The impacts of the digital transformation of the industry

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Abstract

The digitization of industry or plant 4.0 is an interconnected system that connects machines, management methods and products. New technologies, new products and services, as well as new business models can disrupt operations. In this case, the adoption of the principles of Industry 4.0 becomes a necessity. The managers of the firms must be ready to acquire a new organizational structure. In this new economic order, Industry 4.0 will transform businesses in many ways. The article aims to explain the endogenous and exogenous impacts of the digitization of industry on the functioning of organizations, consumer behavior, work organization, market variations, and influences on different activity area.

Key words: Industry 4.0, digitization, value chains, innovation, manufacturing industry, 3D simulation.

Résumé

La numérisation de l'industrie ou l'usine 4.0 est un système interconnecté qui relie machines, méthodes de gestion et les produits. En effet, les nouvelles technologies, les nouveaux produits et services, de même que les nouveaux modèles d'affaires peuvent perturber les opérations. Dans ce cas, l'adoption des principes de l'Industrie 4.0 devient une nécessité. Les dirigeants des firmes doivent être prêts à se doter d'une nouvelle structure organisationnelle. Dans ce nouvel ordre économique, l'Industrie 4.0 transformera les entreprises sur plusieurs plans. L'article a pour objet d'expliquer les impacts endogènes et exogènes de la numérisation de l'industrie sur le fonctionnement des organisations, le comportement des consommateurs, l'organisation du travail, les variations du marché, ainsi que les influences sur les différents secteurs d'activité.

Mots clés : Industrie 4.0, numérisation, chaînes de valeur, innovation, industrie manufacturière, simulation 3D.

Introduction

Industry 4.0 encompasses the digitization of horizontal and vertical value chains, product and service innovation and the creation of new business models. The main operational drivers of the transformation include improving the customer experience, accelerating the time to market and reducing costs. Indeed, the leaders of industrial companies who wish to reap the fruits of this revolution give priority to Industry 4.0.

The creation of a production environment focused on Industry 4.0 is a phased approach that will span several years and include the modernization of existing systems.

Once the transformation is underway, the opportunities for leveraging Industry 4.0 technology and related concepts will be unlimited. In this respect, this article will analyze secondly the economic and managerial impacts of these developments on the functioning of institutions, as well as their influence on the variation of the world of work, and will discuss options for meeting these challenges.

The manufacturing industry is going through an extremely uncertain and unpredictable period of spending and consumer confidence, on the one hand, and the geopolitical and macroeconomic situation in the broad sense is high. In the United States, the protectionist climate makes manufacturing one of the main objectives of the new presidency. In other regions, similar protectionist risks are present.

It is clear that under such conditions, automation and cost reduction are increasingly necessary, while increasing efficiency (increased time to market, scanning and digitization to maximize revenue, etc.). .). It is certainly here that we see an even faster adoption of the Industrial Internet of Things, in which the initial factors are the same as in the initial factors of digital transformation: to increase flexibility and reduce waste, to reduce costs and improve efficiency, from manufacturing operations and operational processes to maintenance and services.

1. Definition and characteristics of a digitized factory

Industry 4.0 is a concept that refers to a fourth industrial revolution and therefore, like the last 3 (steam engine and mechanization in the 19th century, mass production and conveyor in the 20th century, automation since the 70s) , to a new production method. More specifically, the Digitization of Industry or Plant 4.0 is an interconnected system that links machines, management methods (such as Enterprise Resource Planning, ERP) and products. This is a "new workshop" that can take the following forms:

- ✓ An innovative factory
- ✓ A totally digital factory
- ✓ A flexible factory
- ✓ A factory turned towards its external actors
- ✓ A socially responsible factory
- ✓ A plant that is economical and environmentally responsible

2. Issues around the digitized industry

The industry of the future is a much more transversal notion, it responds to challenges in four major areas:

2.1. Technological issues

Markets are changing and the requirement is increasing. It has never been so important to respond to demand in a short time and at negotiated prices. Meanwhile, this same demand is taking off in customizable products, forcing industries to design agile and reconfigurable processes almost instantaneously.

2.2. Organizational challenges

Machine agility is also accompanied by organizational agility. Finally, the upscaling and innovation strategy, coupled with ever more flexible production, requires a rethinking of management and more specifically of human resources.

2.3. Environmental issues

Since the 1970s, the industry has been subject to legitimate environmental pressures. With dwindling resources, climate change, and the energy transition slowly underway in all countries, Plant 4.0 is more than ever in need of a very small ecological

footprint. This plant must also "think" about its products, often a major source of pollution and environmental debt[*].

2.4. Challenges at the societal level

The industry must seek to reduce its negative impacts on its economic and social environment (negative externalities) and thus develop a social responsibility (CSR). New technologies, new relationships of different stakeholders, new management methods, etc. are at the heart of Plant 4.0 and aim to address these issues.

3. The Challenges of Digital Transformation in Industry

3.1. Economic and strategic challenges

- The main challenges of the digitization of the manufacturing sector are as follows:
- The traditional challenge of skill shortages in the manufacturing sector is almost entirely related to the integration of information technology and information technology (operational technology) and other technological and customer / service / innovation developments. ;
- An uncertain macroeconomic and geopolitical context in which risk must be managed, cost reductions and inevitably increased efficiency;
- A more complex and connected logistics chain where data / information and speed are essential;
- The need to better understand the possibilities and benefits that can be obtained. While this is a strategic and informational issue, it also forces manufacturing companies to understand the technological drivers of new opportunities such as digital twins, robotics, artificial intelligence and 3D printing, among their advantages, their use case and their overall context.
- A customer in constant evolution, with a growing need to be not only more customer-centric, but also more adaptive and innovative.

A highly competitive environment in which the fastest are on the verge of gaining benefits and even becoming disruptive;

- The need to diversify and exploit new sources of income, exploiting new ecosystems and (connected) data, to thrive and, in some cases, survive;

[*] Maurice Ricci, [2016].

- Lack of clear vision and strategic overall approach to take advantage of Industry 4.0's revenue growth and potential for new revenue streams;

3.2. The challenges of the human factor

- Regarding the link between the digitization of Industry 4.0 and the adaptation of the factor "work L", it should be noted that the dimension of human talent in a changing reality where technology and innovation play deeper roles and talent in many of the mentioned areas (data, industrial IoT, convergence of information and telecommunications technologies, new business models, etc.), nor culture are present taking the necessary steps.

- Regarding the size of the skills and talent shortage, it is clear that as Industry 4.0 arrives and the digital transformation of manufacturing continues, the reality of work changes.

- According IDC* (data end of 2016), by 2020, 60% of G2000 plant workers will work alongside automated assistive technologies such as robotics, 3D printing, AI and AR / VR.

- In addition, automation, optimization and transformation in progress have a human cost. From a purely commercial point of view, it is also a challenge. To this end, the human consequences must be addressed at a time of rapid digitization a threat. Every organization, and in the manufacturing sector, is certainly a key element, it must be aware of the impact of automation and its role in society, because neglecting human costs can lead to further erosion of brand and trust capital, as well as declining consumer confidence and buying.

4. The managerial strategies of the digital transformation of the industry

Maurice Ricci, [2016] proposed a relevant process for the digital transformation of the industry based on several parameters:

4.1. The reconstruction of the business model of the company

The integration of digital into the production process offers new opportunities for creating value for the company. It allows to reconstitute the means not only to optimize its activity but also to reinvent itself by positioning itself differently on the value creation chain.

* IDC Manufacturing Insights: Service Innovation and Connected Product Strategies The consulting service is perfectly suited to meet the needs of companies: Producers looking for technologies and business models of services and advanced diagnostics to enhance the value and differentiation of products and services, increase service revenues.

4.2. Innovation and acceleration of the digital transition

In the face of technological change and the scope of opportunities offered by scientific research, the capacity for innovation becomes a key factor of differentiation, competitiveness and performance. It must become an essential axis of development of the company. Innovation is no longer the exclusive domain of technology and R & D. It invests the other dimensions of the organization: its processes, its way of working, its customer relationship, its production line, and, of course, its strategy. It becomes a process of transformation of the company as a whole and not only a way to improve the products. It opens up to the ecosystem and builds on it (Ricci, [2016]).

Digital is an almost inexhaustible source of innovation for the product, of course, but also for changing a usage, a process, a business model. From then on, what better way to start opening than to get closer to the queens of the sector: start-ups and SMEs of the digital world. By going to meet them, the company will become familiar with the technologies and uses that it does not necessarily have internally: connected products, 3D printing, mobile uses, Big data, collaborative tool (Ricci, [2016]).

4.3. Strengthening the Company / Client relationship

The digital transformation of the industry contributes to the optimization of the relationship maintained with the customer. Digital technology enriches the latter by bringing more interactivity, proximity and transparency. It thus facilitates the coherence of the customer experience across all interaction channels.

According to Ricci, [2016][*], Collaborative tools and Customer Relationship Management (CRM) software are now called CX - Customer Experience. CX software, for example, provides a complete view of the customer and their situation (360 ° vision) by concentrating in a single space all the information related to it (lead marketing, opportunities, history, contracts in progress, service data, commercial data, litigation, etc.); this, regardless of the channel used by the client to contact the company (call center, email, mail, website, social media ...).

4.4. The acceleration of the design

[*] According to the author, the customer's information must be accessible to all the services of the company in contact with it (marketing, sales department, sales administration, after-sales service, etc.) in order to ensure a coherent and efficient follow-up and fluid of the relation. For its part, the customer lives a harmonized experience of its different modes of interaction with the company.

In a context of intense global competition, we must constantly innovate; reduce costs and time to market. To achieve this, companies have no choice but to design their products differently. This especially as the products themselves evolve and become more complex.

Digital offers a more open and collaborative approach to design. It democratizes the 3D simulation and makes it possible to better take into account the software in the life cycle of the product. It introduces new manufacturing techniques that broaden the horizon.

In the digital world, the evolution of services and software tends to be continuous. To reach this rhythm, digital societies follow two rules: they favor incremental evolutions; they drive the projects in an iterative and collaborative way (Ricci, [2016]).

4.5. Proactivity of the industrial chain

The answer of the digital to the question of the optimization of the production, it is to pilot it by the data. How? By digitizing and interconnecting all links in the industrial value chain: from sales order to delivery including sourcing and supplier interactions (Ricci, [2016]).

Thus digitized and synchronized, the chain is characterized by its flexibility and modularity. It can be reconfigured automatically and adjusted according to demand. It adapts to unavoidable variability (raw material prices and volumes, unpredictable supply, machinery breakdowns, quality fluctuations, etc.) while maintaining its quality objectives and optimized TRS.

The digitization of the chain begins with that of the factory. It is obtained by connecting to the IoT all its components: machines, parts, products, workstations. Equipped with sensors and transmitters, these cyber-physical systems communicate with each other and interact continuously, through networks, adaptation gateways and data exchange platforms.

4.6. The revalorization of the role of the human

Give back the desire to work at the factory. Digital technology can contribute to this other ambition of the Industry of the Future program by better taking into account the human aspects and by revaluing the role of the operator.

In a factory where the machines become more autonomous, the role of the operator evolves towards that of responsible pilot. Equipped with a mobile terminal connected (smartphone, tablet, etc.) possibly reinforced, it gains autonomy, moves and remotely monitors the current operations on several machines. Notifications on his mobile device alert him to incidents. It instantly accesses the necessary documentation (Ricci, [2016]).

5. The impacts of the digital transformation of the industry

A silent revolution is at work at the heart of our economy. This is the emergence of the "Industry 4.0" that affects our economy at very different levels, from production processes to distribution, through the organization of work, or marketing or advertising.

New technologies that mix the physical, digital, biological, digital, 3D printing and Big Data worlds are the first factors of economic and organizational upheaval for companies and their foundations. The integration of these technological and digital developments influences all disciplines, economies, industries and consumer behavior. Properly used, digital technologies can thus contribute to producing goods that are better adapted to demand and more efficiently, thereby reducing the waste of energy and raw materials and increasing the competitiveness of companies.

5.1. The impact on the overall corporate strategy

Industry 4.0 solutions will change the way businesses operate. They will influence the portfolio of products and services of companies. Right now, new smart products and services need to be created, but new business models will quickly become a necessity. In addition, young companies offering a disruptive value model will enter the market. Under these conditions, the implementation of Industry 4.0 will require the full participation of management. Businesses will need to grasp the impact of digital transformation on their entire organization.

5.2. The impact on consumer behavior

Industry 4.0 enhances consumer welfare by increasing the number of varieties and diversifying the consumption basket at a lower cost. The new varieties will even be customized since it is possible to communicate with the machines during the production process and modify by customizing the varieties.

This new production organization is called the "Smart Product" is based on the multiplication of sensors that emit signals to the robots of a production line in order to adapt the varieties according to the tastes or needs of customers.

5.3. The impact on work organization

Industry 4.0 based on robotic and connected systems will upset the production organization of manufacturing industries. It will affect all trades (engineers, workers, maintenance operators, etc.) and the labor market. There will be a job-creating destruction as happened during the first three industrial revolutions.

5.4. The impact on the investment

Industry 4.0 will have a significant impact on the IT sector. Today considered an innovative trend, digitization will become a fundamental skill [*]. The 2016 CGI Global 1000 report [†] revealed that manufacturing organizations are seeking to lower the cost of running existing processes and systems, as well as increasing investment in digital transformation.

However, they are struggling to make the necessary adjustments to fund this transformation, as they must continue their commercial activities while taking the shift in Industry 4.0. In an effort to accelerate transformation, manufacturers are rapidly integrating automation and digitization.

5.5. The impact on business sectors

- ✓ All these smart technologies will affect all sectors:
  The medical sector will be equipped with more and more robots that will be able to perform surgical operations, play the role of nurses in a virtual way and even recognize symptoms of diseases and act in real time;
- ✓ Banks will be more secure by minimizing operational risks. Relationships with customers will be more personalized and faster thanks to connections between robots, mobile applications and customers;
- ✓ E-commerce will grow thanks to 3D images;

[*] "Evolve or change nothing? »CGI.com Website accessed November 28, 2016. https://www.cgi.com/sites/default/files/white-papers/evoluer-ou-ne-rien-change_technical-study.pdf

[†] In 2016, as part of the CGI Global 1000 report, CGI conducted face-to-face interviews with 87 business and IT leaders from manufacturing organizations in 13 countries to gather feedback on key industry trends as well as their priorities and their business and IT plans.

- ✓ The agricultural sector will benefit from artificial intelligence through the use of drones that monitor land, crops, irrigation water requirements, detect microorganisms and genetic mutations.

5.6. The impact on the product lifecycle management

Supply Chain Management, Operations Management, and Product Lifecycle Management. Digitization already facilitates business collaboration. Cloud-based solutions enable organizations to share data with customers, suppliers, and other supply chain partners.

However, a connected, demand-driven supply chain is only possible if departments and businesses open up their structures. The integration of Operational Technologies (OT) and Information Technology (IT) is required to connect process control, operations management, and business planning. Companies will also need digital product models for full product lifecycle management.

5.7. The impact on the economic and managerial evolution of the organization

The transition to digital remains a profound transformation of the company. It modifies the processes the organization. It also drives different ways of working, requiring teams, more collaboration, autonomy and responsiveness. It also requires a change in skills, especially those of employees in the plant, whose working environment and tools change greatly.

- ✓ **Decommissioning of the company's activities**

The end-to-end integration of the flows and processes of the industrial chain, like the refocusing of the company around the customer. The workshop, in particular, must open its doors to the other activities of the company. In order to work intelligently and reactively, trades are brought to communicate and share tools and data.

- ✓ **Opening of the company**

To achieve the expected level of flexibility, the company is also opening up to its suppliers and partners. The client who gives his suppliers a prospective view of his production is more likely to see them adapt and react to his request.

- ✓ **Development of computer skills**

Convergence between IT and industrial technologies at all levels of the chain also requires the acquisition by some businesses of knowledge or even computer skills. If the

head of the supply chain is already more often a computer specialist than an industrialist, it is more rarely the case of the head of security, which must henceforth understand the stakes of cybersecurity. In the same way, the production manager must understand how Big Data can improve its business.

Digital technologies are characterized by their rapid evolution. Knowledge and skills in this area will need to be updated regularly.

Conclusion

In the context of Industry 4.0, several security features need to be considered. Production systems have important requirements in terms of reliability, availability and robustness. Faults and disturbances should be avoided. In addition, access to data and services related to production must be controllable to protect the company's know-how, and prevent economic damage. Security is therefore essential to the success of intelligent manufacturing systems. It is important to ensure that production facilities are safe for people and the environment, as well as the data and information they contain. They must be protected against misuse and unauthorized access.

The transformation of Industry 4.0 is a digitized enterprise through the Internet of Things and virtual networks that allow to control physical subjects in a continuous and instantaneous way through communication with different machines and production lines, the customers and suppliers.

The sensors that communicate are the tool that allows to act on the characteristics of varieties and remote control. To develop Industry 4.0, it would be necessary to invest in a 3D virtual model for digitized products and processes that are fully connected with all stakeholders. It requires investments in scientific research within universities and laboratories of firms that will have to cooperate together by multiplying research partnerships. However, this intelligent technology will be able to set new challenges. The excessive connection between all parties increases the cyber security risks. Zero risk is low and possible faults and configuration faults can be exploited.

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