

Computational Suitability for Industry 4.0 Implementation in Companies of the Metropolitan Region of Sorocaba-SP

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Abstract

This article aims to present the context of the Fourth Industrial Revolution focused on the main technologies and their application and implementation in some companies in the state of São Paulo. The article proposes a case study with 30 companies in the Sorocaba region. The CIOs (Chief Information Officer) surveyed indicated that they have difficulties in understanding what are the best practices in Industry 4.0 and what solutions should be chosen to achieve what their investors and customers expect. Technological innovation and the potential for innovation are becoming indispensable for the improvement of the researched industries, however they indicate the need for more adaptation of their plants for a good adoption of this new technology.

Keywords

Industry 4.0, implementation, information technology, big data, cloud computing.

1. Introduction

With the emergence of the Industry 4.0 theme, first mentioned in 2011 in the city of Hanover by the German government, organizations came to have a more global and systematic view of production management and the provision of integrated and automatic information for decision making. But what is this term being discussed in various forums and congresses around the world?

To Kumar (2018) "Simply put, Industry 4.0 represents smart factories with cutting-edge platforms that support plant operations with the ability to think and interact with each other perfectly as a unit."

According to Klaus (2016) the Fourth Industrial Revolution is a phenomenon unlike anything ever experienced by humanity until nowadays, and cites three reasons to support this evolution: Speed, which unlike other revolutions has grown exponentially, Amplitude and depth that has the digital revolution as its foundation combined with other new technologies, and the Systemic impact that involves the transformation of entire systems.

With all these changes we need to know how we can deal with this concept. Souza (2018) mentions that "it is necessary to understand that Industry 4.0 offers a range of deployment possibilities for the company, but these are not always viable". He also mentions that "it is not necessary for your industry to be 4.0, for all available technologies to be adopted, because it would be unfeasible even in countries with the most developed Industry 4.0." Thus, Brazil that is still in a transition phase, faces greater difficulty in implementing this process.

Souza (2018) also mentions that, with the advancement of technologies and especially with the use of the internet connecting all devices, we will have a very important leap for digital evolution. Klaus (2016) considers that companies need a new mindset to satisfy their own needs and says that the innovation process is a complex social process and not something that we should accept as inevitable.

Both Yáñez (2018) and Souza (2018) report Lean Manufacturing as a tool that plays a key role in this Industry 4.0 deployment stage, it meets the philosophy where we can produce more with new technology with much less.

But what should the factories of the future look like? Souza (2018) points out that "the first step towards the implementation of Industry 4.0 is the modernization of machines or the acquisition of new machines". He also mentions that the second step is due to the acquisition of devices that can integrate the data generated by these machines, that is, connectivity, and it is in this second stage that information technology plays a fundamental role.

According to Yáñez (2018) factories must be automated, to gain speed in processes, must be digital with the possibility of capturing massive, intelligent data where the collected data can be interpreted facilitating the decision process and flexibility. Enterprises that want to deploy Industry 4.0 technologies to improve their competitiveness in products and services find it difficult to find answers, relying on complex and global solutions with numerous technologies that are considered essential for companies to be rated 4.0. What technological

elements allow companies to distinguish complex models capable of engaging in interaction and promising solutions that fit into the Fourth Industrial Revolution?

To answer this question, it will be necessary to (i) analyze the possible technologies to be chosen and promote those that are essential for companies to qualify at level 4.0, and (ii) to verify what are the technological trends available in the market that produce the best technologies and the better results for what is required at level 4.0.

The methodology applied to this research will be carried out through bibliographic research, research materials will be searched through books, publications of national and international scientific articles, congress and annals of events. The bibliographic searches will be in current articles preferably published from 2016 to 2019, with this it will be possible to identify trends or absences of the technologies that are being used.

After collecting the bibliographic data, the information obtained was compiled, in order to establish an understanding of the theme and develop a theoretical framework for the solution of the problem.

Then twenty-eight CIOs (Chief Information Officer) of 30 companies in the Sorocaba's Region of São Paulo state answered a questionnaire, in order to know the maturity and applicability of Industry 4.0 in their companies. The companies are medium-sized, with an average of 85 employees and work in the segments of metallurgy, transformation, information technology and textiles. The survey consists of 15 questions, informing the professionals' vision and understanding on the subject.

Below are some of the questions that were most prominent in the application of the questionnaire that was conducted through the Google Forms tool through the link <https://forms.gle/NUiY4gR8hu2qXx4M8> in June 2019.

1 - Does your company intend to adopt Industry 4.0 technology? Answers: Yes, No.

2 - What is your company's interest in the Industry 4.0? Answers: We are fully engaged and investing in 4.0 technologies, we are up to date and already use the Industry 4.0 concept, we are interested in developing 4.0 technology projects, we are interested, but we do not know how to develop projects in Industry 4.0 and we have no interest in Industry 4.0.

3 - Would you know which technologies to invest in Industry 4.0? Answers: Big Data, Cognitive Computing, RFID (Radio Frequency Identification), Cloud Computing, Internet of Things, Robotics, 3D (Three Dimension) Printing and Simulators.

4 - Do you think Industry 4.0 can bring benefits to companies. Which are? Mark as many as you need. Answers: Improved processes and productivity, faster and more assertive decision making, improved product quality, improved quality of life for people, increased plant flexibility, reduced costs and more customized products.

5 - In the company where you work there is online collection of information of machines or equipment involved in manufacturing processes? Answers: Yes, no or maybe. If so, the information is stored where: Answers: Cloud or local server.

The importance of developing and applying this research is that companies see the need to invest and update Industry 4.0 technology tools, but are unaware of how to implement them. Companies cannot identify which devices to choose because solutions are not yet well defined.

Analyzing the applied questionnaire, based on the survey of the Industry 4.0 maturity, it is understood that companies are not inserted in the Fourth Industrial Revolution. Some of the issues that could be identified in the questionnaire are presented below. Figure 1 shows a strong indication that the surveyed companies are not yet in the context of Industry 4.0.

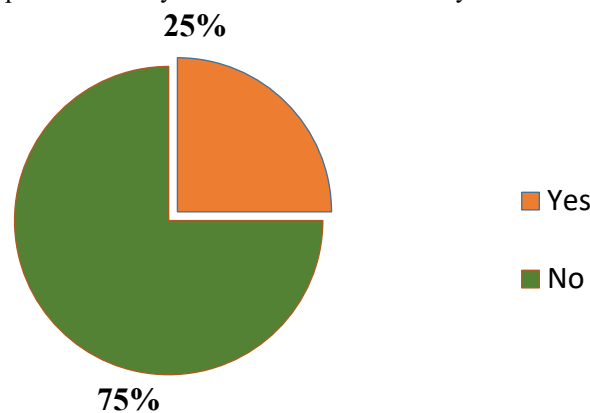


Figure 1. Insertion of surveyed companies in the Fourth Industrial Revolution

Turning to the issue related to the interest of companies in the Fourth Industrial Revolution, there is a relevant inclination for most of the professionals interviewed to develop the technologies of this generation, however it is possible to observe that companies do not know yet how to develop Industry 4.0 projects. The result of this question is shown in Figure 2.

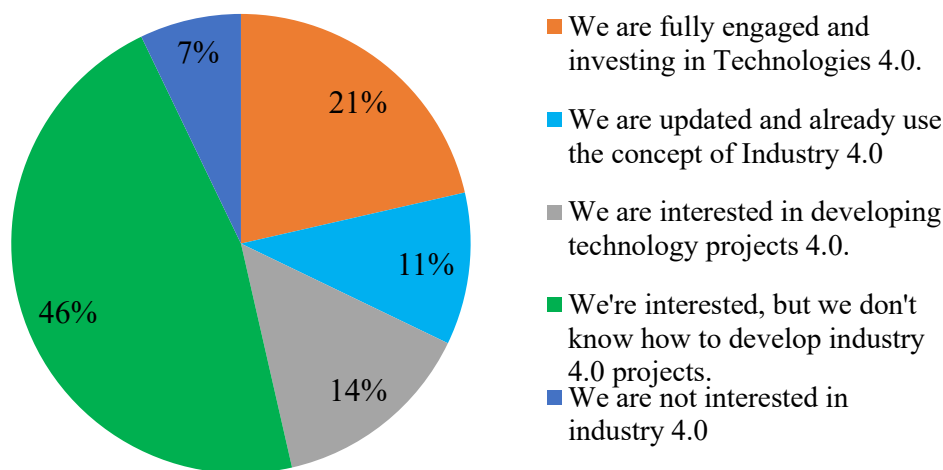


Figure 2. Business Interest in the Fourth Industrial Revolution

There is a very fast advancement of the subject, and it is therefore necessary that organizations keep up to date so that they can make improvements in their machines with automation and improvement in their processes. It is necessary to analyze which techniques can be used and which tools can fit within the era presented, thus enabling the installation of equipment that can collect information and give quick answers to correct various problems encountered in manufacturing environments.

Industry 4.0 proposes that processes be controlled by installing multiple interconnected intelligent systems and devices throughout the supply chain, so you need to know which devices are suitable for companies that integrate 4.0 technology with the right investment and that generates the least impact for organization.

However, it is necessary to look for answers that are plausible, because companies need to be updated, increase their competitiveness, improve their management and give their managers real-time information for more assertive decision making.

The overall objective of this project is to conduct a study in companies focused on their connectivity to the Fourth Industrial Revolution and thus enable an analysis of the best technologies to be used in the management of information technology in Industry 4.0 that can help managers make assertive investment decisions. of technology.

Conduct studies on the technology trends of the Fourth Industrial Revolution, map the foundations for its implementation and know the devices and technologies to be used in the insertion of technologies in industries.

2. Applicability and Deployment of Industry 4.0 in Organizations

There is a complexity in Industry 4.0 technologies, there are several technologies mentioned by the authors and companies need to know what their needs are to invest right. The scholars mention that companies tend to invest in Industry 4.0 over the next three years, as shown in the graph in figure 3.

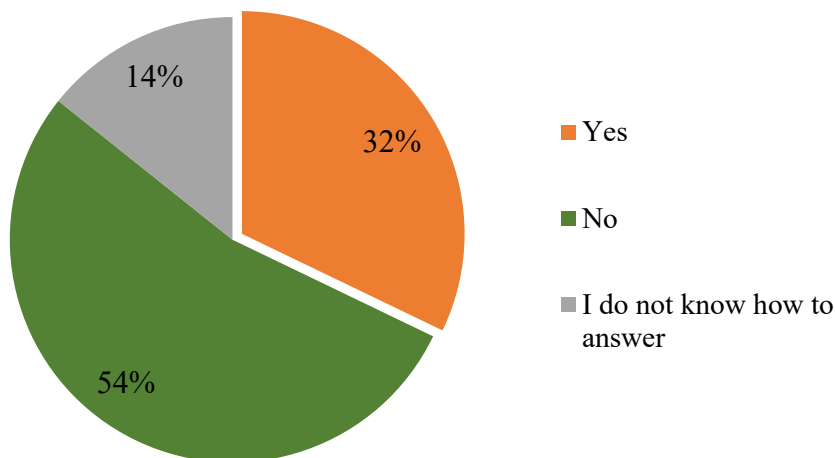


Figure 3. Existence of investment in Industry 4.0 over the next three years

The tendency of companies to invest in the Fourth Industrial Revolution comes from the doubts about which technologies to invest, because besides not having a primer on how to deploy Industry 4.0, each organization has its need and should think about certain investments that allow immediate return to your investors.

The concept of connectivity for information gathering is very important in the Fourth Industrial Revolution, so data processing is a key factor in the evolution of Industry 4.0, so it is necessary to optimize connectivity and data processing technologies such as the IoT (Internet of Things), sensors, RFID, Big Data, robotics and other technologies with newer business models, with advanced technology capabilities that can generate information and resources.

3. Technologies of the Fourth Industrial Revolution

The technologies of the Fourth Industrial Revolution are many, and what technologies should organizations invest in? The technologies most cited by the authors Klaus (2016), Kumar (2018), Souza (2018) and Yáñez (2018) were Big Data, Cognitive Computing, RFID, Cloud Computing, Robotics, 3D Printing and Simulators. Through the research conducted it was possible to see a tendency of companies to invest in technologies aimed at compiling and storing data, such as Big Data presented by the authors as one of the main tools of the Industry 4.0. Other tools suggested were connection technologies, i.e. cloud computing and the internet of things. In such technologies there are major investment trends by companies as shown in Figure 4.

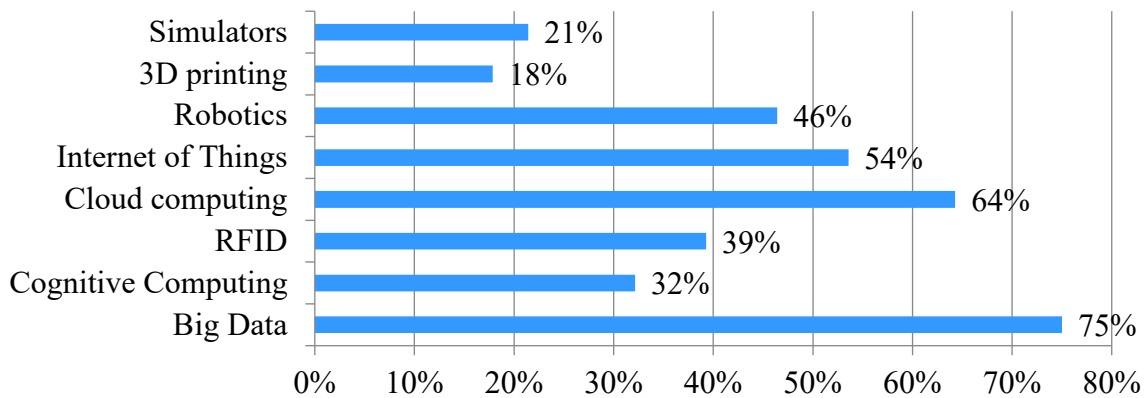


Figure 4. Technologies for Investing in Industry 4.0

Analyzing the most cited technologies, it is mentioned below what is the technological basis of each one and its importance for evolution of the Industry 4.0: Big Data was the technology most cited in the questionnaire, its concept refers to the storage and processing of a huge set of information that traditional software could not process. Cloud computing is the second widely cited technology that tends to take off in this era, so it is necessary to collect information from servers in the cloud. It is important to note that companies are already trying to collect information from their machines and equipment involved in the production process as shown in Figure 5. The majority of the companies (54%) are already trying to communicate their machines with the information systems they have installed in their computers, and 32% are still not providing any data collection to input in their systems. 14% are not sure if they will collect data, but they intend to evaluate this possibility in future time. Although, this storage still occurs on local servers, 83%, (Figure 6), the concept of cloud computing is widespread in companies, it is one of the technologies most cited by them in research. Those companies seem to know the benefits of clouding, but didn't move their data bases to this.

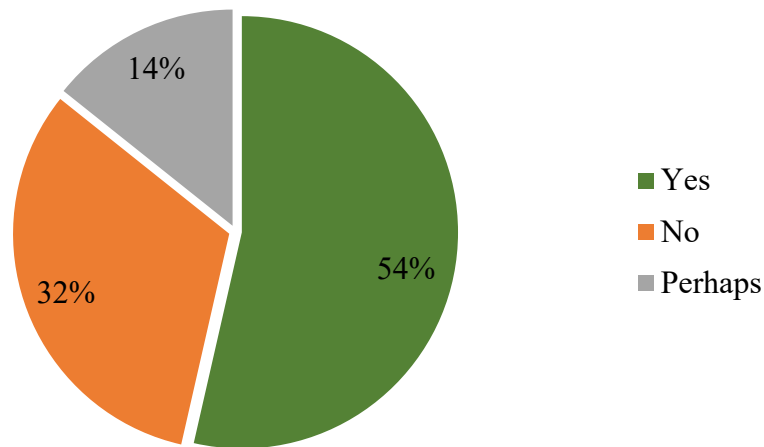


Figure 5. Corporate data collection

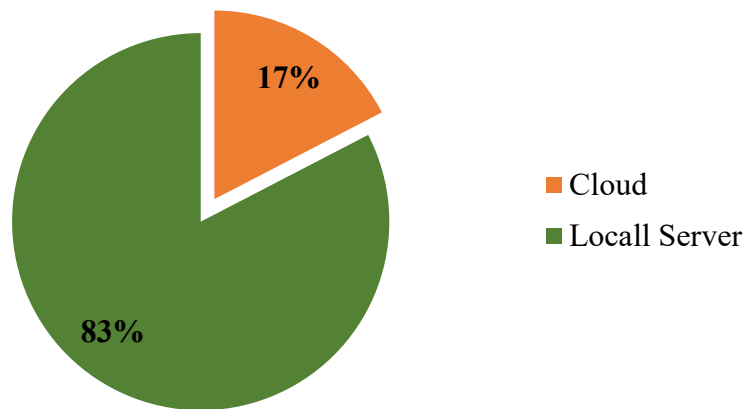


Figure 6. Data collection where it is stored

Cloud computing utilizes the storage capacity of large servers and provides access to information in real time. With the 4.0 concept, organizations tend to generate millions of data every day, the concept of cloud computing comes to ensure the storage and distribution of this information quickly and securely.

The IoT was also cited by the authors and respondents as one of the key technologies for its connectivity, it is considered a core technology of this new generation. The IoT meets Industry 4.0, it can be considered the foundation for automation of equipment and machines that are in production plants. Its concept is based on connecting all things on the internet, each object communicates with other objects and generates information to be used.

IoT devices are responsive, that is, they work by responding to events, so information is captured and can be stored in the database and through that information, knowledge is generated to support decision making.

One of the points cited by the authors that should also be noted is the modifications of machines, they must be automated and have their connectivity available for cloud information collection.

4. Why invest in the Fourth Industrial Revolution

What do organizations expect from Industry 4.0? Research has shown that they tend to achieve faster and more assertive decision making, which is one of the reasons why we have real-time information that is compiled quickly. Improvement in the production process is another item that demands concern, this requirement requires automated machines and full control of the process through the information collected. Another item that has great inclination is the cost reduction that can be obtained by mapping the scenario and the production plant. Figure 7 shows business trends with the Fourth Industrial Revolution.

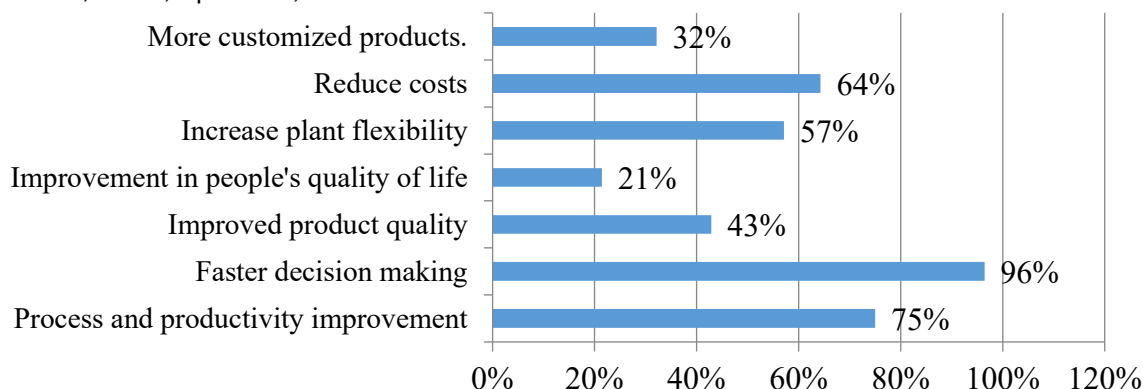


Figure 7. What companies are looking for with the Fourth Industrial Revolution

In addition to decision making, the graph shows that Industry 4.0 can bring an improvement in production processes, so Lean Manufacturing is a methodology cited by several authors that can help companies in this information mapping step, identifying which items are important. and how to improve your production process.

5. Final Considerations

This paper identified that the concept of Industry 4.0 still poses many questions for organizations to invest heavily in technologies that are not yet widespread and are far from the regional reality. For this reason, it is presumed to be premature to say that the technologies mentioned in the article may supply the need for companies in the concept of the Fourth Industrial Revolution in the short term. It is noticed that each company has to map its needs and thus invest in technologies that can provide the connectivity of machines and equipment and thus provide the strategic information for the companies. The questionnaire applied to professionals from various companies showed that the tendency of companies is to invest in connectivity technologies such as IoT technology and cloud computing. There was also a tendency for data storage technology. (Big Data), a more detailed study of these choices is suggested to verify the reason for these trends. Another factor that suggests a more detailed study is about machine automation since many companies still have old machines that do not allow connection for data collection. Lean Manufacturing can also be explored for future research as the authors cite the methodology as an aid to Industry 4.0 for work on process improvement.

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Biographies

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