

PROJECT MANAGEMENT IN INDUSTRY 4.0: TECHNOLOGIES AND SKILLS SUPPORTING PROJECT MANAGERS
A GESTÃO DE PROJETOS NA INDÚSTRIA 4.0: TECNOLOGIAS E ABILIDADES DE APOIO AOS GESTORES DE PROJETOSMichele Cristina Esteves¹ Thales Volpe Rodrigues² Lo-Ruana Karen Amorim Freire Sanjulião³ Vitor Hugo dos Santos Filho⁴ 

Abstract: Project management is considered an innovation that aims to increase the probability of success for a given product or service. The new industrial revolution affected the means of production, throughout the organizational environment. The changes force companies to look for tools that assist in project management in order to improve their process that can bring you more agility without losing quality, be it service or product. The research in question presents, the importance of project management in industry 4.0, highlighting the negative and positive points which leads to project failure and success. Project management when not planned correctly can lead to serious future problems, since it is responsible for control within the organization. Companies that provide this type of service, should pay attention to the way in which their work is developed, always analyzing all the details to see if they are of excellent qualities and if they are effective for management at the moment.

Keywords: Project management. Industry 4.0. Management tools.

Resumo: O gerenciamento de projetos é considerado uma inovação que visa aumentar a probabilidade de sucesso de um determinado produto ou serviço. A nova revolução industrial afetou os meios de produção, em todo o ambiente organizacional. As mudanças obrigam as empresas a buscar ferramentas que auxiliem na gestão de projetos a fim de aprimorar seus processos que possam trazer mais agilidade sem perder qualidade, seja ela serviço ou produto. A pesquisa em questão apresenta, a importância do gerenciamento de projetos na indústria 4.0, destacando os pontos negativos e positivos que levam ao fracasso e ao sucesso do projeto. O gerenciamento de projetos quando não planejado corretamente pode levar a sérios problemas futuros, uma vez que é responsável pelo controle dentro da organização. As empresas que prestam este tipo de serviço, devem estar atentas à forma como o seu trabalho é desenvolvido, analisando sempre todos os detalhes para verificar se são de excelentes qualidades e se são eficazes para a gestão no momento.

Palavras-chave: Gerenciamento de projetos. Indústria 4.0. Ferramentas de gerenciamento.

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1 INTRODUCTION

Society has gone through 4 major revolutions over the years, revolutions that have benefited humanity and led society forward by improving the great productive processes (MARNEWICK, et al, 2019). We are currently dealing with industry 4.0 or fourth revolution, being characterized by the use of different technologies in order to generate specific solutions according to each company (VERMULM, 2018).

Industry 4.0 is full of challenges and opportunities, where it provides customers with quick answers and according to their needs, being a great competitive advantage (CEREZO-NARVAEZ, et al, 2017). And with its arrival, organizations had to adapt to the new scenario, in which new technologies drive the growth and development of the company, assessing its capabilities and adapting to its strategies (SANTOS et al, 2018). According to Darwin (2014), it is not the strongest of the species that survives, nor the most intelligent, but the one that best adapts to changes.

Industry 4.0 is a term commonly used to refer to the development of cyber-physical systems and dynamic data processes, which use large amounts of data to drive intelligent machines. More specifically, it refers to the emergence and diffusion of a series of new technologies, in which intelligent products and devices can communicate and interact with each other (STRANGE; ZUCHELLA, 2017).

As a result of so much change, project management has become critical to the success of many companies and this requires creative and operational competence (SANTOS et al., 2018). This one that has been shaped since the 20th century, where it is characterized by the use of methods, skills and competences, in which there may be changes if the decision maker finds it viable (SANTOS et al., 2010).

In view of this recent change, the theme of project management in industry 4.0 has still been scarcely addressed in the literature. Elucidating for

other researchers the importance of project management for organizations that intend to adopt the technologies of the fourth industrial revolution.

Therefore, this work aims to demonstrate how important project management is in the current scenario of industry 4.0. Highlighting the best practice instruction guide for the development of Project Management, PMBOK and the PMO an office responsible for structuring the projects. Finally, understand the importance of the management model and what future benefits.

For the development of the article, the bibliographic research methodology was used, aimed at researching articles, magazines, monographs and websites, where it was possible to discuss the fundamental points of the topic addressed to have a more in-depth view of the study. This work is divided into three sections, the first of which is represented by the introduction, where a brief contextualization of the theme is presented. Section 2 presents the development of the research, in which it addresses the main points of view on the subject. Technologies 4.0 and their benefits for project management are highlighted, as well as the skills of project manager 4.0. Finally, the final considerations of the work.

2 METHODOLOGICAL PROCEDURES

The research strategy, to understand the importance of Industry 4.0 in project management, was the search for scientific articles on Google Scholar, to provide an overview of existing research and contributions. The selected papers are selected to address the advantages, disadvantages, stages and application of project management from the perspective of Industry 4.0.

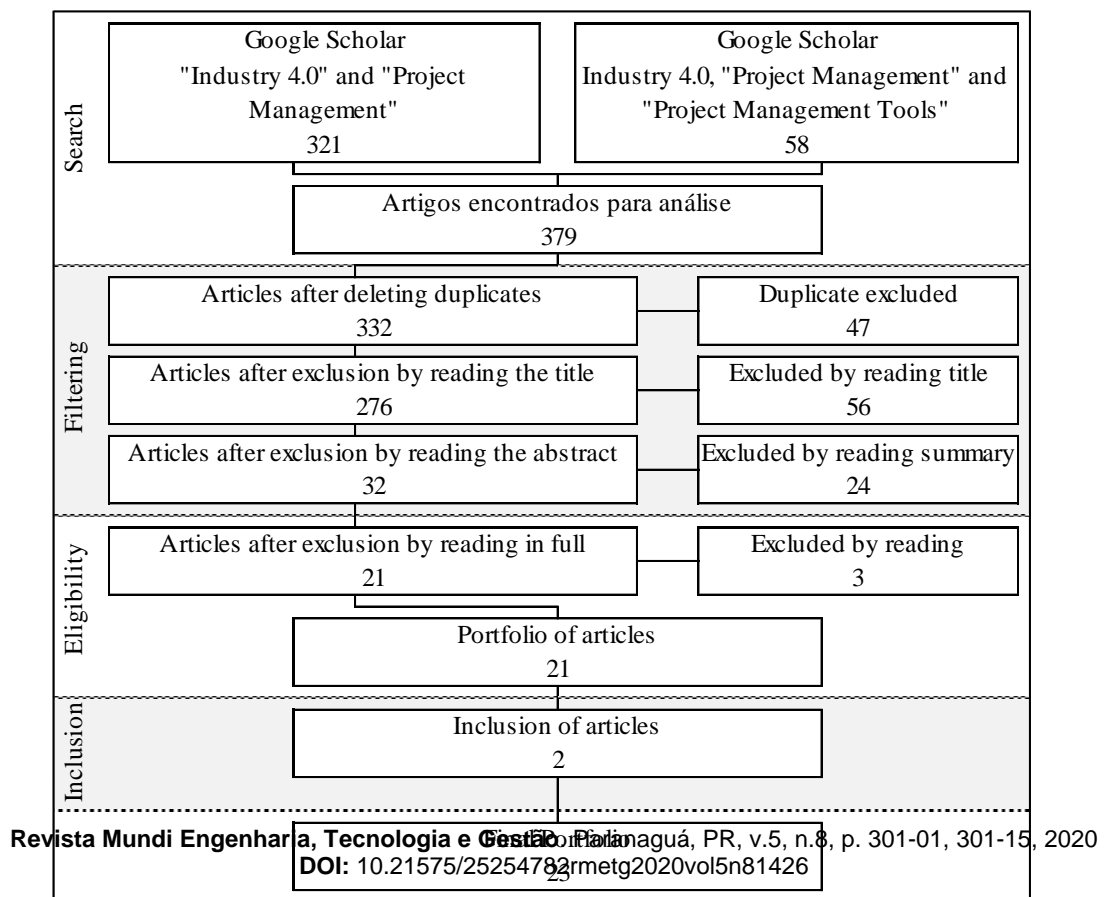
Two surveys were carried out, the first using the terms “Industry 4.0” and “Project Management”, where 321 articles referring to the topic were returned. The second search added the term “Project Management Tools” to better define the search, returning 58 articles. The search was carried out on Google Scholar, for articles published in indexed journals. The search was limiting the results to the period of 2010-2019 The 379 articles were released and filtered according to the PRISMA methodology, where the articles were excluded in

terms of duplicity, reading titles and reading abstracts, providing a range of relevant documents for a search.

Subsequently, the works were read in full and a new filtering step was taken, in which articles that did not fall within the scope of the research were excluded. Some works were identified during the reading phase, in the references of the relevant articles, were relevant to this research and forecast in the inclusion phase. The selected articles were considered in the portfolio and their references analyzed to track the importance of project management in Industry 4.0. Figure 1 illustrates a search strategy using the flow of the PRISMA diagram (MOHER et al., 2009).

The first phase selected 379 works. The resulting exclusion phase in 32 articles to be stopped. Of these, 21 own columns and were included in the set of articles on eligibility, which eliminated 3 more articles. In the inclusion phase, 2 relevant articles were designed. Thus, the final portfolio used for this research contains 23 articles.

Figure 1 - Study search and selection strategy (PRISMA flow diagram)



Source: Adapted Moher et al. (2009).

3 DEVELOPMENT

The use of a project management model is extremely important within an organization, because with this model it is possible to make demands effectively, always taking into account cost and time (RODRIGUES ET AL., 2019; VARGAS, 2005). It appeared in the 60s, but it was not immediately accepted, it only materialized in the 90s when there was a great increase in competitiveness in companies.

Many authors define Project Management differently, but they all lead to the same context. Thus, it can follow a general definition where the organization, planning, direction and control of resources are carried out in a short period of time to complete specific goals and objectives (KERZNER, 2011).

According to Vargas (2005, p.18) one of the great advantages over the implementation of project management is that it can be applied to projects of any diversity, be it a large or small, expensive or cheap, difficult or easy project. Bringing several benefits or failures. These being:

Benefits:

- The contractor or the contractor is not surprised during the performance of the service;
- It can be improved, since the methodology is being structured;
- Decisions are faster to make;
- Has total control of expenses, since a budget is made available beforehand;
- Improves the application of people, equipment and essential materials;
- Demonstrates and simplifies estimates for future projects, among others.

Failures:

- Changes in the company's organizational structure;
- Great risks to the environment;
- Some changes in the available technology;
- Improvement in price and term;
- Inadequate scenario.

According to PMBOK (2013), there are five phases for the elaboration of a project, being:

- **Initiation:** starts as soon as it identifies the needs of the company and assesses the feasibility of the project, where ideas start to emerge to be put into practice and the team is formed. This is when the project life cycle begins;

- **Planning:** In this phase, the necessary information is collected to define and improve the objectives of the project, where it takes into account the suppliers, prices to decide, the possible risks to be faced and the quality to be presented, in addition to carrying out an action plan to facilitate the development of activities and achieve the expected objective;

- **Execution:** Here we put the action plan into practice. Where the manager responsible for the project performs the proposed activities in order to follow the project management;

- **Monitoring and Control:** This is a phase parallel to the execution where it is responsible for analyzing, monitoring and organizing the development of the project, identifying which were the changes and in which areas, and thus, putting them into practice;

- **Closing:** In this phase, we finished all activities focusing on completing the project. Upon completion it is assessed whether all phases have been successfully completed.

Thus, so that there are not so many failures, the project manager must always monitor all activities, planning optimally, establishing deadlines that are within reach and working in an agile and interactive way, carrying out each activity carefully. And one of the issues to be successful managing a project is

to adapt to the current scenario following the news. Where Industry 4.0 is one of the revolutions that brought great changes in processes, allowing to create faster, more flexible and more efficient processes.

In order to remain competitive, manufacturing companies need to constantly evolve their production systems and accommodate new market demands (NAGY et al, 2018). One of the main drivers of this change is the emergence of new technologies that allow for more efficient production in terms of costs and resources. The adoption of these manufacturing technologies heralds a future with shorter, more localized, more collaborative value chains and offers significant sustainability benefits.

Rüßmann et al. (2015), presents nine technologies that characterize Industry 4.0, including tools and technical methods. They are automated robots, simulation, horizontal and vertical systems integration, industrial IIoT, cyber security, cloud-based services, additive manufacturing, augmented reality and big data analysis. However, Industry 4.0 represents a "new paradigm" in manufacturing, which leads to "faster and more accurate decision making" and a "completely new approach to production". This new approach leads to the industrial value chain that is not only automated, mainly within individual factories, but also interconnected between objects, products and human beings (MÜLLER, et al., 2018; SILVA, 2017).

Porter (2011) states that the competitive advantage of an organization cannot be seen in general, it is necessary to understand the internal structure of the company, that is, how individual elements contribute to the delivery of the product or service at a lower price or with a higher price. quality. This structure depends on the implementation of the strategy and corporate traditions (LIMA; PINTO, 2019; RODRIGUES, et al., 2019b).

According to Rodrigues et al. (2016), Industry 4.0 is seen as a strategic approach for combining technologies with the development of a product or process that provides communication between machines and people leading to better efficiency and increased productivity. Thus being able to have a fully automated production without the need of manpower. According to Gomes et al.

(2018), we can mention four key pieces for the elaboration of Industry 4.0. Being them:

- **Cyber Physical Systems - CPS:** It is that system that allows the interaction between the physical and the virtual world, where computers control the entire process. CPS: is responsible for the interaction of the physical and virtual world, where it stores, identifies and analyzes the data;
- **Internet of Things - IoT:** it is considered as the basis of technology, as it is able to communicate, interact or feel with the external or internal environment;
- **Internet of Services (IoS):** it is basically offering services over the internet, where new services will be inserted or improving those that already exist. And such services can support technical or functional resources;
- **Smart Factories:** In the future, the entire process of an industry will be able to communicate in real time, generating better efficiency spent less time and resources, totally reducing expenses. Having this as a great differential compared to other industries.

As a result of these new technologies, organizations see the emergence of Industry 4.0 as an obligation to establish organizational strategies to train employees in skills that cannot be replaced by machines. Since for a successful organization to have successful processes and products it is necessary to adapt (SANTOS, 2018).

So the objective of project management is to achieve greater productivity and better efficiency and for that, projects need to be adapted and aligned. The scenario of the fourth revolution allows information to be passed in real time, thereby increasing awareness and helping with decision making. Before it was a manual process, consequently it ended up taking a long time, because first I had to do a research to identify the information and follow it with printed material, feedback among others today with the support of technologies we can count on several tools to collect necessary information and be able to progress in the faster and more efficiently (GHIMIRE, 2017).

With that we see the great need and importance of project management in the new scenario. Because with it we can remotely monitor the production processes, in order to avoid possible failures, dealing with more certain situations, not to mention the optimization in production and energy savings (GOMES, 2018; RODRIGUES et al., 2019b).

The industries are made up of projects, distributed throughout its value chain. When dealing with industries aligned with the 4.0 concept, project management professionals must understand the data involved in the process, considering the recurring innovations of Industry 4.0. Seeking to help in the manufacturing process of a particular product or service, through new emerging technologies. The knowledge of these technologies helps the project manager to understand which are feasible for the reality of each plant and make the implementation in the fastest, most efficient and strategic way possible (BALLUFF BRASIL, 2017; PEDERNEIRAS, 2020).

Only with an efficient project management sector that truly understands industry 4.0, manufacturers will be able to enjoy the benefits of all these technological advances, increasing their productivity, reducing their aggregate costs and improving quality and competitiveness (AEVO, 2019; BALLUFF BRASIL, 2017). These technologies provide advancement in organizations and help to optimize project management, leading to real-time decision making and better control of the activities performed on the project. Table 1 presents these technologies and their benefits for project management.

Table 1 - Technologies 4.0 in project management

Technology	Benefits	Authors
Big data	Data is what moves industry 4.0, providing support for automation and intelligence technologies, but also showing managers, in real time, the conditions of production, the market and how to optimize it. Looking at complete reports, the project manager can have insights to improve production, anticipate problems and make decisions in favor of sustainable project growth.	(AEVO, 2019; BALLUFF BRASIL, 2017; PEDERNEIRAS, 2020)
Automation and sensors	Project execution is optimized based on process automation. With the use of data, some repetitive and conditional activities can be automated through machine learning, increasing the speed of production and decreasing errors. The sensors, in turn, allow these processes to be monitored without having to shut down machines or interventions.	

Internet of Things	The intelligence in the production process of the projects makes everything more autonomous and follows the number one principle of industry 4.0: shorten the production time and increase the quality of the products.
3D printers	Flexibility in processing custom resources, with less waste. Allowing the project manager an elasticity with respect to the best time for a given piece to be produced.

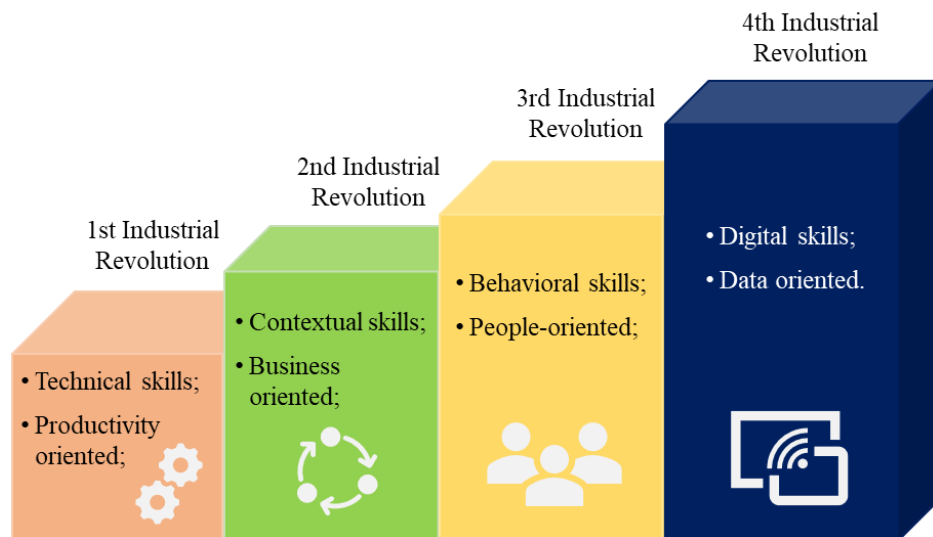
Source: Authors (2020)

This technological advance makes the demand for project management that follows these trends much greater. Therefore, project management needs to keep up with this change, with appropriate software that allows planning and developing products, projects and innovations. Only with an efficient project management sector, the industries will be able to produce more, with reduced costs and with high quality, encompassing all the technologies present and will still be able to become strong and competitive worldwide (AEVO, 2019).

With this change of scenery in the industry, it is necessary to understand the extent to which these changes impact the way projects are managed. With Industry 4.0, the machines are interconnected and a range of information is collected instantly, this volume of data is analyzed and decisions are made to improve the process quickly, consequently resource optimization and increased production happen (SOARES; NETO, 2019).

The Project Manager will undergo a transformation process, following what is suggested by the new industrial model. The acquisition of skills imposed by the industrial revolution will bring new opportunities and guarantee the success of the Project Manager's career (MALANIMA, 2018; SOARES; NETO, 2019). Figure 2 shows the evolution of the Project Manager under.

Figure 2 - Evolution of the Project Manager



Source: Authors (2020)

Thus, according to Malanima (2018), for manager 4.0 he must have certain skills that the lack of them may compromise his performance and performance throughout the project:

- Having a passion for technology;
- Domain of concepts, methodologies and tools (Business Intelligence as an example);
- Knowledge about database;
- Knowledge of statistics and probability;
- Interpretation and analysis of data and graphics;
- Knowledge in programming;
- Knowledge in robotics.

Therefore, effective project management becomes of paramount importance for organizations to achieve their business objectives since project management is the application of knowledge, skills, tools and techniques to project activities in order to meet their requirements (PMI, 2017).

Over the past few decades, several authors have addressed the importance of the Project Manager having adequate skills for the effective

management of projects. However, Industry 4.0 brings new challenges for all areas and professionals, requiring new skills as stated by Hecklau et al. (2016). According to Brynjolfsson and McAfee (2015), this industrial revolution brings with it the demand for people with special skills capable of extracting the potential of new technologies to generate value for organizations and their projects.

4 FINAL CONSIDERATIONS

The article addressed, by means of a theoretical framework, the importance, benefits and failures that can occur in the execution of project management, especially in the current scenario. Since it refers to a new production concept with the possibility to modify the role of the old assembly lines. The fourth industrial revolution brought major improvements to project management, since its technology reduces costs and improves quality and competitiveness within an organization.

It was observed that the lack of information and control of the deadlines, costs and progress of the activity can cause the project to fail. Where it was possible to realize that industry 4.0 is an ally for project management, because with it we can remotely monitor production processes, in order to avoid possible failures, dealing with more precise situations, not to mention optimizing production and saving energy. energy.

Thus, this study contributes to demonstrate to the social dimensions that the fourth industrial revolution came to optimize processes

and activities and that the need for qualified professionals is very important for social development. In addition to presenting the benefits of management 4.0 for better project development. It is understood, therefore, that in the light of the study, companies that adopt the new technologies of the fourth revolution for the development of project management will certainly reach a new level of productivity and competitiveness. However, project management needs

to follow this current scenario, with adequate software that allows planning and developing products, projects and innovations.

For future research, research related to project management professionals 4.0 is suggested, covering in more depth the most used technologies. Still conducting a field research, seeking to identify the current state of this topic.

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