(REVIEW ARTICLE)

The use of artificial intelligence in supply chain management: A bibliographic review

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Abstract

The tools and production processes are constantly evolving. Initiated by the Industrial Revolution, the mechanization of the production line is undergoing a process of simple automation to perform tasks on their own. Before, machines only performed the most repetitive and heavy tasks. Today, through Machine Learning, they can even make quick, precise, and safe decisions about the best sequence for the production line of a particular product or service. For the elaboration of this article, a qualitative approach was used as a methodological basis, and the investigation procedure adopted was the development of a bibliographic review. The general objective of this research is to investigate how Artificial Intelligence (AI) can optimize the processes of the supply chain. This study indicates that the use of AI is increasingly becoming an irreversible path, as companies depend on profitability and less waste to survive, in addition to more agility and accuracy. All these advantages, combined with the lowest possible production cost, favor the permanence of AI among companies and society as a whole.

Keywords: Industrial Revolution; Machine Learning; Artificial Intelligence; Supply Chain

1. Introduction

With the emergence of the internet, possibilities have expanded, and technology seems to have no limits. Every day we come across novelties, whether in hardware or software. The smartphone has become an essential part of people's lives, and people are increasingly connected to each other and the world. Wearable devices such as watches, bracelets, and shoes are now a reality, analog products that have become digital and capable of providing us with a wide range of real-time information.

Artificial Intelligence (AI), which was once only seen in science fiction movies, has become a part of our lives. Machines are now capable of processing and storing data, analyzing, learning, and even acting if necessary. In the industry, these machines have replaced a large portion of the workforce, generating cost savings and greater profitability. In general commerce, major brands have launched on the internet, creating a trend that started timidly and insecurely, but over time, overtook those who did not see the future in the same way.

The giants of Silicon Valley are also a great example of how technology has changed and continues to change the market. Amazon, Walmart, Americanas, and others have shown that it is possible to evolve and, above all, make the customer experience fast, secure, and comfortable. All these big companies use AI, whether in creating devices or improving their internal processes.

The choice of topic was based on its relevance to the constant need for improvement in processes within an organization. Optimizing the processes of the production chain, from the beginning, in the manufacturing of the product,

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management, and distribution of production. Technology advances quickly, and it is not possible to stand still. Increasing competition pressures companies to change or risk bankruptcy and closure of their activities. It is necessary to be attentive to the new tools that emerge in the market.

AI is something that is already part of our daily lives; we constantly use it on various platforms and situations. Wherever you go, you will find a device connected to the internet capable of providing data, whether by physical command or even by voice. Being constantly connected is already part of our lives, and the world seems to be functioning faster and faster. There is no time to waste with slow and manual processes, and it is a fact that, from a profit point of view, a machine generates more profit and less expense than an employee.

The choice of the topic was also due to the interest that technology in general arouses in all of us. It can be seen that AI is still not fully explored in companies, especially in medium and small-sized companies. For the elaboration of this article, a qualitative approach was used as a methodological basis, and the investigative procedure adopted was the development of a bibliographic review.

The general objective of this research is to investigate how Artificial Intelligence (AI) can optimize supply chain processes. The specific objectives were defined as follows: to highlight the importance of AI in the logistics process, to demonstrate how AI favors the management process, and to discuss the role of AI in the production process.

The article was structured into four sections. The first was the introduction, in which the research objectives were highlighted. The second was the theoretical foundation, in which a discussion was developed among authors who researched the same topic. The third was reserved for the methodology, where the research procedures used for the article's elaboration were explained. In the fourth section, we presented the final considerations resulting from the research conducted.

2. Material and methods

To develop this article, a qualitative approach was used as the methodological basis, and the research procedure adopted was the development of a literature review. The research was based on the reading of several academic articles on the topic, as well as research on the subject on websites on the Internet. It appears that the topic is already widely studied, which further reinforces its relevance.

2.1. Regarding the qualitative approach, Patton (2015, p. 15) clarifies that

The qualitative approach allows for a deeper understanding of the phenomena studied, exploring the perspectives of the participants and providing insights that could not be obtained solely through the use of quantitative methods. Instead of focusing on numerical measurements and statistical analysis, qualitative research seeks to understand the meaning attributed by participants to their experiences, and how these experiences relate to the social and cultural context in which they occur [1].

### 2.2. Regarding the literature review, Bryman (2016, p. 89) makes the following comment

The literature review is a fundamental stage of scientific research, as it allows the researcher to identify gaps in existing knowledge, evaluate the relevance of previous studies for their own work, and identify possible approaches to investigation. The literature review is also important to avoid the repetition of studies already carried out and to provide a solid theoretical basis for research. Conducting a systematic and comprehensive literature review is essential to ensure the validity and reliability of the results obtained [2].

The knowledge and expertise of the authors regarding the topic under discussion were taken into consideration in this article. Additionally, knowledge about some AI-based devices was shared, as well as various routine situations where we are exposed to this technology without even realizing it.

Among the authors researched and studied, I highlight the following: Furini and Prazo (2019), Vieira, Almeida, and Carvalho (2021), and Cavalcanti (2022), all with recent works, showing that the topic is still new and there is much to be explored.

3. Literature Review

In order to carry out this project, a better understanding of AI and how it can be integrated into various processes of the supply chain was sought. Understanding and making good use of this tool that evolves day by day, transforming manual tasks into autonomous and more intelligent ones. First, let us contextualize the trajectory of this transformation process in the industry and production process.
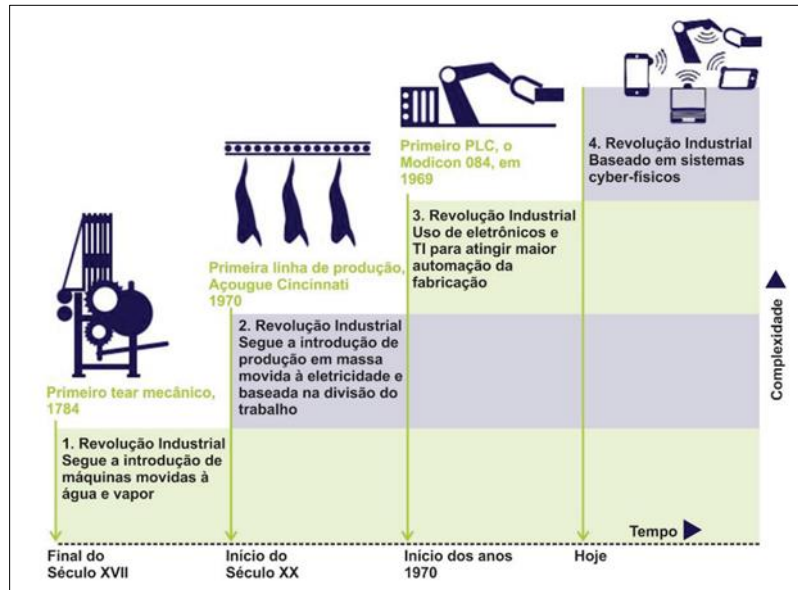
Source: Adapted from [3]

Figure 1 The 4 stages of the Industrial Revolution

In the above figure, we can see the stages of the so-called Industrial Revolution, which marked the beginning of machine use in the production process. It was only after the 1970s, in the 3rd stage of this revolution, that automation was introduced into the process, but AI was not yet in use. Machines were used only as part of the heavy process, in repetitive tasks that required greater precision.

Currently, we are in stage 4 of this revolution, where processes can be automated and managed remotely via the Internet. Results can be seen in real-time, allowing for adjustments and corrections throughout the process, and even enabling machines to make necessary corrections using AI and Machine Learning.

3.1. The Importance of AI in the Logistics Process

For a long time, the logistics process has gone beyond just delivering goods to the end customer. Logistics is responsible for managing the entire product flow, from raw materials to manufacturing or transformation, storage, production flow, and proper disposal. The growth of online sales has made this chain increasingly intelligent, fast, and secure. Marketplaces have grown and expanded their geographic territories to make the consumer experience more satisfactory, while also reducing shipping costs and times.

"Logistics is the process of planning the flow of materials, aiming at delivering the required quality needs at the right time, optimizing resources and increasing quality in services [4]".

AI within this process ensures that information is transmitted in real-time without the need for human interference. The machine receives the demand, processes it, and gives the necessary command for the continuation of the process. At the same time, everything is recorded, and the data is passed on to those interested. Thus, the customer receives a notification of the status and the estimated delivery time of their product [5].

Artificial intelligence (AI) has become increasingly important in the logistics process of companies. With AI's help, companies can analyze large amounts of data and obtain important insights to improve logistics process efficiency and quality [6].

Moreover, AI can automate routine and repetitive tasks, such as inventory management and delivery routing, freeing up employees for more strategic and creative tasks. AI can also help predict future demands, facilitating decision-making on issues such as production planning, resource allocation, and transportation of goods [7].

This can lead to cost reduction and increased process efficiency, resulting in greater customer satisfaction and better financial performance for the company. However, it is essential to remember that implementing AI in the logistics process should be done with care and proper planning. Data analysis must be precise and reliable, and AI must be integrated transparently and coherently with existing processes. Moreover, it is crucial to consider ethical and privacy issues related to the use of data and artificial intelligence.

3.2. The Use of Artificial Intelligence in Management Processes

Information systems have been used within companies for a long time. Mostly, they are fed with information provided by their users and are often underutilized. AI and Machine Learning are tools that operate semi-autonomously. They collect, store, organize, and suggest actions, making the decision-making process more accurate and faster. As they are fed, they are capable of predicting events, avoiding or minimizing the chances of human errors.

According to Furini and Prado (2019, p. 06),

Artificial Intelligence is a valuable resource to improve decision-making and optimize management processes. By using machine learning algorithms and data analysis, it is possible to identify patterns and trends that would be impossible to detect manually. This ability to process large amounts of data and generate actionable insights can lead to a better understanding of the business and continuous improvement of management processes [8].

Consumers are increasingly demanding when it comes to product and service quality. Additionally, agility and accuracy are also important points in the current market.

The combination of management with technological innovations is an important path for the future of the supply chain. The consumer indirectly demands changes in processes as needs arise, and it is the responsibility of companies to choose the best options available in the market [9].

 Bureaucratic and slow processes are tiring and can lead to a waste of time. There is no longer room for the use of pen and paper, filling out long forms, and processes that can make the user experience negative. The company needs to be attentive to the innovations in its market to avoid becoming obsolete and being "swallowed" by competitors.

3.3. The Use of Artificial Intelligence in the Production Process

Continuous improvement of supply chain processes within an organization is crucial to keep up with the ever-increasing pace of globalization and technological advancements. Companies must stay vigilant to the constant changes in the market, and utilizing up-to-date and connected tools is essential to stand out.

According to Vieira, Almeida, and Carvalho (2021, p.13),

Artificial Intelligence can be used to optimize the production process by allowing real-time detection and correction of problems, prediction of equipment failures, and identification of opportunities for improvement in production. By using machine learning algorithms, large amounts of data can be analyzed to identify patterns that indicate the need for maintenance or adjustments in equipment. Furthermore, Artificial Intelligence can enhance production efficiency by optimizing production parameters and allocating resources [10].

The internet has broken down geographical barriers and made the exchange of experiences an indispensable part of organizations. The portability of information, available to everyone at their fingertips through smartphones, has given consumers immense power.

The term Artificial Intelligence was coined in 1956 by Professor John McCarthy. It has become popular in recent years due to the unprecedented computational power and the abundance of information available. AI systems can emulate human characteristics such as learning, decision-making, perception of the environment, voice and image recognition, and broadly, human intelligence [11].

Most companies already use some form of machinery in their production process, which is mediated by the supply chain. Nevertheless, an operator is still required to give some command for the machine to produce. These machines, made of metal, gears, and electricity, now also have processors, network cards, and computer chips.

With the use of the internet and connectivity (machine-network), the machine can be pre-programmed to do the work. While producing, it can also share real-time information, providing productivity data and whatever else is necessary. Furthermore, they can be remotely accessed, allowing for necessary corrections to be made.

4. Conclusion

Artificial Intelligence (AI) is still a relatively new and little-known technology, but it has great potential as a tool for optimizing management and production processes within organizations. Existing literature on the subject indicates that there is still much to be explored and discovered about the possibilities of using AI. The Internet has played a fundamental role in driving and accelerating the process of expanding the possibilities of AI use. Unfortunately, currently, the technology is mostly used by large companies, especially e-commerce giants, while many startups develop their activities based on the use of AI and later sell their products to larger companies.

Research indicates that the arrival of 5G Internet represents a major breakthrough, as the flow of data between devices is critical to ensuring tool quality and rapid device processing. The advances that companies will experience when AI is fully implemented in all their production processes will be evident, especially in the supply chain.

In addition to the aforementioned advantages, it is important to highlight that AI can help reduce costs, increase efficiency, improve product and service quality, and even enable the creation of new business models.

It is worth noting that once AI is integrated into production and management processes, it is possible to obtain a broader and more detailed view of the business, allowing for more accurate decision-making based on concrete data. However, it is also important to consider the ethical and security challenges that the use of AI can bring, such as the need to protect sensitive data and avoid algorithmic discrimination.

Compliance with ethical standards

Acknowledgments

Disclosure of conflict of interest

The authors assure that there is no conflict of interest with the publication of the manuscript or an institution or product mentioned in the manuscript and/or important for the result of the presented study.

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