

CONCEPTUALITY X REALITY, THE CURRENT CONJUNCTURE FOR THE IMPLEMENTATION OF INDUSTRY 4.0 IN BRAZIL

CONCEITUALIDADE X REALIDADE, A CONJUNTURA ATUAL PARA A IMPLEMENTAÇÃO DA INDÚSTRIA 4.0 NO BRASIL

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Vinícius Radetzke da Silva¹
Alicy Ferreira Lopes dos Santos¹
Ermilo Sampaio Limana¹
Vityano Buzata Tambara¹
Ana Carolina Cozza Josende da Silva²

1 Instituto Federal Farroupilha- IFFAR, 2 Franciscan University-UFN

ABSTRACT

Purpose: To analyze the impact of technological evolution on industrial production capacity and how Industry 4.0 can be developed for the Brazilian industrial scenario.

Design/methodology/approach: Data collection was through the selection of studies - scientific articles, books, dissertation, among others - current and relevant on the topic, through an exploratory descriptive research, as well as the use of an electronic platform such as Google Scholar, Journals CAPES, Scielo and Scopus. The analysis took place through reading, comparison and discussion between the different authors and studies found.

Findings: The results evidenced, show that the Brazilian context falls short of what would make the country a player of world production. The roles in this process process an integrating responsibility between governments, companies and international partnerships, for a more agile adaptation to the latest world production model.

Practical Implications: Investments by political-governmental segments are still ineffective, compromising the generation of wealth, taxes and fees in Brazilian companies.

Social Implications: Thematic contemporary to the reality of the country, in order to offer new alternatives for research and knowledge to be used by companies, academics and society.

Originality/Value: It consists of investigating the current level of industry 4.0 dimensions in the Brazilian context, and proportional improvement for national companies in global markets.

Keywords: Industry 4.0. Fourth Industrial Revolution. Smart Factories.

RESUMO

Objetivo: Analisar o impacto da evolução tecnológica na capacidade produtiva industrial e, como pode ser desenvolvido a Indústria 4.0 para o cenário industrial brasileiro.

Metodologia: A coleta de dados foi através da seleção de estudos - artigos científicos, livros, dissertação, entre outros – atuais e relevantes sobre o tema, através de uma pesquisa descritiva exploratória, bem como a utilização de plataforma eletrônica como, Google Acadêmico, Periódicos CAPES, Scielo e Scopus. A análise deu-se por meio da leitura, comparação e discussão entre os diferentes autores e estudos encontrados.

Resultados e Conclusões: Os resultados evidenciados, dão conta de que o contexto brasileiro está aquém ao que tornaria o país em um player de produção mundial. Os papéis nesse processo exigem uma responsabilidade integradora entre governos, empresas universidades e parcerias internacionais, para uma adaptação mais ágil ao mais recente modelo de produção mundial.

Implicações Práticas: Investimentos de segmentos político-governamentais ainda são ineficazes, comprometem a geração de riquezas, impostos e competitividade de empresas brasileiras.

Implicações Sociais: Temática contemporânea à realidade do país, com intuito de proporcionar novas alternativas de pesquisa e conhecimento a ser utilizado por empresas, acadêmicos e sociedade.

Originalidade: Consiste em investigar o atual patamar das dimensões da indústria 4.0 no contexto brasileiro, e propor estratégias de melhoria para a competitividade de empresas nacionais em mercados globais.

Palavras-chave: Indústria 4.0. Quarta Revolução Industrial. Fábricas Inteligentes.

1 INTRODUCTION

Historically, the first industrial revolution has been marked basically by the transition from artisanal production to mechanized production processes. These were revolutionary changes for the economy at that time since they significantly increased productivity. The evolution in industry and production systems were perfected by the incorporation of information technologies to manufacturing processes, which, therefore, brought benefits capable of further leveraging industrial productivity, with the presentation of effective solutions in customer service, with quality, speed and better cost-benefit (Cheng et al., 2015).

What contemporaneity calls Industry 4.0 can be conceived as a new industrial revolution, as it differs from the previous ones by making mass production technologies flexible and customized (NG Informática [NGI], 2017). According to Perez (2010), industries that want to follow this path for Industry 4.0 need, first of all, to evaluate their adaptation capabilities, as well as review and reorganize their strategies. With these actions as a starting point, the desire to be part of the new context may become a reality.

Industry 4.0 (I. 4.0) refers to a high-technology strategy that aims to make production systems greater, flexible and collaborative, in an environment where machines use self-optimization, self-configuration, or artificial intelligence to accomplish complex tasks, providing higher cost efficiency and higher quality of goods and services (Bahrin, Othman, Azli, & Talib, 2016). And, the great protagonist, is the Internet, consolidated as the great channel of convergent communication of all technologies, being inserted in the industry in machines and equipment.

In Brazil, Industry 4.0 is even more conceptual than real. For organizations to reach levels consistent with the rest of the world, Industry 4.0 requires government incentives, which include investments in research and development. This is because the transformations caused by this industrial process are irreversible and those who wish to succeed in this new reality will also need to develop new skills, as the profile of the workforce will have to change completely. New professionals will need to have multidisciplinary training, adaptability, a sense of urgency and good relationship (Confederação Nacional da Indústria [CNI], 2016b).



It is important to justify this study because it is a contemporary theme to the reality of the country, it aims to provide new research and knowledge alternatives to be used by companies, academics and society. It may also contribute to the understanding of the strategic scenario in which the productive sector is set, contributing to the acceleration of new practices in the context of I. 4.0. In view of that, to investigate what is the current level of the dimensions of industry 4.0 in the Brazilian context justified the importance of the study in view of proposing improvement strategies for and competitiveness of national companies in global markets.

The general objective of this study was to analyze the impact of technological evolution in the industrial production capacity and, how Industry 4.0 can be developed for the Brazilian industrial scenario, as well as the applicability factors necessary for the implementation of this new industrial revolution. As specific objectives, to conceptualize Industry 4.0; to raise the aspects for its implementation in the industries; to identify in which stage is the implementation in Brazil; to evidence the factors promoting the development of Industry 4.0.

2 INDUSTRY 4.0

In order to better understand Industry 4.0 and its context, it is necessary to observe the previous industrial revolutions, due to the importance of the preceding events for the beginning of the process of the fourth industrial revolution. The discussion on the theme is not recent, in the course of time it has gone through several transformations in Brazil and the world, so it is relevant to analyze, even if briefly, its historical perspective according to the authors Abreu et al. (2017); Amorim (2017); Coelho (2016) and Schwab (2016), as follows.

Between 1760 and 1860, the 1st Industrial Revolution in England took place, characterized by the authors by the creation of the steam engine, in the period from 1860 to 1900, the second phase of the Industrial Revolution began, recognized for innovation and progress. The authors agree, stating that the production process started to use steel, fuels derived from oil and electric power. In the mid-1940s, the same authors comment that the advances became known as the 3rd Industrial Revolution, caused by technological innovations: new technologies, computerized systems and robotics being used in production.

Industry 4.0 arises from the 2000s, being recognized by several scholars as to the 4th Industrial Revolution, or Smart Factory. The model was presented at the Industrial Fair in Hannover, Germany, in 2011, from the initiative of the German government to develop a project with strategic methods that would promote the insertion of new technologies in the manufacturing production processes and allow greater competitiveness among companies in the global market. (Abreu et al., 2017; Freitas, 2017; Ribeiro, 2017; Rodrigues, Jesus, & Schützer, 2016).

According to Schwab, in the interview granted to Perasso (2016), Industry 4.0 marks a new era, in which the world market should be inserted, in a model characterized by the use of advanced technologies, automation, control and information technology. The technological revolution will provoke a transformation in the way the population lives, works and relates. For Amorim (2017), the production process has advanced towards integrated intelligent systems that make decisions related to the shop floor, from the connection of production with products/services, generating data and information for the system to organize and operate.

Freitas (2017) also states that this connection and independence result in an intelligence able to predict possible setbacks and complications, as well as being able to adapt to different situations that may arise in the production process. However, among the various high technologies being developed in Industry 4.0, the use of the Internet, software and hardware that were deployed in the 3rd Industrial Revolution and, now in this new revolution are being transformed through incremen-



tal innovations.

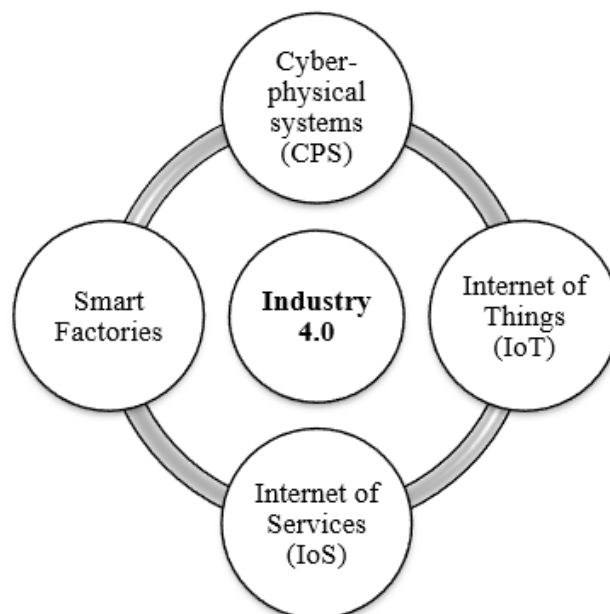
The 4th Industrial Revolution has five principles (Amorim, 2017; Santos, Manhães, & Lima, 2018):

- Real-time operation capacity: it is the competence to collect and assimilate data and information in an immediate way that allows it to issue commands;
- Virtualization: it is the digital duplication of the shop floor plan, to control the production mode through sensors;
- Decentralization: the production stages are controlled by interconnected cyber-physical systems that exchange data and information in real-time that allow instant decisions;
- Service orientation: refers to the use of software that allows the connection between systems, machines and equipment through the internet of service and the internet of things;
- Modularity: it is the adaptation and versatility of the stages of the production process in face of new needs and demands.

It is evident that Industry 4.0 provides changes in the industrial sphere in machines and equipment; exchange for virtual data and information; different innovations. The new scenario of the global market is a result of the constant purpose of improvement, success and income - production and profit - sought by companies. More demanding customers require companies to keep up with adaptation, invest in the modernization of industrial parks and enhance their production processes innovatively and efficiently. Becoming able to enter the market and keep up with the challenges and competitors (Aires, Moreira, & Freire, 2017; Santos, Alberto, Lima, & Charrua-Santos, 2018).

The advantages of technologies, as Freitas (2017) points out, will allow the achievement of productivity gains, establishment of new business models, increased cooperation among economic agents, strengthening of competitiveness, the emergence of new activities and professions, in addition to cost reduction, real-time control, increased safety and quality of life. According to Hermann, Pentek and Otto (2015), this new industrial revolution has four basic factors, as shown in Figure 1 below.

Figure 1 - Four basic factors of Industry 4.0



Source: Elaborated by the authors.

The use of these factors in the implementation of industry 4.0 will make the system ingenious, fast and efficient indeed, as will be discussed in the following topics.

2.1 Cyber-Physical Systems (CPS)

According to Khaitan and Mccalley (2015), a cyber-physical system is known as an on-board system, a set of computational elements cooperating with each other, in order to control physical entities.

In this perspective, Hofmann and Hüsich (2017) claim that the cyber-physical system is the integration of networks through the use of multiple sensors, actuators, control processing units and communication devices.

Likewise, the Brazilian Agency for Industrial Development [ABDI] in partnership with the Ministry of Industry, Foreign Trade and Services [MDIC] (n.d.), characterized, through the Brazilian Agenda for Industry 4.0, as the integration between the physical, virtual and biological field, in other words, the production process is simultaneously replicated and incorporated in real-time in the digital environment. They are software with the ability to manage and command actions and activities and even machines and equipment. Thus, with minimal or no labor interference.

Lee, Bagheri and Kao (2015) characterize a CPS as integrations of computing, networks and physical processes. On-board computers and networks monitor and control physical processes, with feedback cycles in which physical processes affect computations and vice-versa. The economic and social potential of such systems is much greater than what has been achieved, and major investments are being made worldwide to develop the technology.

The technology is based on the old technology of on-board systems, computers and software embedded in devices whose main mission is not computing, such as cars, toys, medical devices and scientific instruments. CPS integrates the dynamics of physical processes with those of software and the network, providing abstractions and modeling techniques, design and analysis for the integrated whole (Lee et al., 2015).

2.2 Internet of Things (IoT)

According to Santos et al. (2016), the Internet of things is a network of physical objects that have onboard technology, sensors and Internet connection. Objects capable of collecting, processing and transmitting data and information, which are later processed to define a certain action, that is, it has the capacity to self-manage and self-configure. The Brazilian Agenda for Industry 4.0 uses, for instance, autonomous cars that communicate with each other and define the best time, with speed and predefined routes in urban roads (ABDI & MDIC, n.d.).

According to Ray (2018), the term IoT encompasses everything that is connected to the internet, but it is increasingly used to define objects that talk to each other. The IoT is composed of devices from simple sensors to smartphones and wearables (wearable technologies) interconnected that provide the possibility of interconnecting objects in the digital world, being able to work with data and information to each other or the human being.

Hofmann and Hüsich (2017) affirm that the Internet of things makes possible several economic opportunities, besides the great possibility of being one of the greatest agents in the transforming processes of this industrial revolution. In this sense, Ray (2018) states that by combining the connected devices with automated systems, it is possible to collect, transfer, store and measure data and information for a certain purpose. This junction allows devices in closed private internet connections to communicate with other people, allowing devices to communicate not only in nearby

locations but in different types of networks, creating a much more connected world.

2.3 Internet of Services (IoS)

According to Gilchrist (2016), the internet of services is considered a true innovation that emerged in this new industrial revolution. This new technology consists of using the Internet of Things resources in an integrated system, allowing cooperation with other digital services, adding greater value to the consumer.

The author also claims that the company must analyze its business model so that it finds out how a product can become a service that promotes long-term revenue flow and, consequently, explore opportunities to improve its operations, because smart factories need to be flexible and produce smart products.

For Motlagh, Taleb and Arouk (2016), as we nowadays live in the so-called service society, there are strong indications that similar to the Internet of Things (IoT), the Internet of Services (IoS) is emerging, based on the idea that services are easily available through web technologies, allowing companies and private users to combine, create and offer new types of value-added services. It can be assumed that in the Internet-based market, the services will play a key role in future industries.

The author also proposes a broader definition of the term service, describing it as a commercial transaction in which one party grants temporary access to the resources of another party in order to perform a prescribed function and a related benefit. Resources can be workforce and human skills, technical systems, consumables, land, and others.

2.4 Smart Factories

Smart factories have the potential to manage possible complex situations that may occur in the production process and are more effective in the manufacture of products and services, due to the interrelation between resources, labor, machinery and equipment (Kagermann, Wahlster, & Helbig, 2013). Their goal is to optimize quality, quantity and costs in the production process.

Hofmann and Rüsç (2017) complement this by ensuring that the goods produced move through the production process autonomously. In addition, it has the control of its position and its immediate recognition. The production line is carried out on a large scale, in an adaptable and personalized way.

The expression “smart” consists of data and information acquired throughout the production cycle of the product, in order to develop adaptable production processes that react quickly to possible changes in demand at a low cost. All information about the manufacturing process is available when, where and in the form that is necessary (Azevedo, 2017).

The main characteristics of smart factories are visibility, connectivity and autonomy. Factories have long relied on automation, but smart factories take this concept a step further and are able to function without virtually any human intervention. Through the use of modern technologies, smart systems can adapt to different situations, enabling factories that are more flexible and efficient when compared to those of the past (Prinz et al., 2016).

In order to understand more clearly the functioning of an intelligent factory and its relationship with the other technologies that make up Industry 4.0, Prinz et al. (2016) explains its application, which derives mainly from the extensive use of sensors and IoT devices, connects machines and allows visibility of their conditions, as well as from factory processes, creating an Industrial Internet of Things (IIoT).



Increasingly sophisticated analysis and applications based on Artificial Intelligence (AI) and machine learning deal with many routine tasks, letting people concentrate and focus on exceptions and make high-level decisions. Robots are expected to occupy smart factories for routine work, working alongside people (Prinz et al., 2016).

The author also explains that smart factories rely on smart manufacturing, which connects the factory to other entities in the digital supply network, allowing more effective supply chain management. They also rely on digital manufacturing, which uses a digital twin to digitally connect a product at all stages of its life cycle (Prinz et al., 2016).

3 METHODOLOGY

The object of this research is Industry 4.0, analysis in the literature to present an overview and its applications in Brazil. As well as, to intensify the current scenario of debates and research on it, since it is a recent subject in Brazil.

The methodology used was through bibliographic research, classified as exploratory research, of qualitative nature. According to the author Gil (2002), the methodology of bibliographical research has the magnitude of expanding the sphere of study beyond the analysis properly outlined by the researcher.

In order to better meet the objectives of this study, data collection was through the selection of studies - scientific articles, books, dissertation, among others - current and relevant on the subject, through exploratory descriptive research, as well as the use of electronic platforms such as Google for Education, CAPES Journals, Scielo and Scopus. The analysis was made through reading, comparison and discussion among the different authors and studies found.

Gil (2002) describes the descriptive research as the one elaborated based on studies already carried out, consisting mainly of scientific articles and books. Opening the possibility for the researcher to address a greater number of phenomena.

Thus, the present study is focused on the intensification of the study, debate and formation of an overview of Industry 4.0 and its applications, as well as outlining the factors necessary for its implementation in Brazil, since the country is still in the first steps regarding this technology.

4 DISCUSSION

The importance of ascertaining the level of industry 4.0 dimensions for the Brazilian context, is to expand a framework of knowledge to contribute to the discussion of strategies that make it possible to improve the competitiveness of national companies in global markets. For NGI (2017), when the industrial revolution started, only when 80 - 90% of the machines used in industries at the time were exchanged for steam machines and equipment, the revolution was considered integrated. In this new revolution, it is equivalent, only when industries implement high technology that Industry 4.0 will be reached.

In this sense, CNI (2016a, p. 15) states:

The development of Industry 4.0 in Brazil involves challenges that range from investments in equipment that incorporate these technologies to adapting layouts, adapting processes and forms of relationship between companies throughout the production cycle, creating new specialties and developing skills, among others. The crossing of information allows connecting the purchase order, production and distribution autonomously, without people having to make decisions at all times.

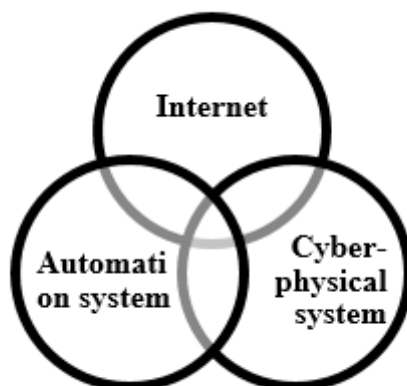


According to the COLLABO e-book (n.d.), this new revolution enables a virtual ecosystem in the value system of a product or service, allowing companies to collect, transfer and process digital data and information that can help in the creation of strategies, problem-solving and improvement in the production process, involving all stakeholders. For Coelho (2018), the process of discussions on the subject of Industry 4.0 was late in Brazil in comparison with other countries, which started the discussions in 2011. It is observed that most literature points to the vanguard in studies on I. 4.0 among those cited: Germany, United States, China, South Korea, which had government incentive policies, dealing with development (governmental, industrial and academic). In Brazil, such a delay in addressing this issue is mainly attributed to the reflexes of the 2008 economic crisis (FIEP, 2018).

The technological advances brought about by Industry 4.0 have been adapted to the manufacturing process, with confirmation of the integration between the virtual and real universe. According to CNI (2016a) and NGI (2017), the machines and equipment acquired autonomy and were reprogrammed to carry out activities without the action of man, the positive point is that they will be assisting the company in customer-oriented production, automatically making reports of maintenance, being able to collect, analyze and reach conclusions about the data obtained even during the product manufacturing process. This is possible, with the insertion of self-optimization, self-cognition and self-customization in an integrated automation system using IoT and cyber-physical systems.

In this sense, a communication network between the machines is formed, according to Figure 2, through IoT (CNI, 2016a; NGI, 2017).

Figure 2 – Integration in Industry 4.0



Source: Elaborated by the authors based on CNI (2016a).

From a collaborative point of view, the industry, according to Accenture (2015), in an estimate by 2030, investments in IoT and its consequent productivity gains are expected to add US\$ 6.1 trillion to the United States GDP, with gains of up to \$ 7.1 trillion by 2030. In other countries like Germany, an estimated GDP increase of \$ 700 billion by 2030 in the UK by up to \$ 531 billion. For the BRIC's economies, China is in a better position to reap the economic gains of the IoT when compared to Russia, India, or Brazil, plus Spain and Italy as the countries with the worst support conditions.

According to the National Bank for Economic and Social Development [BNDES] (2017), an estimate that by 2025 the Internet of Things (IoT) should generate, on a global scale, gross revenue between U \$ 3.9 trillion and US\$ 11.1 trillion, confirming the impact as explained above. In this context, Brazil appears in 9th place with an estimated potential of US \$ 70 billion by 2022.

In 2016, CNI conducted a survey on the use of technologies in Brazilian industry, with a sample of 2,225 small, medium and large companies (CNI, 2016b). When pointing to a list of digital technologies, as shown in Table 1, 58% of the participating companies stated that they know the importance of these technologies for the industry's competitiveness and less than half use them, represented by 48%. It is noteworthy that 31% of the companies replied that they did not know if they use the technologies or did not respond, making evident the lack of knowledge and information on the topic. And, it was noted that the sector that most uses technologies is that of computer, electronic and optical equipment.

Table 1 - List of Digital Technologies

List of digital technologies	Use	Importance
Digital automation without sensors	11	3
Digital automation with sensors for process control	27	20
Production monitoring and remote control with MES and SCADA systems	7	14
Digital automation with sensors with product identification and operational conditions, flexible lines	8	21
Integrated engineering systems for product development and product manufacturing	19	25
Additive manufacturing, rapid prototyping, or 3D printing	5	9
Simulations/analysis of virtual models (Finite Elements, Fluid Dynamics, Computational, etc.) for design and commissioning	5	5
Collection, processing and analysis of large amounts of data (big data)	9	15
Use of cloud services associated with the product	6	11
Incorporation of digital services in products ("Internet of Things" or Product Service Systems)	4	12
Computer manufacturing projects – CAD/CAM (2) (3)	30	9
None of the listed above	15	3
No not know / Do not answer	31	39

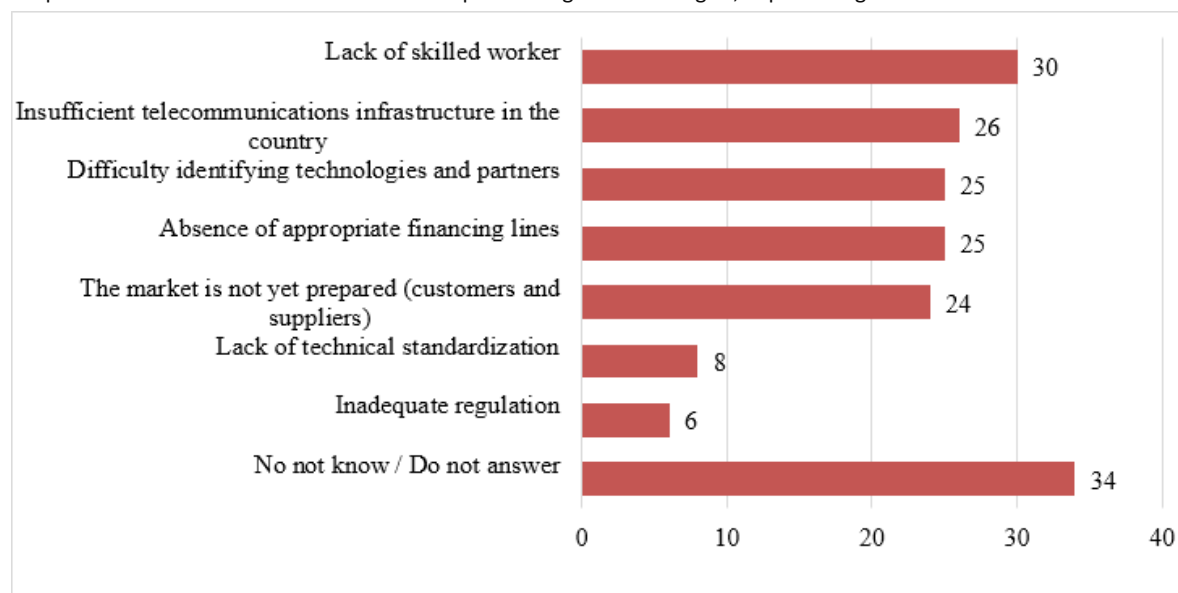
Source: Special Survey – CNI (2016b).

There are some remnants of Industry 4.0 in Brazil, some companies have a good automation index, like the automotive industry, which has machines with data communication and information received from sensors (Agência Auto Data, 2017).

According to a survey conducted by Fiesp (Federation of Industries of the State of São Paulo) in partnership with Senai from São Paulo, 227 industries were interviewed in order to identify the companies' knowledge concerning the subject I. 4.0. The results of this analysis were that: 68% have heard of it; 90% agree that "it will increase productivity"; 67% expect an average impact on implementation; 30% are "very optimistic" about the implementation in their own industry and 17% are "very optimistic" about the implementation in the industry sector; 23% are "not prepared at all", while 5% are "very prepared" to adapt to I.4.0 (FIESP, 2018).

In this context, it was investigated which external barriers hinder the adoption of digital technologies in the view of companies. CNI found in its research two main factors: the lack of qualified workers and insufficient telecommunications infrastructure in Brazil, with 30% and 26% respectively, according to Graph 1. And, the least considered relevant items by them were inadequate regulation (6%) and lack of technical standardization (8%). However, 34% of companies did not know which barriers or did not respond.

Graph 1 - External barriers that hinder the adoption of digital technologies, in percentage



Source: Special Survey - CNI (2016b).

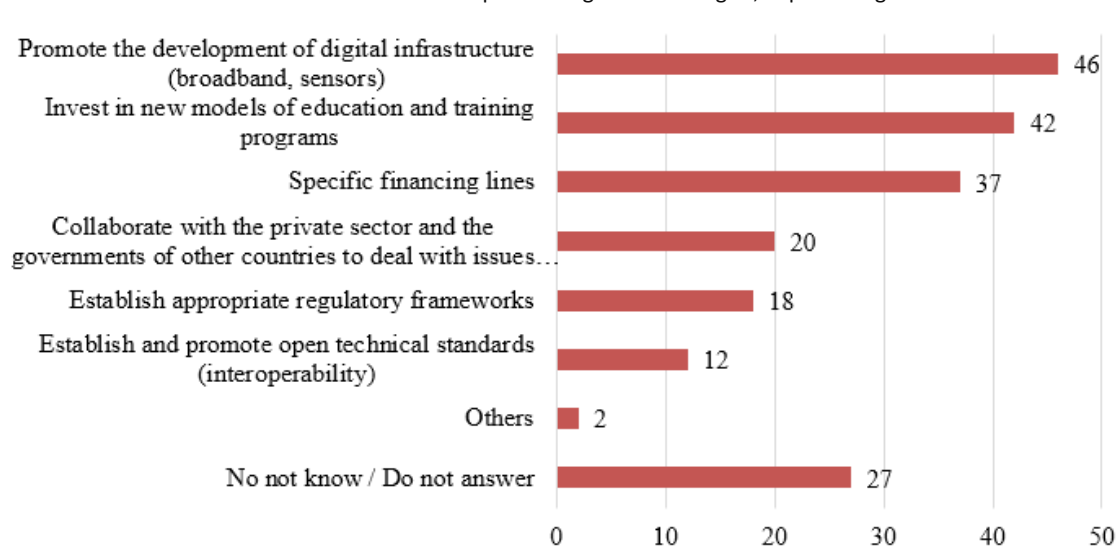
* The sum of the percentages exceeds 100% due to the possibility of multiple responses.

It is also worth mentioning that when the survey verified which actions of the Brazilian Government would speed up the implementation of high technologies in the country, according to Graph 2, CNI observed that 46% of the companies surveyed agree that the government should promote the development of digital infrastructure (broadband, sensors). As well, 42% support that it is necessary to invest in new models of education and training programs. And, 27% did not know which actions are fundamental or did not respond.

Investing in innovation and education is one of the only ways to start changing the scenario in Brazil. Some organizations are already investing in the fourth industrial revolution, clarifying the understanding of the new virtual world, however, the concepts are scattered and there are no efforts to generate qualified labor (Zancul, 2016).

In this context, Professor Zancul states in his interview with Studio ABC (2016) that there is a need to reform the economy because Brazil does not generate enough qualified labor and has high taxes. These are factors that intimidate the entrepreneur to change his business plan, especially due to the fluctuating circumstances of the Brazilian market, there are few products and services that can generate satisfactory demand. The change will provide competitiveness - including in the credit market - and more debureaucratization.

Graph 2 - Government measures to accelerate the adoption of digital technologies, in percentage



Source: Special Survey - CNI (2016b).

* The sum of the percentages exceeds 100% due to the possibility of multiple answers.

The results of the CNI survey in 2016b may be justified by the fact that Brazilian companies are experiencing in their industries the technologies of Industry 2.0 and 3.0, with the challenge of embarking on Industry 4.0 in order not to lose competitiveness in the market (Santos et al., 2018).

Therefore, it can be seen that for progress in Brazil to be successful, companies need to know about the changes that are happening in the world, how they will be impacted, such as increased productivity, reduced time and waste, easy adaptation to different scenarios in the production line. As well as being informed about the relationship between investment and earnings in these technologies.

In these circumstances of many uncertainties and doubts, CNI (2016a) initiated a program with a plan for the progress of the fourth industrial revolution in Brazil, highlighting seven prime factors:

- Concentration on the productive system and development of suppliers;
- Techniques for the introduction of new technologies;
- Technological progress;
- Expansion and improvement in broadband;
- Normative and regulatory dimension;
- Labor development;
- Institutional articulation.

In the NGI *e-book* (2017), strategic recommendations are outlined for companies to join Industry 4.0:

- Strategy: The company needs to adapt to the constant changes in the market, only then will it be able to be competitive; using the technology of Industry 4.0 should be part of the strategy.
- Opportunities: Enjoy growth opportunities, constantly searching for new technologies.
- Business model: Have strategic management that analyzes the business model, to be able to adapt to changes.
- Investment in technology: To be part of Industry 4.0, it is necessary to acquire technologies that impact the production process, in order to enjoy the benefits and gains.

However, Schwab (2016) calls attention to some challenges to be faced, some are mentioned below:

- To be a leader in the market, the entrepreneur must constantly seek improvement, be flexible and instigate himself in his plans for success;
- The new technologies that enable various possibilities and facilities can be used to monitor the user;
- Society can become individualistic, identified only by personal interests and goals;
- Losing the notion and domain of data and information;
- The virtual world is unknown.

Naturally, entrepreneurs have uncertainties regarding the need for high investment to be possible the modernization of production processes, but Aires, et al. (2017) claim that over time and new releases of technology will become cheaper. In the economic scenario, the e-book of FoccoERP (n.d.) mentions that the impacts on macroeconomics are directed to factors such as GDP, employment, consumption, trade pattern, inflation and investment

In another study, conducted in 2017 by “Projeto Indústria” (Industry Project) 2027, at the request of the National Confederation of Industry at the Federal University of Rio de Janeiro - UFRJ in partnership with the University of Campinas - UNICAMP, sought to ascertain information on the adoption of technologies in 759 medium and large industrial companies. The result revealed that “only 1.6% of the companies were in generation 4 (the most advanced in technological terms) 77.8% were in generation 1 and 2 (no production integration) not reaching generation 3 that uses technologies in industrial automation process” (IEL, 2017, p.5).

The study also presented a worrying result, 8 out of 10 companies are in generation 1, characterized as manual industrial processes, outdated machines, slow processes, with this it can be inferred that the Brazilian industry is outdated, when compared to the scenario of small companies, “about 64% consider it difficult for digital technologies to become a reality by 2027, reinforcing the distant idea of adopting technologies that will be fundamental for the development of I. 4.0”. (IEL, 2017, p.7).

In this sense, regarding the situation in Brazil:

Much of what will be needed to convert manufacturing, modes of transportation, agribusiness and other industrial sectors remains to be developed. Much of these disruptive technologies still require improvement, customization and the creation of comprehensive solutions that work and generate the expected benefits (Rodrigues & Alcântara, 2018, p. 208).

Companies seeking to be participants in Industry 4.0 must primarily analyze the scenario in which they are inserted, their strategic management and the ability to adapt. In this way, it will facilitate reaching the reality of the new revolution (Perez, 2010). Therefore, it can be seen that Industry 4.0 is an innovative world with several industrial benefits that for some is already a reality, but does not have a model to be followed for its implementation and most studies only suggest ways of its application. It is extremely important to highlight that some impacts will only be noticed after a certain period of implementation and studies.

Government actions should be intensified. According to the Institute of Studies for Industrial Development [IEDI] (2018), the main items to be followed to promote I. 4.0 in Brazil would be the adoption of four classifying areas: Governance, International Integration, Laboratories and the *Testbeds* Network. For the item Governance, the planning consists of fomenting a kind of program entitled Leadership Committee, which is the responsibility of the federal government with many

representatives of this sphere, entrepreneurs and scientists. Some political measures would be built, such as financing for the internationalization; financial support for shareholding and the acquisition of technology companies abroad; seeking to attract foreign investors to technology-based companies in Brazil (IEDI, 2018)

In addition, the proposal for the dissemination of data regarding international integration for organizations, focusing on startups in laboratory spaces in technological parks of universities and research institutes, which still lacks a certain commitment from the private sector, no matter how much. projects are considered to be of low value and low ambition (IEDI, 2018).

Understanding the importance for the economy, the Brazilian government published in June 2019 Decree No. 9,854, which created the National Plan for the Internet of Things with the main objective of accelerating the development of IoT technology in the country. Therefore, it expanded its support by launching a package to stimulate the generation of the context of I.4.0 in Brazilian industry, such program allocated R\$ 8,6 billion to help industries import robots, with tax exemption. In addition, the BNDES will allocate R\$ 5 billion in credit to develop industries in this context. The Ministry of Industry, Foreign Trade and Services has made available a financial contribution of approximately R\$ 30 million to encourage startups and industries to develop technological solutions (Pupo & Simão, 2018).

5 FINAL CONSIDERATIONS

Industry 4.0 involves integrating synergy with the use of high technology, making the emergence of smart factories, integrating IoS, IoT, cyber-physical systems in a new productive perspective. This scenario, values the reduction of costs, high productivity, speed, flexibility, and prevention of possible failures in the production process, among other benefits.

It appears that although world powers are at the forefront of the fourth revolution, the Brazilian context falls short of what would make the country a player in world production. The roles in this process demand an integrating responsibility between governments, universities, companies and international partnerships, for a more agile adaptation to the latest world production model. Efforts are still small, but they still need more impulse, incentives, reduction of fees, as verified in initiatives in the description of this study.

The research presented throughout the study confirms the low knowledge about I.4.0, as well as the production matrix of Brazilian companies, in its majority, is still similar to the characteristics of the first and second industrial revolution.

Brazil still has a precarious telecommunications network, late infrastructure, insufficient labor training, common problems for any nation, when it comes to technology, but actions need to be taken to face the competitiveness of Brazilian products in the global context.

New production models, technologies, knowledge are necessary and guarantee economic survival for any country. It is suggested in future studies the development of research that identifies the level of regional maturity of I.4.0 in Brazil, and from this knowledge government and business entities can allocate efforts customized to each location, proposing alternatives with economic bias and infrastructure.



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AUTHORS

1. Vinícius Radetzke da Silva

Administration teacher in Instituto Federal Farroupilha- IFFAR, Master in Production Engineering, PhD student in Administration at the Federal University of Santa Maria. São Vicente do Sul, Rio Grande do Sul, Brazil.

E-mail: Radetzke.vinicius@gmail.com

ORCID: <https://orcid.org/0000-0001-9128-9564>

2. Alicy Ferreira Lopes dos Santos

Administration student. São Vicente do Sul, Rio Grande do Sul, Brazil

E-mail: ferreiraalicy@gmail.com

ORCID: <https://orcid.org/0000-0002-3442-0199>

3. Ermilo Sampaio Limana

Business student. São Vicente do Sul, Rio Grande do Sul, Brazil.

E-mail: ermilopro@gmail.com

ORCID: <https://orcid.org/0000-0002-1450-3018>

4. Vityano Buzata Tambara

Business student. São Vicente do Sul, Rio Grande do Sul, Brazil.

E-mail: vityano_tambara@hotmail.com

ORCID: <https://orcid.org/0000-0002-3258-7550>

5. Ana Carolina Cozza Josende da Silva

Administration teacher at the Franciscan University, Master in Production Engineering. Santa Maria, Rio Grande do Sul, Brazil

E-mail: ana.carolina@ufn.edu.br

ORCID: <https://orcid.org/0000-0002-2947-3990>

Contribution of authors.

Contribution	[Author 1]	[Author 2]	[Author 3]	[Author 4]	[Author 5]
1. Definition of research problem	√	√	√		√
2. Development of hypotheses or research questions (empirical studies)	√		√	√	
3. Development of theoretical propositions (theoretical work)	√			√	√
4. Theoretical foundation / Literature review	√	√		√	
5. Definition of methodological procedures	√		√		
6. Data collection		√	√		√
7. Statistical analysis	√	√			
8. Analysis and interpretation of data	√	√			√
9. Critical revision of the manuscript	√	√			√
10. Manuscript writing	√	√	√	√	
11. Other (please specify)					

