

The manufacturing sector in the 21st century: beyond the factory A veritable revolution is under way

Faced with increasing international competition, manufacturers are on the look-out for better tools with which to upgrade their performance. In the past two decades, accelerating globalization and fast-paced technological evolution have been largely responsible for the transformations to which manufacturers have had, and still have, to adapt. It has become increasingly essential to revive investments, since the slowdown of the 2000s has made Quebec industries less competitive. Companies must now rebuild their models and perhaps even their factories. Competition demands a lot: the issue facing the manufacturing sector lies in businesses' ability to implement comprehensive investment plans over the long term. Two priorities stand out with respect to manufacturers' ability to ensure their long-term survival: developing workers' skills in using new technologies, and integrating businesses into international supply chains.

THE MANUFACTURING SECTOR: A PILLAR OF QUEBEC'S ECONOMY

In the past 15 years, Quebec's manufacturing sector has faced numerous upheavals that had definite adverse effects on its performance. The manufacturing sector's share of the economy (over 20% of total GDP in 2002) fell to 14% in 2014. One explanation for this lies south of the border: the economic impasse in which the United States put itself during those years weighed very heavily on Quebec manufacturers' sales to that country. Since the United States had always been their primary export market, Quebec firms not only felt the fragility of their American trade partners, but they were also obliged to adapt to the marked appreciation of the Canadian dollar between 2004 and 2014. All of this clearly cast doubt upon Quebec's competitiveness in that market, resulting in particular in a very sharp drop in the balance of trade with the United States from 2006 to 2014.

In the global arena, competition from the emerging countries and the explosive development of their industries also upset the apple cart in terms of the traditional positions of the developed countries in international markets. On top of their relatively low wage costs, the emerging countries began making more and more use of advanced technologies. This enabled them to start producing increasingly sophisticated goods, putting added pressure on the competitiveness of Quebec manufacturers.

Meanwhile, the unprecedented acceleration in technological advances over the past two decades has triggered a race to innovate and to invest, imposing new standards in production processes and technologies. Quebec's manufacturing sector now urgently needs to make investments to become more competitive and better position itself in international markets.

This is a major issue. Manufacturing is one of the engines that drive Quebec's economy, for several reasons: First, that sector accounts for nearly 80%¹ of Quebec's total exports. Its performance is therefore key to the long-term robustness of the economy.

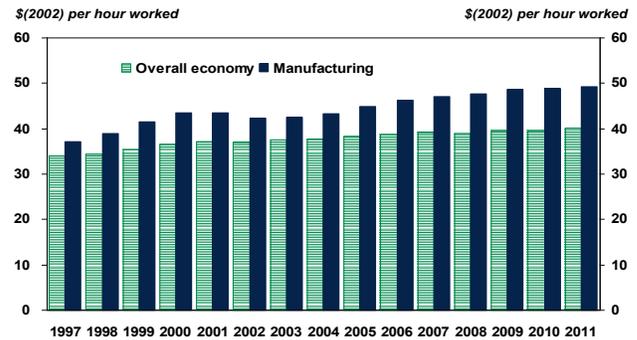
Quebec is very wealthy in terms of natural resources, and its economy depends in large measure on the exploitation and processing of those resources. Accordingly, numerous firms that are engaged in agriculture, fishing, mining and forestry supply Quebec's manufacturers. The availability of natural resources is a plus in terms of businesses' competitiveness and attractiveness.

¹ Ministère de l'Économie, de l'Innovation et des Exportations, *Le Calepin – Commerce extérieur du Québec*, July 2014
http://www.economie.gouv.qc.ca/fileadmin/contentu/publications/etudes_statistiques/echanges_exterieurs/calepin_exterieur.pdf

Creating new wealth depends on the technologies and innovations spearheaded by manufacturing industries. They account for over 50% of research and development spending in Quebec.² In addition, industrial research is essential to the design and marketing of new products, and is mainly orchestrated by manufacturing firms.

Between 2007 and 2011 (the most recent data available), the productivity of Quebec's manufacturing sector surpassed that of the economy as a whole by more than 20% (table 1). It is true that value-added services contribute to Quebec's productivity, but it is to a large extent in manufacturing plants that productivity gains are generated (graph 1). There is still room for improvement, however, especially when we consider the new manufacturing powers that are nipping at Quebec's heels. The productivity gap between the manufacturing sector and the rest of the economy is widening, showing how important that sector is to wealth creation.

Graph 1 – Labour productivity, Quebec
Dollars per hour worked



Sources: Statistics Canada, table 383-0011 and Desjardins, Economic Studies

Average weekly wages appear to be far higher in the manufacturing sector than in the rest of the economy, reminding us what an extraordinary contribution that sector makes to economic vitality.

Table 1 – Productivity gap between the manufacturing sector and the overall economy, Canada - Quebec - Ontario

	Chained \$(2002) per hour			In %		
	Canada	Quebec	Ontario	Canada	Quebec	Ontario
1997	4,8	3,2	7,4	13	9	20
1998	6,3	4,6	9,6	17	13	26
1999	7,1	6,2	11,0	19	18	28
2000	8,4	7,1	12,8	22	19	32
2001	7,0	6,4	10,2	18	17	26
2002	7,4	5,4	11,6	19	15	29
2003	7,1	4,9	11,3	18	13	28
2004	7,2	5,6	10,7	18	15	26
2005	8,1	6,6	11,5	20	17	28
2006	8,9	7,4	12,7	22	19	30
2007	9,1	7,9	12,7	22	20	30
2008	8,6	8,7	10,5	21	22	25
2009	7,8	9,1	8,6	19	23	21
2010	9,0	9,2	10,6	22	23	25
2011	9,5	9,2	11,0	22	23	26
Average 1997-2011	7,8	6,8	10,8	20	18	27

Sources: Statistics Canada, table 383-0011 and Desjardins, Economic Studies

² Statistics Canada, table 358-0161, Business enterprise research and development (BERD) characteristics


BOX 1
RECENT PERFORMANCE BY THE MANUFACTURING SECTOR

- After plummeting in 2014, manufacturing employment has rallied in 2015, but employment levels are still relatively low compared with the peak recorded at the beginning of the 2000s.
- Quebec's factory shipments have been on a clearly upwards trend since the low of 2009, but have yet to catch up to the peak of 2008. This apparent recovery is still fragile, however; annual growth in the manufacturing sector has been oscillating around a rate of zero since the beginning of 2015.
- Between 2010 and 2014, factory shipment growth came mainly from four key manufacturing industries: transportation equipment, food, wood products and rubber and plastic products. This dependence puts the diagnosis of robust health in the manufacturing sector as a whole into proper perspective.
- Across Canada, the rate of use of production capacity, after dropping from a level of around 83% in 2007 to 70% in 2009, has almost recovered (data from Q2 2015: 82%), but has yet to surpass the levels of 2005 (average of 83.7%).
- Quebec's trade deficit is largely attributable to its oil imports. However, the manufacturing sector posted a trade balance of close to zero between 2011 and 2013, given that 89% of Quebec's exports come from the manufacturing sector. This sector's role is therefore key to foreign trade's contribution to GDP growth. It would appear that the depreciation of the Canadian dollar contributed strongly to the rebound in net exports of manufactured goods that has been observed since 2014.

- Quebec accounts for 38% of Canadian high-tech manufacturing exports, and for 9% of medium-high technology exports. Looking at Quebec's exports of manufactured goods, high technology represents 24% of total exports while medium-high technology represents 19% (for a total of 43%, compared with 51% for the Canadian total).³
- Fixed asset spending on machinery and equipment is heading up again in Quebec, after bottoming out in 2009. But this growth has yet to attain a satisfactory level: spending on machinery and equipment in 2014 was barely above the amount reached in 2008. That said, after rising for the first time in 2014, investment intentions are on the upturn in Quebec's manufacturing sector in 2015.⁴ While this growth is not dramatic, it is nonetheless encouraging.

All told, Quebec's manufacturing sector is showing some resilience. Its apparent recovery is no guarantee of industrial renewal, however. The aggressiveness of the economic and industrial strategies that are being adopted in many economies, the dependence of Quebec's manufacturing performance on a few key sectors, and the relatively high proportion of low-tech exports are all factors that are weighing the province's competitiveness down. Intensifying globalization and the speed of technological advances are pushing businesses to engage in a process of constant innovation and to boldly integrate advanced technologies.

³ Ministère de l'Économie, de l'Innovation et des Exportations, *Le Calepin – Commerce extérieur du Québec*, July 2014
http://www.economie.gouv.qc.ca/fileadmin/contenu/publications/etudes_statistiques/echanges_exterieurs/calepin_exterieur.pdf

⁴ Statistics Canada, Table 029-0045 - Capital and repair expenditures, according to the North American Industry Classification System



ECONOMIC BOUNDARIES ARE BREAKING DOWN: INDUSTRIAL CONSEQUENCES

In recent years, the volume of international trade around the world has increased, despite hitting bottom in 2009 and the relative fragility of global growth.⁵ This has been accompanied by a repositioning of production clusters, largely in favour of the emerging countries. The relocation of manufacturing activities close to new, developing markets and to countries with lower production costs, the growth of intra-firm activities and the global activities of multinational corporations are all factors that have been breaking down economic borders. This process has resulted in greater segmentation and geographic dispersal of work and production. In addition, the proliferation of trade agreements (in particular bilateral ones) providing better frameworks for trade rules, has also encouraged increased trade and, more broadly, the internationalization of business.

The changing trends in global trade have forced businesses, especially SMEs, to adjust their growth strategies and their internal management models. Their ability to go global, and to participate in global value chains, has become all-important.

Nowadays, international trade requires that production be flexible and reactive; this implies excellent mastery of the business environment. The growing interdependence of economies increases the external risks facing businesses, increasingly pushing them to establish strong ties with their business partners. The effects of globalization are making themselves felt more and more and are having consequences on national economies. These include the instability of global markets (commodities, energy, etc.), protectionist behaviours and the consequences of geopolitical tensions.

This trend towards globalization has also affected the domain of information and technology. The emerging countries have become industrialized with the huge advantage of “starting from scratch” and of quickly adopting advanced technologies. The more developed economies, traditionally more active in industrial research and development and in the manufacture of value-added products, now find themselves facing emerging economies that are able to make a stand in markets that, in the past, were largely their own preserve.

The western economies must therefore become more productive and more competitive. This seems to be at the core of the strategies that have been adopted in the United States and in some European countries, in particular Germany, which are sparing no effort to boost and strengthen the performance of their factories.

According to Statistics Canada, 54% of the world’s imports consist of intermediate goods⁶ (semi-finished goods), while the foreign content of Canadian exports is tending to increase. Thus the “made in” label has become an increasingly murky indication of the source of products. This is precisely what characterizes the reorganization of industrial production: the value chains are completely and definitively global. However, the increase in foreign content does not necessarily imply a decline in national production, but rather a redefinition of the competitive advantages and industrial specializations of each country.

For businesses, growth depends on the scope of their international activities and on the technological level of their production, in response to three major industrial transformations. These are a) a new market structure characterized by global value chains; b) the emergence of advanced manufacturing technologies; and c) the growth of intangible capital in manufacturing activities.

GLOBAL VALUE CHAINS: A NEW REALITY

Globalization has thus multiplied the forms that international trade relations can take, broadening and complexifying businesses’ field of action. They must now adopt a definitively global vision in their production operations. This new complexity can be gauged from the value chains: from product design to marketing, understanding value chains makes it possible to better grasp all the possible ways to improve a firm’s productivity, to benefit from technological transfers, and to optimize procurement, production processes and distribution and logistical operations. Once inserted into a global value chain, the firm develops a business intelligence and perspicacity specific to the realities of international markets. Global trade has not only broken down geographic borders, it has also rendered the segmentation of industries obsolete; instead, it favours an approach more focused on optimizing operations and creating value at every step of production and distribution. In short, we must make the best use of each player’s strengths.

⁵ Desjardins Economic Studies, *Why has growth flagged in international trade?*, April 2015
<https://www.desjardins.com/ressources/pdf/pv150427-e.pdf?resVer=1430142036000>

⁶ Statistics Canada, *Global Value Chains and the Productivity of Canadian Manufacturing Firms*, March 2014
<http://www.statcan.gc.ca/pub/11f0027m/11f0027m2014090-eng.pdf>



In sectors where production standards are determined globally, the manufacturing phase no longer offers much in the way of profit margins. In high-wage economies, gains are increasingly to be found upstream (innovation, design) and downstream (marketing and branding strategy) of the intermediate, production phase, even though a strategic procurement strategy can increase profitability all along the value chain.

To an increasing degree, manufacturing firms are striving to achieve greater profitability by combining the sale of their products with service activities. The distinction that was traditionally made between goods production and service production appears less and less valid. We also note that the various phases of value chains are increasingly less partitioned from each other. An example may shed some light on this idea: marketing and customer relations functions are increasingly connected to the production functions, with direct communications about the existence of manufacturing defects or changes to orders.

Beyond cost reduction (linked to location or to procurement strategies, for example), it appears that the bulk of the gains achieved by optimizing the value chain are to be found in the transfer of technologies: the firm benefits from the effects

of learning by being present in the export markets. This is revealed in a study from Statistics Canada.⁷ According to this study, while firms that are integrated into a global value chain can indeed lower their costs through procurement from low-wage countries, the productivity gains associated with exports mainly arise from the integration of technologies, in particular information technologies and new production technologies. Being present in the most technologically advanced markets pushes firms to adopt production models that are increasingly computerized, automated or robotized. Thus businesses' adoption of cutting-edge technologies and their international development are two concurrent processes that are essential to their growth.

ADVANCED MANUFACTURING, OR INDUSTRY 4.0

Advanced manufacturing consists in using innovative technologies to improve products and production processes. This involves using "cutting-edge" technologies. While some sectors, such as aerospace or biotechnologies, consider using the latest technologies an obvious necessity for their activities, all industrial sectors, including long-established ones (such as forestry or agri-food) need to raise the technological standards of their production and distribution operations. Quebec is not a leader in this regard (table 2).

Table 2 – Percentage of manufacturing establishments using advanced technologies by operations group⁸

	<i>Among those, use of advanced technologies by group</i>						
	<i>Establishments using advanced technologies</i>	<i>Design, engineering and virtual manufacturing</i>	<i>Processing, manufacturing and assembly</i>	<i>Inspection</i>	<i>Communications</i>	<i>Automated handling of materials</i>	<i>Integration and control</i>
Ontario	92,9	72,8	55,1	26,0	96,1	38,4	69,6
Quebec	91,7	65,9	50,9	21,3	94,7	34,5	71,4
Canada	91,5	69,3	50,3	22,5	95	34,7	68,4

Source: Institut de la statistique du Québec, Les technologies de pointe dans le secteur de la fabrication au Québec en 2007

⁷ Statistics Canada, *Global Value Chains and the Productivity of Canadian Manufacturing Firms*, March 2014
<http://www.statcan.gc.ca/pub/11f0027m/11f0027m2014090-eng.pdf>

⁸ Institut de la Statistique du Québec, Les technologies de pointe dans le secteur de la fabrication au Québec en 2007,
<http://stat.gouv.qc.ca/statistiques/science-technologie-innovation/technologie-pointe/technologies-pointe-fabrication.pdf>



BOX 2

EXEMPLES OF NEW ADVANCED TECHNOLOGIES

The digital revolution, spurred on by the Internet and by information and communications technologies (ICT), has made it possible to reach new peaks in the fields of robotics and mechanization. The manufacturing sector knows how to seize all these opportunities, but it is also a master when it comes to developing new production technologies. Of these, 3D printing, nanotechnologies, connected objects and augmented reality appear to be the most revolutionary.

3D printing

3D printing is a process in which a real object is produced from a digital file by depositing and solidifying material in layers to obtain the final object. While plastic and metal are most frequently used, more recent developments in 3D technology make it possible to also use organic materials such as food products or biological tissue. Many techniques and processes are used, often depending on the materials. In the manufacturing sector, the production of one-off items, with complex geometry or consisting of one, single piece, makes 3D printing technologies particularly useful, especially in the aerospace and automobile industries.

Nanotechnology

Nanotechnology (sometimes called the technology of the extremely small) consists of a series of processes for manufacturing and manipulating structures, such as electronic or chemical structures, devices and material systems at the scale of a nanometer. Nanotechnology is used as extensively in industrial settings as in the field of medicine, and is enjoying rapid growth. Major nanotechnology projects include the development of nanorobots and nanomedicines. In the manufacturing sector, nanotechnology is found in energy storage, technical textiles (used in agriculture, roadworks, construction, the field of medicine and transportation),

microelectronics, as well as in traditional sectors such as the manufacturing of wood products. Nanotechnology is also used in 3D printing.

Connected objects

These are objects connected to the Internet that offer extra value in terms of functionality, information and interaction with their environment. These are not computer peripherals, but rather objects that are in communication with other systems. Connected objects are made possible by the extreme miniaturization of electronic components and are used in particular for collecting information, reacting to their environment and triggering particular actions. In the manufacturing sector, connected objects may be found throughout the production chain, often in the form of sensors or control systems, measuring a multitude of parameters and making it possible to make real-time adjustments as needed at every step of production. The fields of maintenance, management of energy consumption, transportation and logistics now use connected objects almost systematically.

Augmented reality

Sitting at the crossroads of various technologies, augmented reality makes it possible to put a set of virtual data into interaction with the real world and increases the perception of reality, in real time. The Google Glass head-mounted device is one frequently mentioned example. Initially used in military applications, augmented reality is being extensively developed in industrial settings. Some examples include: simulation in the field of transportation helps improve safety; viewing assembly process data in real time reduces production errors; product design and prototype development make use of applications that promote more innovative and productive manufacturing.

Advanced manufacturing technologies enable firms to confront the various pressures of global competition. These technologies:

- help make firms more flexible and enable them to react faster, in particular thanks to information technologies that provide ongoing communication between the various devices and the steps of manufacturing and distribution;
- help to improve quality and encourage continuous improvement thanks to the systematic use of sensors dedicated to control and self-diagnosis;

- offer the benefits of better production planning thanks to simulation technologies that can also be used to validate and accelerate processes used to innovate and to develop new products;
- offer the advantage of contemplating mass customization,⁹ without compromising economies of scale, thanks to mechanization, robotization and 3D printing;

⁹ Mass customization refers to a firm's ability to produce a customized product at a unit cost that is both profitable and comparable to that of large-scale production. Mass customization has become possible thanks to digital technologies.

- lead to an overall increase in production efficiency, thanks to cost reduction, increased collaboration with suppliers, better management of procurement, zero defects and a faster pace of production;
- facilitate interactions with customers thanks to communications between the producer and the consumer (transactional Internet);
- lie at the heart of the development of green technologies and the accelerated adoption of sustainable development principles. They can reduce firms' ecological footprint by increasing their energy efficiency and minimizing the use of materials and natural resources, thus helping them evolve towards eco-design.¹⁰

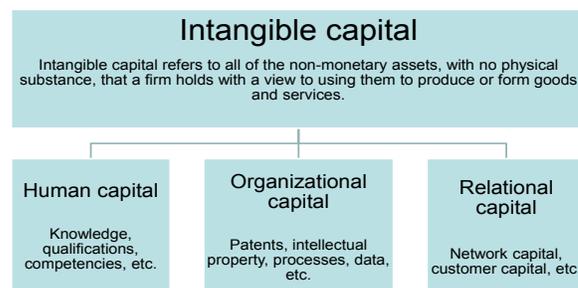
The advanced production chain produces, collects and processes a multitude of data that enable the firm to monitor its production processes very precisely and to generate technical expertise specific to its activity, promoting continuous improvement and innovation. Making use of this new knowledge constitutes the foundation of so-called intangible capital, which is now the main pillar on which the value of manufacturing firms is built.

INTANGIBLE CAPITAL: DEFINITION AND ISSUES

Manufacturing firms are positioning themselves in a new environment and are seeking new, competitive advantages that will make them unique and ensure that their business grows.

A firm's value is no longer measured just on the basis of its material or financial assets, but increasingly on what are referred to as its "intangible assets," i.e. those that stem from information and knowledge (box 3). Data show that in the United States, investments in intangible assets have reached 12% of GDP,¹¹ a level higher than that of investments in machinery and equipment (graph 2). With investments in intangible assets reaching 9% of GDP, Canada is also one of the countries where the relative share of intangible capital is the highest. Thus, manufacturing production systems are looking more and more like information systems.

Encadre 3 – What is Intangible capital?

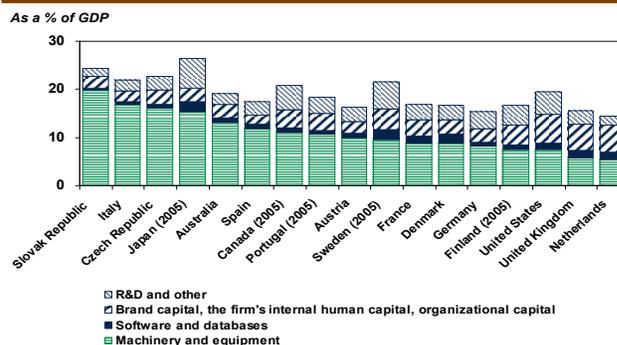


Source: Various Wikipedia articles - Capital immatériel https://fr.wikipedia.org/wiki/Capital_immat%C3%A9riel

Since innovation systems and intangible assets are at the heart of value creation, the firm itself is increasingly intangible.

Clearly understanding what constitutes intangible capital is therefore indispensable to the enhancement of a firm's value and its growth. While material assets are naturally still important in the manufacturing sector, the role played by intangible assets in value production and in the competitive position of firms is expanding. Tertiary activities upstream and downstream of product manufacturing are increasingly wielding more influence over manufacturing activities. This trend is changing the value of information and is reformulating management methods, which are now more focused on managing knowledge. This makes the quality of labour crucial.

Graph 2 – Investments in fixed and intangible assets in relation to GDP*



* Data of 2006
Source: OECD Science, Technology and Industry Scoreboard 2011

¹⁰ Desjardins Economic Studies, *Ecodesign: When the environment and the economy work together*, June 2015

<https://www.desjardins.com/ressources/pdf/per0615e.pdf?resVer=1433350219000>

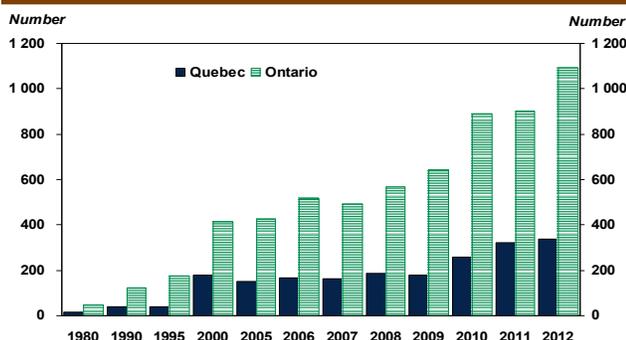
¹¹ Organisation for Economic Co-operation and Development, *OECD Science, Technology and Industry Scoreboard 2011*.

Effective matching of workers' professional qualifications with the needs of businesses is key to increasing the ability of firms to innovate in markets that are constantly changing. On this point, the German model of worker training serves as a benchmark: it proposes training that is adapted to the needs of industry. The dual system of professional and technical training that is applied in Germany proposes a theoretical component that participants learn concurrently with their work placement in industry. Thanks to a highly developed internship system and training centres that are operated within the firms, employees receive an education that is tailored to the firm's performance objectives. Bridges are encouraged between university, technical and vocational education, an approach that probably fosters innovation. While this model is certainly not perfect, it does present the enormous advantages of promoting the integration of young workers into the job market, and of increasing production quality, engagement, productivity and employees' ability to participate in the firm's technological progress.

Two major issues remain for achieving full recognition of intangible capital: that of the accounting measurement of intangible assets, and that of the protection of intellectual property, both of which can be interrelated. Patents, which are intangible assets, constitute both the foremost legal instrument protecting intellectual property and an indicator of innovation in themselves. The data on patents held in Quebec suggest that we are somewhat behind in this regard, especially in terms of the number of invention patents per billion dollars of gross domestic expenditure on research and development (GERD). In addition, the data on the numbers of people in R&D have been declining since 2009.

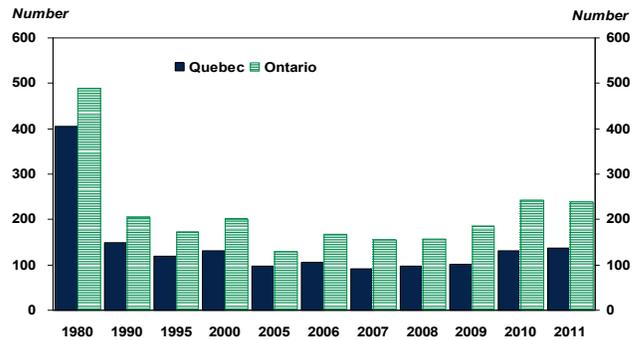
Now that information and knowledge can be infinitely shared, the ability of firms to capitalize on their differences and to turn their intangible assets into a lasting comparative advantage is one of the major challenges of the digital age. The race towards innovation is on.

Graph 3 – Number of inventions patented at the USPTO through international collaboration



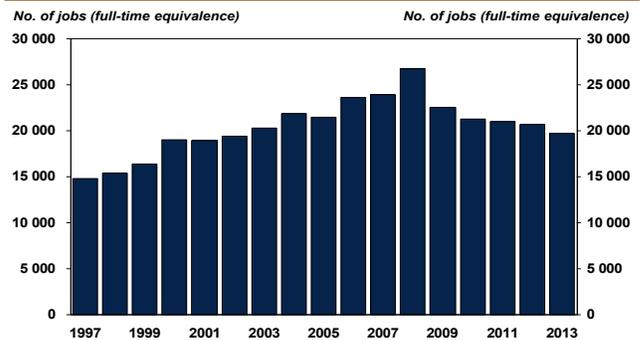
Sources: United States Patent and Trademark Office (USPTO) and Institut de la statistique du Québec

Graph 4 – Number of inventions patented at the USPTO per billion dollars of GERD



Sources: United States Patent and Trademark Office (USPTO) and Institut de la statistique du Québec

Graph 5 – Total personnel in research and development (full-time equivalence)



Source: Statistics Canada, table 358,0161, Research and development in Canadian industry

LONG-TERM INVESTMENT PLANNING FOR NEW INDUSTRIAL MOMENTUM

Considered to be one of the pillars that will reinvigorate the economy, both in Quebec and in the majority of industrialized countries, the manufacturing sector is in the throes of change. The unprecedented acceleration of globalization has definitively expanded the playground open to firms, which are facing both new, competitive pressures, and new business opportunities.

Manufacturing firms are not only more internationalized, they are more “intangible,” and at the core of their performance lie several things: an organization of production closely tied to data management, a well-trained labour force, knowledge development, continuous improvement and the constant necessity to innovate. In order for a firm to achieve gains in productivity and competitiveness, it must put long-term investment plans in place.



Linked to the growing importance of intangible capital, two aspects of business models take priority in the ability of firms to evolve towards a model of advanced manufacturing:

- First of all, issues relating to human capital: the ability to absorb new technologies and to adjust production processes accordingly—and on an ongoing basis—means that competency development must be considered a strategic priority. Germany's industrial performance is largely based on businesses' investments in labour force development. Flexibility in the organization of work and ongoing training are necessary to enable firms to adjust to changing markets, and will guarantee their performance over the long term. Therefore, advanced manufacturing requires the most promising approaches to human resource management. Another reason why this aspect has priority is that it certainly involves the changes that are most delicate and that take the longest time to put in place.
- Another priority aspect to be considered is the integration of firms into international supply chains, which enables them to better grasp changes in the markets, to better position themselves against the competition, and to benefit from technological transfers more quickly. The more intangible nature of their activities also pushes firms to “get out of the firm”: partnerships and open innovation thus appear to be increasingly important for strengthening businesses' foundations within their business networks. High-tech sectors (such as biopharmaceuticals and aerospace) are increasingly relying on international and intercompany cooperation for research and development, the costs of which just keep growing and the anticipated profitability of which is more uncertain. So with globalization, the need to stand out from the crowd also involves cooperation. This is also the case in business relations with suppliers, with whom the sharing of data is becoming a practice that is essential to smooth operations, in particular logistical operations. Lastly, positioning oneself in foreign markets requires proactive marketing and prospecting strategies.

The manufacturing sector is undergoing profound changes. At the same time, its importance in Quebec's economy has diminished since the beginning of the 2000s. Now that we are rediscovering the virtues of this sector, we find that Quebec, like the industrialized countries, is far from being up to date, and that it urgently needs to adapt to the new state of affairs. While the appeal of major industrial investment projects is still important for strengthening and validating the competitiveness of Quebec manufacturing, the establishment of conditions that are conducive to the start-up and growth of exporting SMEs is a top priority.¹²

The apparent recovery of Quebec's manufacturing sector since the end of the recession is no guarantee of industrial renewal: we must do more. With globalization, developing countries have become fierce competitors, equipped with cutting-edge technology. Faced with these competitors, the industrialized countries have no choice but to increase their productivity and to follow the new game rules for international trade. Understanding value chains enables firms to better grasp every opportunity to improve their productivity. The bulk of the gains achieved through the optimization of value chains appears to lie in the transfer of technologies. Advanced technologies force us to think not only differently, but more efficiently. Meanwhile, a firm's value is no longer measured merely on the basis of its material or financial assets, but increasingly on its assets that are referred to as “intangible.” In this context, matching workers' qualifications to business needs becomes crucial. In addition, in order for a manufacturing firm to achieve gains in productivity and competitiveness, it must establish long-term investment plans to tackle its competitors on equal terms and to become a world-class trading partner. The rules of the game have changed, the manufacturing sector is going through a veritable revolution, and Quebec needs to keep up with the times.

¹² Desjardins Economic Studies, *The internationalization of Quebec SMEs - A necessity for making Quebec more productive, more entrepreneurial and more prosperous*, October 2014
<https://www.desjardins.com/ressources/pdf/pv141016e.pdf?resVer=1413469162000>