 5). The survey also shows that investment is higher for businesses that expect to grow revenue by 10% or more in each of the next three years.

Figure 5 – Businesses that invest more find it easier to implement Industry 4.0

Average investment in Industry 4.0 projects in the past two years
(in thousands of dollars)

How well did implementing Industry 4.0 projects go in your case?



How ready are you to adopt new Industry 4.0 technologies?



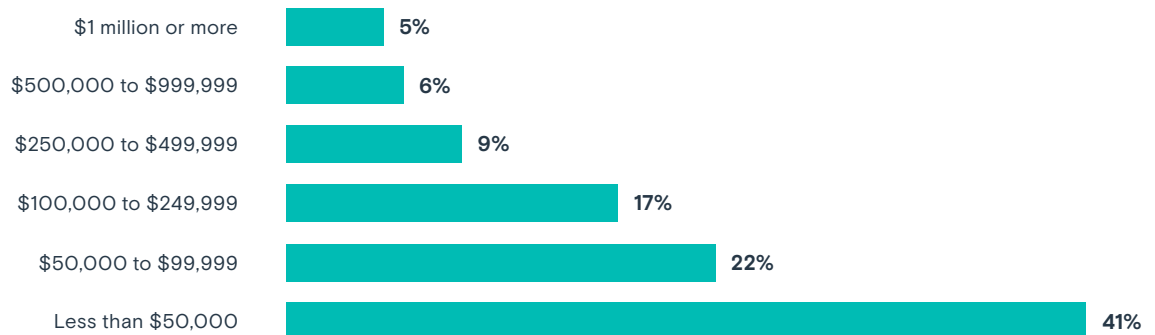
Source: Ad Hoc Research, Survey on Industry 4.0 in the Canadian manufacturing sector, 2017.
Base: Digital adopters, excluding those who did not provide an answer or who answered "I don't know" (n=364). A number in blue (red) represents a result that is statistically significantly higher (lower) than numbers for other groups, with a confidence level of 95%.

However, overall investment in these technologies remains low, a sign that Canadian manufacturers still have a long way to go to catch up with their international competitors.

We estimate that, on average, Canadian manufacturers in our survey invested \$261,000 in Industry 4.0-related projects over the last two years. We have to take into account the fact that a few companies have made large investments, exceeding \$1 million, which pull up the average. Only 5% of adopters invested over \$1 million, mostly larger mid-sized firms with annual sales of \$10 million or more (Figure 6). By contrast, 41% of respondents invested less than \$50,000.

Figure 6 – The majority of manufacturers invested less than \$100,000

How much have you invested in Industry 4.0 projects in the past two years?



Source: Ad Hoc Research, Survey on Industry 4.0 in the Canadian manufacturing sector, 2017.
Base: Digital adopters, excluding those who did not provide an answer or who answered “I don’t know” (n=364).

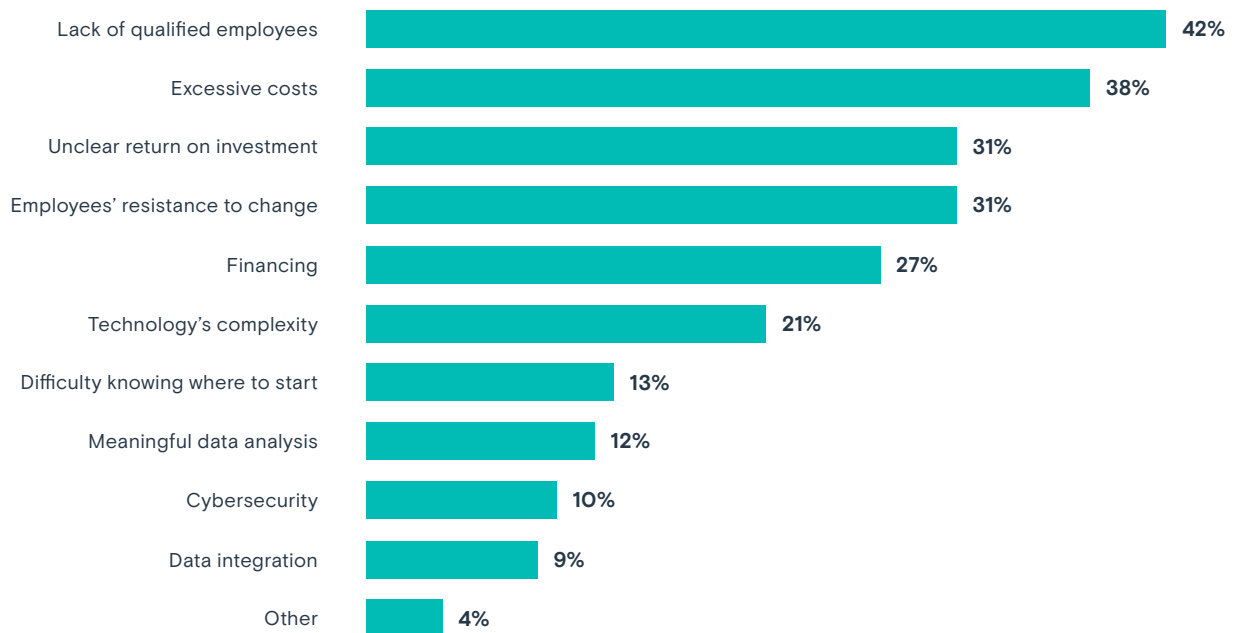
Talented employees at the centre of Industry 4.0

Adopting new technologies can be hard for a business, especially when change goes to the core of its operations. However, 65% of manufacturers that have adopted digital technologies said their experience went well or very well, while 35% found it more difficult.

To better understand the latter result, we asked entrepreneurs to identify the biggest challenges they'd faced when implementing digital technologies (Figure 7). A lack of technically skilled employees came first, followed by excessive costs and an unclear return on investment (ROI).

Figure 7 – Talent and costs are the main difficulties when shifting to digital

What are the biggest challenges in implementing Industry 4.0 solutions?



Source: Ad Hoc Research, Survey on Industry 4.0 in the Canadian manufacturing sector, 2017.
Base: Digital adopters, excluding those who did not provide an answer or who answered "I don't know" (n=370).



Metal 7

Company reaps cost savings and quality improvements

Metal 7 may manufacture equipment for a traditional industry, but its knack for innovation has made it a global leader in its niche.

The company, based in Sept-Îles on Quebec's North Shore, makes equipment for the iron ore and aluminum industries. Its products are in more than 40 iron ore pelletizing plants in 20 countries and in every aluminum plant in Canada.

In the iron ore industry, Metal 7 has carved out a formidable competitive advantage by developing surface coatings that it applies to its equipment, says CEO Marc-André Gervais. The coatings increase the durability of the equipment while improving the quality of iron ore pellets. Competitors have tried and failed to match Metal 7's expertise in coatings, Gervais says.

And it's in the coating department where the company has made another breakthrough by using leading-edge digital manufacturing technologies. As part of a three-year project in collaboration with a local college, it has developed the ability to continuously monitor the thickness of coating applied to the equipment it sells to its customers.

This results in two money-saving advantages. First, it allows operators to apply an optimal amount of coating, reducing waste. Second, the company can judge when equipment needs to be replaced rather than relying on the manufacturer's recommended lifespan. The average lifespan of certain parts it uses has jumped to 10,000 minutes from 2,000.

"In terms of replacement parts, we have saved about \$75,000 or 10% of our annual budget," Gervais says. "More importantly, there are productivity gains from fewer production stoppages. We also have better quality."

Now Metal 7, which has 85 employees, is ready to embark on another project. This time, it wants to use sensors to monitor the performance of its equipment in customer facilities. The data will be transmitted back to Metal 7 via the Internet, so it can alert customers to problems or the need to replace parts.

Gervais said the technology will improve customer service and allow his company to further differentiate itself from competitors.

"It will be part of our total product offering," he says. "We always want to be on the cutting edge of technology to show we are the leader in our sector."

Operations Director Patrice Tremblay encourages other manufacturers to experiment with digital technology.

"Our advice would be: 'Don't wait. Take the plunge.'"

3

The benefits of introducing digital technologies

The benefits to manufacturers of adopting digital technologies are real.

Our survey indicates the following.

→ **60% of adopters say digital technologies helped boost their productivity.**

The main driver of productivity growth in a smart factory is the capacity to predict and prevent downtime, and to optimize equipment effectiveness and maintenance.

→ **Almost 50% say they save operating costs.**

Savings may come from the following processes:

- real-time production monitoring and quality control to reduce waste and rework
- predictive maintenance to prevent costly repairs and unplanned downtime
- higher automation to save labour costs and improve throughput
- the use of 3-D printers to achieve faster prototyping, reducing the cost of engineering and accelerating time to market

→ **42% say they have improved overall product quality.**

For instance, real-time quality controls allow you to reduce, or even eliminate, customer returns that occur when products do not meet specifications.

→ **13% identified greater capacity to innovate as a benefit.**

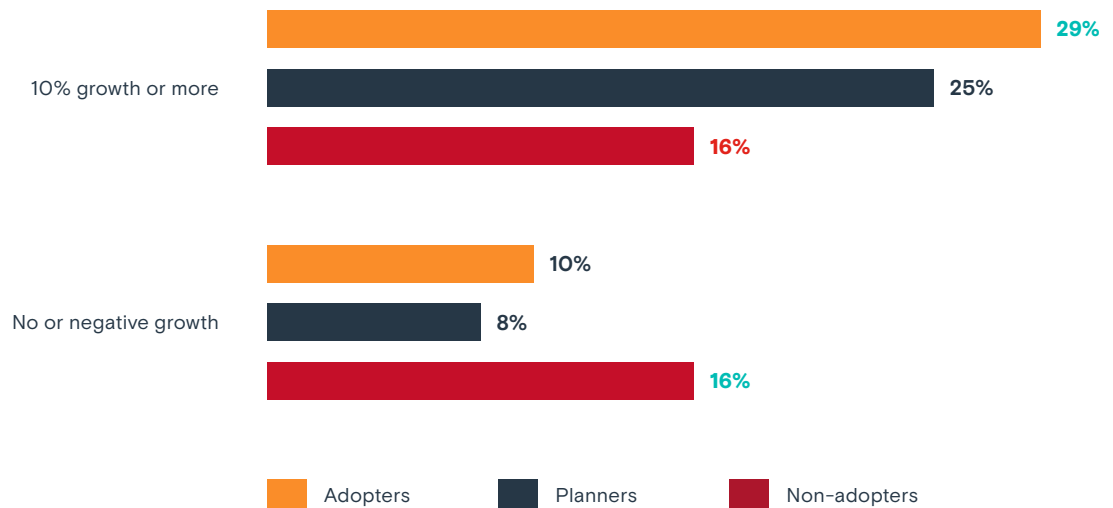
While this is a low score, we believe greater innovation may unlock the most value for your business. New business models made possible by smart products and new advanced technologies, such as 3-D printing, are only beginning to emerge. They promise to spark innovation on a monumental scale over the next five to 10 years. We are already seeing inspiring examples of how small businesses are using connected products and customization to reinvent themselves in the digital context.

A brighter outlook for digital adopters

Another way to look at the positive impact digital technologies have on a business is to compare the growth outlooks of adopters and non-adopters. Our study indicates adopters of digital technology tend to forecast a much brighter future than non-adopters do. Indeed, digital adopters in our survey were almost twice as likely as non-adopters to predict annual revenue growth of 10% or more over the next three years (Figure 8).

Figure 8 – Digital adopters have better growth forecasts than non-adopters do

In the next three years, what do you think the average annual growth of your company's revenue will be?



Source: Ad Hoc Research, Survey on Industry 4.0 in the Canadian manufacturing sector, 2017.
Base: All respondents, excluding those who did not provide an answer (n=913). A number in blue (red) represents a result that is statistically significantly higher (lower) than the numbers for other groups, with a confidence level of 95%.



Superior Cabinets

Digital transformation gives manufacturer a new lease on life

Superior Cabinets, a Saskatoon-based designer and manufacturer of custom kitchens, has invested heavily in digital technologies to boost productivity, reduce costs and improve the customer experience.

During the last recession, the company fell into financial difficulty amid falling sales, excessive overhead and operational inefficiency. As part of a turnaround strategy, a new management team invested \$2 million in technology to transform the company.

A key decision was to introduce software that allows staff to design a kitchen with customers in its stores in Saskatchewan and Alberta and send the order directly to the factory in a smooth, paperless process.

Scott Hodson, Superior's President and CEO, says the system dramatically improved Superior's customer experience because it allowed for quicker order times, better visibility on an order's progress and the elimination of many manual processes.

"Now, no one touches an order," Hodson says. "We eliminated all of the non-value-added costs that customers weren't prepared to pay for."

The company has also "fully embraced the 3-D printing movement," creating various items for use in its manufacturing processes, as well as a product it sells to do-it-yourself customers to help them easily drill holes for their own handles and knobs.

In the early stages of its turnaround plans, Superior spent more than \$1 million to map every process, from initial customer contact to kitchen design and installation. That initiative helped the company reduce the number of software systems it was using from 17 to two.

The company began tracking a series of financial and customer service measures—including quality control, on-time delivery and other key performance indicators. It also built an online portal where staff could monitor how their customers' orders were progressing and see real-time service statistics.

Hodson estimates productivity gains to be about 50%; waste has been reduced from 7% of sales to 2%.

Hodson says he believes it's essential to invest in technology to be able to compete and grow as a manufacturer in today's economy.

"If you're dependent on manual, traditional ways of doing things, you can't scale your business."

4

How to make the digital shift in your business

We asked survey participants which strategies they used when implementing Industry 4.0. With this information, we identified four key strategies that work best for entrepreneurs and came up with the following tips for getting your business started in adopting digital technologies.



Focus on customer needs

One of the key benefits of digital technologies is an enhanced capacity to deliver value to your customers. This may take the traditional form of less expensive, higher quality products. However, customers increasingly value products that allow them to work better, save time or enjoy life more.

- Start by striving to understand what your customers currently find valuable about your products. Once you have **discovered customers' true motivations** for buying from you, you can find digital technology that will help you increase that value.
- If you are in a price-sensitive industry, technology may help you drive down your costs, making you more price competitive. However, customers don't always buy on price. Often, they find installation services, delivery time, product quality, warranties and other services more important and are willing to pay a premium for those features.

For example, a kitchen cabinet manufacturer that uses tracking technologies to provide fast and accurate deliveries to its customers will be more successful than competitors that cannot.

2

Be strategic

It's important to evaluate your current digital maturity, decide where you need to be in the coming years and make a plan to get there.

- Start by reviewing the work you did to determine what your customers value the most from you. Then, develop a **digital strategy** for using technology to create and deliver that value to the market.
- Be careful not to focus on a specific technology at this stage. Instead, consider your customers' wish list and **identify the technologies that could meet** those requirements. You can then **evaluate the digital maturity** of your equipment and computer systems, and plan for changes to your IT infrastructure and employee skills.
- It is often valuable to integrate your technology implementation plan into a broader **productivity enhancement program**. Adopting operational efficiency best practices and a culture of continuous improvement are key to a successful digital transformation.

3

Empower your employees

It's critical to find and retain talented employees, especially in the digital age. As our survey shows, access to skilled employees is the main challenge facing technology adopters. Another key challenge is employees' resistance to change. Therefore, your ability to hire skilled staff and manage your team effectively when introducing new technology will be a key factor affecting your success.

- **Involve your employees** from the outset in selecting the technology you want to implement. **Share your vision** for why this choice is important to the company, how it will enhance the value you deliver to your customers and how it will affect employees' jobs. Some employees may fear the impact technology will have on their jobs or even that it will displace them. Whether this is the case or not, you need to address these concerns head on. An open and honest discussion about the technology will help lessen concerns and get the staff excited about the new direction the company is taking.
- Of course, discussion is not enough. You need to offer the appropriate **training for employees** who will be using the new technology. You may also need to devise a plan for each employee who will be significantly affected by the new technology.

4

Walk before you run

Introducing digital technology does not mean you have to turn your company into a high-tech start-up. Rather, successful businesses start with small projects to build skills, iron out problems and prove return on investment. This is important, especially considering the uncertainty many entrepreneurs feel about the value of investing in these technologies. An early win on a pilot project will help demonstrate the value of digitization to you and your team.

- If you've so far made only limited investments in technology, **start with a small pilot project**. For example, connect your equipment to capture information needed to measure **key performance indicators** as part of a program of continuous improvement.
 - Once you have successfully implemented a pilot project and become more confident in implementing and using technology, it's time **to build on that success**. A second step could be to share key performance indicators with an electronic dashboard displayed on the shop floor, measuring where each order is and whether that order is on time, ahead of time or delayed. As employees become more aware of order flow, they will be more inclined to improve operations and become more efficient.
 - You can then use these early wins to **demonstrate the value** of digital transformation and continue to implement other Industry 4.0 applications.
-

Conclusion

It's time to get started

The digital age has arrived. New digital technologies are changing the way products are developed, manufactured and delivered to customers.

Our survey found that four out of 10 small and mid-sized manufacturers in Canada have already begun their digital transformation. Those that have adopted these technologies have reaped impressive rewards, including higher growth, improved productivity and better product quality.

If you're among those who still haven't started, it's not too late. In fact, there's never been a better time to get involved—technologies have matured and become more affordable and user-friendly. What's more, there are tried and tested ways to make sure you choose the right technologies and implement them in a way that makes your company more competitive, profitable and growth oriented.

The bottom line? The time is right to join the Industry 4.0 revolution.

Join the digital manufacturing revolution with our financing and advisory services

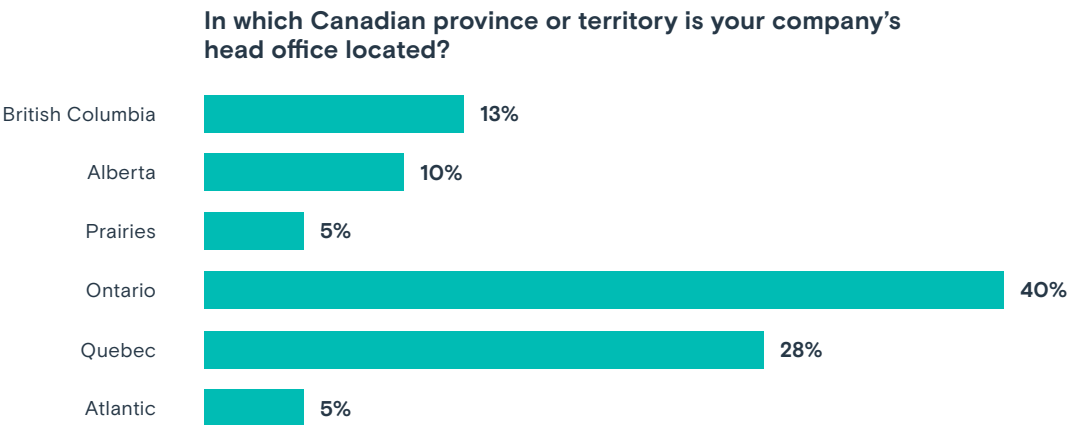
- Obtain financing to invest in digital technology, provide new skills to your employees or purchase equipment and machinery. For more information, visit [bdc.ca/financing](https://www.bdc.ca/financing).
- Power up your productivity with advisory solutions designed to make your business more efficient and competitive in today's marketplace. For more information, visit [bdc.ca/productivitysolutions](https://www.bdc.ca/productivitysolutions).
- Are you lagging behind your competitors? Use the Canadian business productivity benchmarking tool to find out in just a few minutes where you stand compared to other Canadian businesses in your industry at [bdc.ca/productivity](https://www.bdc.ca/productivity).

Appendix

Survey methodology

For the purposes of this study, we first interviewed a dozen Canadian manufacturers, as well as professionals with clients in the manufacturing sector, who had experience with Industry 4.0 projects. We then asked Ad Hoc Research to conduct a telephone survey of 960 leaders of manufacturers with 10 to 499 employees. The survey was carried out between January 16 and February 22, 2017. A stratified sampling plan was prepared to ensure sufficient respondents in every region of Canada. Next, the results were weighted by region to ensure findings were representative of Canada’s manufacturing base as a whole. The sample maximum sampling error for all respondents is 3.2 percentage points, 19 times out of 20.

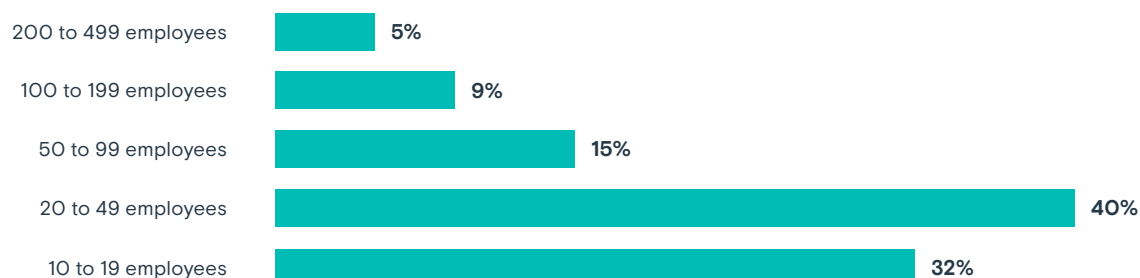
Figure 9 – Distribution, by region



Source: Ad Hoc Research, Survey on Industry 4.0 in the Canadian manufacturing sector, 2017.
Base: All respondents (n=960).

Figure 10 – Distribution, by number of employees

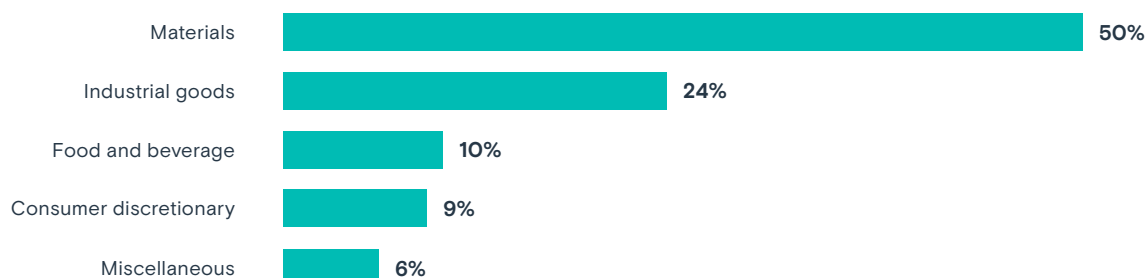
How many employees does your company have on its payroll in Canada?



Source: Ad Hoc Research, Survey on Industry 4.0 in the Canadian manufacturing sector, 2017.
Base: All respondents (n=960).

Figure 11 – Distribution, by manufacturing industry

What is your company's manufacturing sector of activity?



Source: Ad Hoc Research, Survey on Industry 4.0 in the Canadian manufacturing sector, 2017.
Base: All respondents (n=960).

The materials sector includes manufacturers of wood products, paper, chemicals, plastics, rubber products, non-metallic mineral products, primary metals and fabricated metal products. The industrial goods sector includes manufacturers of machinery, electrical equipment, appliances and components, and transportation equipment, as well as printing and related support activities. The food and beverage sector includes manufacturers of food, beverage and tobacco products. The consumer discretionary sector includes manufacturers of textiles, clothing, leather and allied products, furniture and related products, and computer and electronic products. The miscellaneous sector includes manufacturers of medical devices, signs, toys, jewellery, sporting goods and office supplies, as well as petroleum and coal products.

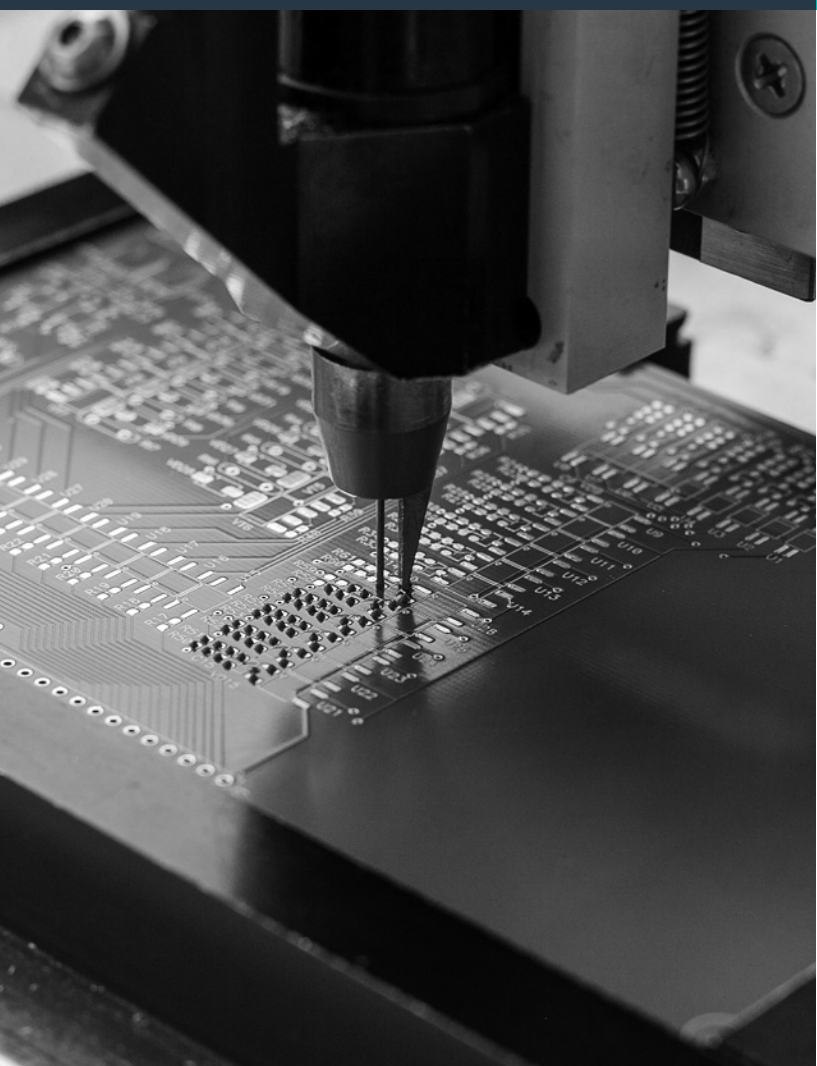
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