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Use of artificial intelligence in the Production Planning and Control (PPC) sector for decision-making in manufacturing

Utilização da inteligência artificial no setor de Planejamento e Controle da Produção (PCP) para tomada de decisão em indústria

Uso de la inteligencia artificial en el sector de Planificación y Control de la Producción (PCP) para la toma de decisiones en la industria

Thiago França dos Santos – Universidade Federal de Mato Grosso do Sul, thiagofranca199907@gmail.com
Thiago Galbiati Lagoin – Universidade Federal de Mato Grosso do Sul, thiago.lagoin@ufms.br

Abstract: Digital transformation and the advancement of technologies associated with Industry 4.0 have expanded the use of Artificial Intelligence (AI) in industrial processes, particularly in activities requiring the analysis of large volumes of data and rapid decision-making. Against this backdrop, this study aimed to analyze the use of Artificial Intelligence in the Production Planning and Control (PPC) sector as a decision-support tool within industrial organizations. The research sought to understand how the use of AI in PPC can contribute to the decision-making process in an industrial environment. Twelve scientific publications related to Artificial Intelligence, PPC, demand forecasting, supply chains, production balancing, predictive maintenance, and Industry 4.0 were analyzed. The results showed that AI offers various application possibilities within PPC, notably in demand forecasting and planning, the use of artificial neural networks, production line balancing, supply chain optimization, and predictive maintenance. It was found that these tools can help convert operational data into information relevant to planning, enabling the identification of patterns, the anticipation of scenarios, and support for decisions regarding demand, production capacity, inventory, resources, and equipment availability. However, the effectiveness of AI implementation depends on factors such as data quality, technological infrastructure, system integration, and professional qualifications. The study concludes that Artificial Intelligence has the potential to make PPC more predictive, integrated, and data-driven, thereby strengthening decision-making and contributing to greater industrial operational efficiency. Nevertheless, its use should be viewed as a tool to support professionals, maintaining the integration of technology, organizational processes, and human knowledge.

Keywords: Artificial Intelligence. Production Planning and Control. Decision-making. Industry 4.0.

Resumo: A transformação digital e o avanço das tecnologias associadas à Indústria 4.0 vêm ampliando o uso da Inteligência Artificial (IA) nos processos industriais, sobretudo em atividades que exigem análise de grandes volumes de dados e decisões rápidas. Diante desse cenário, este estudo teve como objetivo analisar a utilização da Inteligência Artificial no setor de Planejamento e Controle da Produção (PCP) como ferramenta de apoio à tomada de decisão em organizações industriais. A pesquisa buscou compreender de que maneira o uso da IA no PCP pode contribuir para o processo decisório no ambiente industrial. Foram analisadas 12 publicações científicas relacionadas à Inteligência Artificial, ao PCP, à previsão de demanda, às cadeias de suprimentos, ao balanceamento da produção, à manutenção preditiva e à Indústria 4.0. Os resultados mostraram que a IA apresenta diferentes possibilidades de aplicação no PCP, com destaque para a previsão e o planejamento da demanda, o uso de redes neurais artificiais, o balanceamento de linhas produtivas, a otimização das cadeias de suprimentos e a manutenção preditiva. Pode-se verificar que essas ferramentas podem contribuir para converter dados

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operacionais em informações relevantes ao planejamento, possibilitando identificar padrões, antecipar cenários e apoiar decisões relacionadas à demanda, à capacidade produtiva, aos estoques, aos recursos e à disponibilidade dos equipamentos. Entretanto, a efetividade do uso da IA depende de fatores como qualidade dos dados, infraestrutura tecnológica, integração dos sistemas e qualificação dos profissionais. Assim, foi possível verificar que a Inteligência Artificial apresenta potencial para tornar o PCP preditivo, integrado e orientado por dados, fortalecendo a tomada de decisão e contribuindo para maior eficiência das operações industriais. Sua utilização, contudo, deve ser compreendida como instrumento de apoio à atuação dos profissionais, preservando a integração entre tecnologia, processos organizacionais e conhecimento humano.

Palavras-chave: Inteligência Artificial. Planejamento e Controle da Produção. Tomada de decisão. Indústria 4.0.

Resumen: La transformación digital y el avance de las tecnologías asociadas a la Industria 4.0 han ido ampliando el uso de la Inteligencia Artificial (IA) en los procesos industriales, especialmente en actividades que requieren análisis de grandes volúmenes de datos y decisiones rápidas. Ante este escenario, este estudio tuvo como objetivo analizar el uso de la Inteligencia Artificial en el sector de Planificación y Control de la Producción (PCP) como herramienta de apoyo a la toma de decisiones en las organizaciones industriales. La investigación buscó comprender cómo el uso de la IA en PCP puede contribuir al proceso de toma de decisiones en el entorno industrial. Se analizaron 12 publicaciones científicas relacionadas con Inteligencia Artificial, PCP, previsión de la demanda, cadenas de suministro, equilibrio de producción, mantenimiento predictivo e Industria 4.0. Los resultados mostraron que la IA presenta diferentes posibilidades de aplicación en PCP, con énfasis en la previsión y planificación de la demanda, el uso de redes neuronales artificiales, el equilibrio de líneas de producción, la optimización de las cadenas de suministro y el mantenimiento predictivo. Se puede observar que estas herramientas pueden contribuir a convertir datos operativos en información relevante para la planificación, permitiendo identificar patrones, anticipar escenarios y apoyar decisiones relacionadas con la demanda, la capacidad de producción, los stocks, los recursos y la disponibilidad de equipos. Sin embargo, la eficacia del uso de la IA depende de factores como la calidad de los datos, la infraestructura tecnológica, la integración de sistemas y las cualificaciones profesionales. Así, se pudo comprobar que la Inteligencia Artificial tiene el potencial de hacer que el PCP sea predictivo, integrado y basado en datos, fortaleciendo la toma de decisiones y contribuyendo a una mayor eficiencia en las operaciones industriales. Su uso, sin embargo, debe entenderse como un instrumento de apoyo al desempeño de los profesionales, preservando la integración entre tecnología, procesos organizacionales y conocimiento humano.

Palabras clave: Inteligencia artificial. Planificación y Control de la Producción. Toma de decisiones. Industria 4.0.

1. Introduction

The digitalization process that permeates production systems has significantly changed the way industries plan, execute and monitor their operations. Faced with an increasingly

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competitive market, marked by pressure for lower costs, high productivity and constant quality, organizations are led to seek mechanisms that make their decisions more agile, precise and supported by reliable data (Pereira et al., 2024). In this scenario, the incorporation of new technologies into production management systems becomes a relevant path to increasing operational efficiency and strengthening companies' ability to respond to market fluctuations.

Within this set of technologies, Artificial Intelligence (AI) has been gaining increasing space in the industrial environment. The use of algorithms capable of processing large volumes of data, recognizing patterns, generating predictions and supporting decisions considerably expands the possibilities of applying this technology in different areas of an organization (Silva et al., 2022).

In the industrial context, AI can be used in activities such as demand forecasting, production scheduling, inventory control, identifying operational bottlenecks, machine maintenance, managing production capacity and improving the use of available resources.

The Production Planning and Control (PPC) sector plays a central role, as it is responsible for organizing and integrating the various resources involved in the functioning of the production system. Its responsibilities include decisions about what to produce, in what quantity, at what time, with what resources and how to monitor the execution of activities (Leão et al., 2023). Thus, the quality of available information, as well as the ability to interpret different variables, has a direct impact on the organization's productive performance.

The adoption of AI in the PPC can contribute, for example, to the construction of more assertive demand forecasts, favoring a more appropriate sizing of production and stocks. Likewise, intelligent systems have the potential to analyze data regarding the availability of machines, materials, labor, deadlines and production capacity, supporting the definition of operations scheduling. Such possibilities gain even more relevance in industrial environments subject to unexpected variations in demand, delays in the supply of inputs, equipment failures or changes in production capacity, situations that require quick responses from those responsible for planning.

Given this scenario, the following question is defined as a research problem: how can the use of Artificial Intelligence in the Production Planning and Control (PPC) sector contribute to decision-making in the industrial environment?

The general objective of this study is to analyze the use of Artificial Intelligence in the Production Planning and Control sector as a tool to support decision-making in industrial organizations. Specifically, the aim is to understand the main applications of AI related to PPC

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activities; identify how these technologies can help professionals in analyzing information and making decisions; verify the potential benefits arising from its use for planning and controlling production operations; and analyze the main challenges and limitations associated with the implementation of these tools in the industrial context.

The justification for this study is based on the growing need for industrial organizations to improve their planning and decision-making processes in the face of increasingly dynamic and complex production environments. The PPC directly influences aspects such as productivity, meeting deadlines, use of production capacity, stock levels, operational costs and meeting customer demands.

2 Theoretical Framework / Results

2.1 Artificial Intelligence and transformation of Production Planning and Control processes

In the industrial context, Artificial Intelligence can be understood as a set of technologies and computational methods aimed at data analysis, pattern recognition, generation of predictions and support for decision making. The increased use of these tools is associated with the digital transformation process and Industry 4.0, marked by the growing integration between digital technologies and production systems. As Telles, Barone and Silva (2020) point out, AI plays a prominent role in this scenario by enabling applications that favor the automation and intelligence of industrial processes.

The transformation resulting from Industry 4.0 also influences the way organizations select and implement their technologies. Silva et al. (2022) show that the decision on the choice and implementation of technologies associated with Industry 4.0 involves multiple criteria and organizational factors. This indicates that the adoption of Artificial Intelligence should not be based solely on the availability of the technology, but needs to take into account its suitability for the company's needs, strategic objectives, available resources and intended results.

Within the scope of Production Planning and Control, the need to integrate different sources of information makes the use of intelligent technologies especially relevant. Pereira et al. (2024), when examining trends and perspectives of Artificial Intelligence in the PPC, highlight the proximity between technological advances and operations planning and control

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activities. The use of AI can contribute to the interpretation of complex production scenarios, offering information that helps those responsible for the PPC to identify alternatives and select solutions compatible with production conditions.

Among the fields benefited by this technology is demand planning. Adequately estimating future needs is an essential element for organizing productive resources, since inadequate decisions can generate excess production and stocks as well as unavailability of products. Mattos and Correia (2023) deal with the digital transformation applied to demand planning through the adoption of Artificial Intelligence, highlighting the relationship between the incorporation of these technologies and the modernization of the methods used in forecasting and organizational planning.

In the same vein, Mattos and Scur (2022) discuss the implementation of Artificial Intelligence in the demand forecasting process. The use of intelligent models makes it possible to work with historical data and other relevant variables to recognize patterns and generate estimates that support planning. For the PPC, more accurate forecasts can favor decisions related to the quantities to be produced, the necessary resources, stock levels and the scheduling of activities.

The use of artificial neural networks is one of the alternatives in this field. Soares, Chiquetano and Kleina (2020) investigated the application of an artificial neural network aimed at forecasting demand in a metalworking company. The use of this technique in a business context highlights the possibility of integrating Artificial Intelligence methods with the concrete needs of organizations, especially when historical data can be used to identify behaviors and support future predictions.

Other techniques can also be incorporated into forecasting processes. Moraes et al. (2023) examined demand forecasting from Artificial Intelligence optimized by genetic algorithms. The combination of different computational methods demonstrates that AI applications are not restricted to a single model, which allows the development of solutions adjusted to the particularities of the problems analyzed. In the PPC, this flexibility is relevant, since the characteristics of demand and production systems vary significantly between companies and industrial segments.

Sousa et al. (2024), in turn, evaluated long-term demand forecasting using Prophet. Although the study is focused on the retail context, its results reinforce the relevance of computational forecasting techniques for organizational planning. Long-term forecasting can provide important support for decisions related to production capacity, stocks, resource

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acquisition and the definition of production strategies, helping to reduce uncertainty in the planning process.

In addition to demand forecasting, Artificial Intelligence can be associated with the sizing and organization of production operations. Moraes and Corso (2022) studied optimized line balancing based on demand forecasting and artificial neural networks. This association demonstrates that predictive information can be used not only to estimate future needs, but also to guide the configuration of the production system itself, allowing forecasting and planning to be integrated to benefit a more appropriate use of resources.

Equipment maintenance represents another relevant field for the PPC. Unexpected interruptions can compromise production scheduling, cause delays and harm meeting demand. Zaro and Webber (2023), in a case study on the development of a system aimed at predictive maintenance 4.0, show how digital technologies can anticipate needs related to the operation of equipment. For production planning, having this information in advance can contribute to more realistic scheduling and reducing the impacts caused by unexpected downtime.

The application of Artificial Intelligence also extends beyond the internal limits of production, reaching the management of supply chains. Leão et al. (2023), in a systematic literature review, analyzed the optimization of supply chains through AI techniques. The articulation between production planning and the supply chain is fundamental, since the availability of raw materials, demand behavior, supplier deadlines and product distribution have a direct influence on the decisions taken by the PPC.

The use of Artificial Intelligence in the PPC is an extension of the digital transformation process observed in industrial organizations. AI can act at different levels, ranging from demand forecasting to balancing operations, equipment maintenance and supply chain analysis. Its effectiveness, however, does not only depend on the sophistication of the models used, but also on the quality of the data, the integration between the systems used and the organizational capacity to convert the results of the analyzes into concrete actions.

2.2 Artificial Intelligence to support decision-making in the industrial environment

Decision-making represents a central activity for the functioning of Production Planning and Control. The professionals responsible for the PPC need to continually decide on production volumes, priorities, sequencing of operations, capacity, stocks, materials and necessary adjustments in light of changes observed in the production environment. For this

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reason, the availability of reliable and updated information has a direct influence on the quality of the decisions made.

Artificial Intelligence can play a supporting role in this process by enabling the systematic analysis of large volumes of data. Pereira et al. (2024) associate AI trends in the PPC with the possibilities of improving planning and control activities. From this perspective, technology can act as a complementary instrument to managers' actions, offering forecasts, identifying patterns and supporting the evaluation of different alternatives before defining a certain action.

This capacity gains special relevance given the uncertainties related to demand. When forecasts deviate significantly from actual market behavior, production planning can result in excessive inventories, idle resources or an inability to fulfill orders.

Mattos and Scur (2022) highlight the importance of implementing Artificial Intelligence in demand forecasting, while Mattos and Correia (2023) associate this application with the broader process of digital transformation of planning. In this way, intelligent tools can offer informational support for decisions that need to be made in advance.

The use of neural networks reinforces this perspective, especially in situations in which the behavior of variables presents complex patterns. Soares, Chiquetano and Kleina (2020) present an application aimed at forecasting demand in the metalworking segment, while Moraes and Corso (2022) associate neural networks with forecasting and line balancing. These studies have shown that results generated by AI tools can be incorporated into different stages of the decision-making process, connecting future estimates to operational decisions. The combination of Artificial Intelligence and optimization algorithms can also expand the alternatives available to managers. Moraes et al. (2023) demonstrate the application of genetic algorithms associated with AI methods aimed at optimizing demand forecasting. In the decision-making process, this combination of techniques can facilitate the comparison between different possibilities and support the choice of configurations that present better results according to the criteria defined by the organization.

Industrial decision-making, however, is not limited to demand behavior. Supply chain performance constitutes another essential variable. Leão et al. (2023) showed that Artificial Intelligence techniques can be applied to the optimization of supply chains, while Lunardi and Lima Junior (2021) analyzed neural networks aimed at evaluating their performance. These applications can generate information related to supplier behavior, material flows and logistical performance, elements that directly interfere with the ability to execute production plans.

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Similarly, information about the condition of equipment can significantly influence decision-making in the PPC. Predictive maintenance allows you to use data to anticipate possible intervention needs, reducing the degree of unpredictability associated with failures. The study conducted by Zaro and Webber (2023) on predictive maintenance 4.0 reinforces the possibility of using technological systems to generate information capable of supporting decisions related to the availability and functioning of productive resources. In PPC, knowing in advance about the possible unavailability of certain equipment can allow adjustments to the schedule before the failure compromises the production process.

The implementation of these technologies, however, requires organizational decisions that precede their actual use. Silva et al. (2022) showed that the choice and implementation of Industry 4.0 technologies involve decision-making processes that need to consider different factors. Therefore, the simple acquisition of Artificial Intelligence tools does not guarantee improvements in performance, and it is necessary to evaluate aspects such as infrastructure, integration between systems, professional training, availability and quality of data, investments and compatibility between technology and organizational objectives.

Data quality deserves special attention, since Artificial Intelligence systems depend directly on the information used in their development and operation. Incomplete, inconsistent or unrepresentative data can compromise predictions and analysis. Therefore, the implementation of AI in the PPC needs to be accompanied by appropriate practices for collecting, organizing, storing and processing information. The digital transformation of planning, discussed by Mattos and Correia (2023), presupposes not only the introduction of technological tools, but also changes in the processes used to produce and use information.

Another relevant aspect concerns the relationship between technology and human participation. AI can process data and generate recommendations faster than exclusively manual analysis, but industrial decisions involve strategic and contextual factors that cannot always be fully represented by computational models. Therefore, the use of technology tends to be more appropriate when understood as a decision support mechanism, preserving professionals' responsibility for interpreting information and evaluating the consequences of the alternatives presented.

In this sense, Artificial Intelligence can contribute to transforming the role played by PPC professionals. Part of the effort traditionally dedicated to manual data consolidation and the preparation of repetitive analyzes can now be supported by automated tools, allowing greater dedication to analytical and strategic activities. This transformation, however, requires

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the development of new skills, mainly related to data interpretation, understanding the limitations of models and the critical use of the information provided by the systems.

The joint analysis of the works of Telles, Barone and Silva (2020), Silva et al. (2022) and Pereira et al. (2024) allows us to understand that the insertion of Artificial Intelligence in the production environment must be observed within a broader process of technological and organizational transformation. This means that the benefits related to the speed of analysis, predictive capacity and decision support need to be accompanied by adequate implementation planning and alignment between technology, people and processes.

3. Material and Method

The research methodology brings together the set of procedures used to conduct the development of the study and allow the proposed objectives to be achieved. Considering that this research aims to analyze the use of Artificial Intelligence (AI) in the Production Planning and Control (PPC) sector as a tool to support decision-making in the industrial environment, we opted for a methodological approach based on bibliographical research, of an applied nature, with a qualitative approach and exploratory and descriptive objectives.

As for its nature, the research is classified as applied, as it deals with knowledge related to a problem present in the context of industrial organizations. The study seeks to understand how resources based on Artificial Intelligence can be used in PPC activities and what contributions these tools can bring to decision-making processes. Thus, although developed from scientific literature, the work directs its discussion to applications and problems related to the management of operations and production processes in organizations.

Regarding the approach to the problem, the study is characterized as qualitative. This choice arises from the purpose of interpreting and discussing the contributions, applications, benefits, limitations and challenges associated with the use of Artificial Intelligence in Production Planning and Control. Therefore, the intention is not to carry out statistical treatment of the results obtained, but rather to critically analyze the information present in the selected publications, relating the knowledge produced by the different authors to the problem investigated.

As for the objectives, the research has an exploratory and descriptive nature. The exploratory nature is related to the need to expand understanding of the use of Artificial Intelligence in the PPC, particularly with regard to the possibilities of applying these

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technologies in forecasting, planning, scheduling, control and decision support processes. The descriptive dimension is associated with the identification and characterization of the main applications found in the literature, as well as the benefits and challenges related to the use of these tools in the production environment.

As for technical procedures, bibliographic research was used. The survey was carried out by consulting scientific articles and works published in journals and academic events linked to the areas of Production Engineering, Production Management, Artificial Intelligence, Industry 4.0 and supply chain management. This procedure made it possible to gather knowledge already produced on the topic and build a theoretical basis capable of supporting the analysis of the relationship between Artificial Intelligence, Production Planning and Control and decision making.

To compose the analysis material, 12 scientific publications produced between 2020 and 2024 were considered, selected because they had a direct or complementary relationship with the object investigated. The time frame was defined with the aim of prioritizing recent studies, given the rapid evolution of Artificial Intelligence technologies and their growing application in industrial environments. Among the selected works, there are studies published in scientific journals and works presented at national events in the area of Production Engineering.

The selection of publications took into account the following inclusion criteria: works published in Portuguese; studies within the defined time frame; scientific articles and complete works published in journals or academic conference proceedings; and research related to Artificial Intelligence applied to production planning and control, demand forecasting, supply chains, production balancing, predictive maintenance, Industry 4.0 or decision making.

As exclusion criteria, materials unrelated to the production or industrial context, publications that only mentioned Artificial Intelligence without discussing its application, and works that did not present sufficient information to contribute to the research objectives were discarded.

For the analysis of the bibliographic material, the information identified in the works was organized into thematic categories aligned with the research objectives. Four main categories were established:

a) applications of Artificial Intelligence in the PPC;

b) Artificial Intelligence applied to demand forecasting and planning;

c) AI contributions to decision-making and improving production performance;

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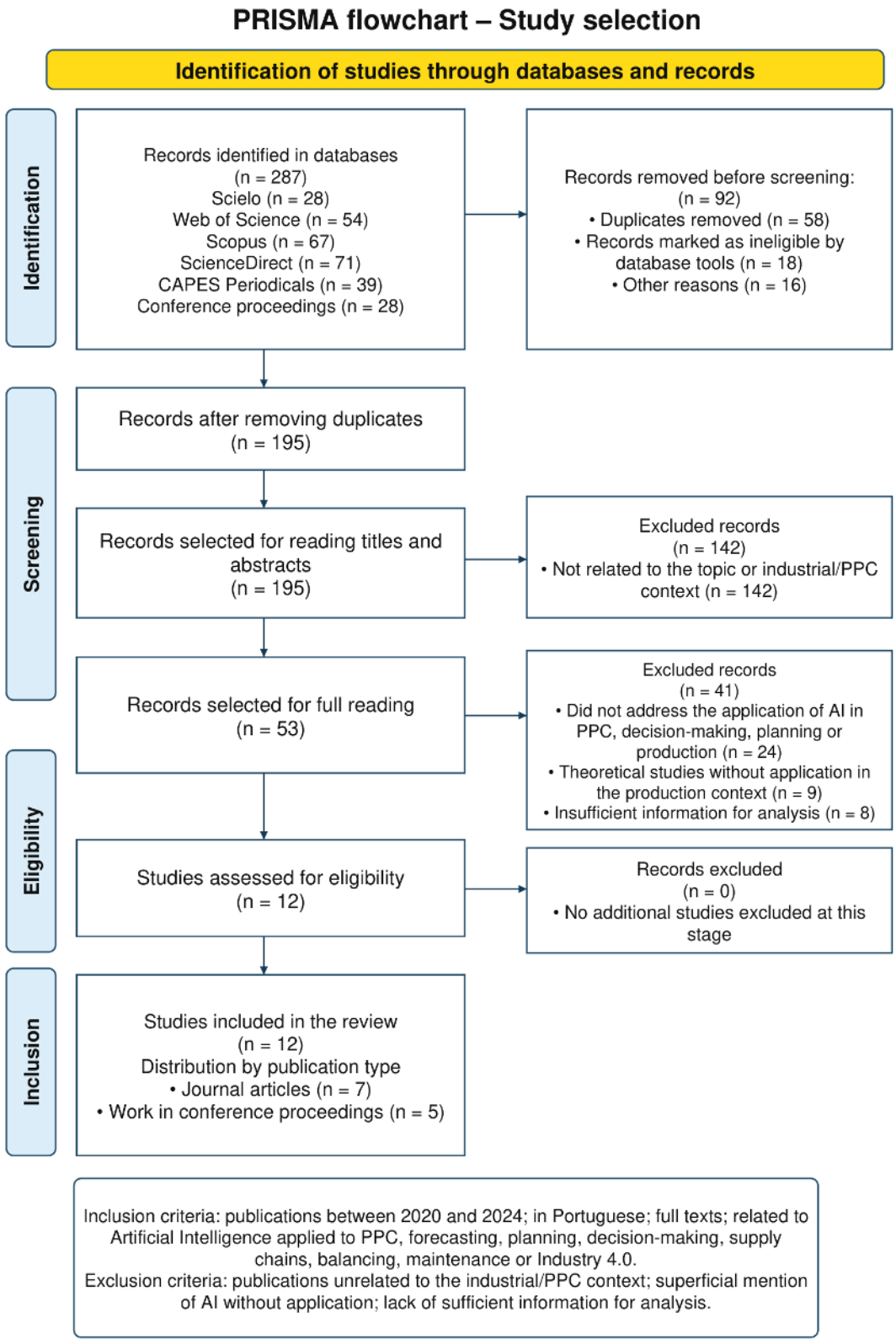
d) challenges and limitations related to the implementation of these technologies in the industrial environment.

This organization made it possible to compare the results presented by different studies and identify convergences, particularities and aspects relevant to the discussion of the problem investigated, as detailed in the selection process illustrated in Figure 1.

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Figure 1 – Methodology flowchart



Source: Adapted from Page et al. (2021) – PRISMA 2020.

Figure 1 visually details the funneling of searches and the selection of studies that make up this research. The flowchart demonstrates the gradual reduction of the 287 records initially identified until the final sample of 12 publications, made up of seven journal articles and five

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works from conference proceedings. The rigorous application of the inclusion and exclusion criteria was decisive in eliminating research outside the productive context, ensuring that only works with direct adherence to the problem investigated served as the basis for presenting the results.

4. Results and Discussion

The analysis of the 12 selected publications made it possible to identify different applications of Artificial Intelligence (AI) related to Production Planning and Control (PPC) and the decision-making process. In general, the studies examined point to an expansion in the use of AI techniques in activities linked to demand forecasting, production planning, line balancing, supply chain management, performance assessment and predictive maintenance. The results show that the application of AI in the production environment does not focus on a single activity, but can reach different processes capable of providing relevant information for PPC decisions.

The organization of the results allowed us to define four main categories of analysis: applications of Artificial Intelligence in the PPC; use of AI in demand forecasting and planning; contributions of AI to decision-making and productive performance; and challenges related to the implementation of technologies in the industrial environment. These categories made it possible to compare the contributions presented by the studies and understand how different technological resources can be related to production planning and control activities.

With regard to the first category, it was found that the application of Artificial Intelligence in the PPC has a diverse nature. Pereira et al. (2024), when examining trends and perspectives of AI in Production Planning and Control, they highlight the growing rapprochement between intelligent tools and operations planning activities. This relationship involves the possibility of using productive data to improve analyses, forecasts and decisions, making PPC a relevant area for the incorporation of technologies associated with digital transformation.

The results also showed that the insertion of AI in the PPC needs to be understood within the broader context of Industry 4.0. Telles, Barone and Silva (2020) point out Artificial Intelligence among the technologies related to the changes brought about by the fourth industrial revolution. The data processing and interpretation capacity provided by these tools

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expands the possibilities for developing more connected production systems capable of generating information for operations management.

Silva et al. (2022), in turn, demonstrate that the choice and implementation of Industry 4.0 technologies constitute decision-making processes that involve different organizational factors. This result is relevant to the present research as it shows that the benefits of AI do not simply result from the acquisition of a certain technology. Its implementation needs to consider aspects such as the organization's needs, available resources, strategic objectives and the ability to integrate the new technology into existing processes.

Among the applications identified in the literature analyzed, demand forecasting was particularly prominent. This activity is directly related to the PPC, since demand estimates guide decisions regarding production volumes, capacity use, material needs and stock levels. Mattos and Scur (2022) specifically address the implementation of Artificial Intelligence in the demand forecasting process, highlighting the relevance of this application for taking advantage of historical information and improving planning processes.

Mattos and Correia (2023) also associate the adoption of Artificial Intelligence with the digital transformation process of demand planning. The results of this study reinforce that the introduction of intelligent tools can change the way organizations structure their forecasts, especially in contexts with a large volume of data available. For the PPC, this transformation may represent greater availability of information for the preparation of production plans.

The use of artificial neural networks appears as one of the techniques used for prediction. Soares, Chiquetano and Kleina (2020) analyzed its application aimed at forecasting demand in a metalworking company. The study highlights the use of AI techniques in a concrete business context, demonstrating its ability to support estimates that can later be incorporated into the planning of production activities.

The results presented by Moraes et al. (2023) expand this perspective by demonstrating a demand forecasting application based on Artificial Intelligence optimized by genetic algorithms. The combined use of techniques shows that different computational methods can be used to improve forecast models. This result is relevant for the PPC as it shows the possibility of developing models adapted to the characteristics of the data and the specific needs of the production process.

Sousa et al. (2024), when studying long-term demand forecasting using Prophet, also demonstrate the use of computational methods to estimate future behavior. Although the study is related to a retail company, its results contribute to understanding the importance of

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predictive tools for organizational planning. The availability of long-term estimates can support decisions about capacity, inventories, resource acquisition and organization of operations.

Another result identified refers to the possibility of integration between demand forecasting and organization of production capacity. Moraes and Corso (2022) analyzed an application of optimized line balancing based on demand forecasting and artificial neural networks. This approach demonstrates that the results generated by predictive models can be used as input for other decisions related to the production system. Thus, Artificial Intelligence can contribute not only to anticipating demand, but also to supporting the adaptation of the operational structure to anticipated needs.

This integration between forecasting and production organization has relevant implications for decision making. When the PPC has more structured information about future demand, it becomes possible to analyze in advance the need for adjustments in capacity, distribution of activities, use of equipment and availability of resources. The results presented by Moraes and Corso (2022) thus highlight an application in which AI establishes a connection between predictive information and operational decisions.

In the context of supply chains, the selected studies also point to relevant applications. Leão et al. (2023), through a systematic literature review, address the use of Artificial Intelligence techniques aimed at optimizing supply chains. The results demonstrate the breadth of possibilities for using AI in this context, an aspect directly related to the PPC due to the dependence between production planning and the availability of materials and other resources from the chain.

Lunardi and Lima Junior (2021) analyzed artificial neural network learning methods applied to supply chain performance assessment. The results indicate the possibility of using these techniques in processing information related to performance, contributing to more structured assessments. In the context of the PPC, this information can help identify external conditions capable of interfering with the fulfillment of production plans.

The analysis of publications also identified predictive maintenance as a relevant application among the technologies associated with Industry 4.0. Zaro and Webber (2023) present a case study on the development of a system aimed at predictive maintenance 4.0. This application has an important relationship with the PPC, as the availability of equipment is an essential variable for planning execution. The possibility of anticipating maintenance interventions can help reduce the impacts of unexpected downtime on production scheduling.

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Considering the set of studies analyzed, it is observed that the contribution of AI to the PPC occurs mainly through the transformation of data into information capable of supporting decisions. Instead of acting only on already consolidated historical data, some applications allow you to identify patterns and make predictions about future behavior. The studies by Mattos and Scur (2022), Moraes and Corso (2022), Moraes et al. (2023) and Sousa et al. (2024) exemplify this characteristic through applications aimed at demand forecasting and planning.

Another relevant result concerns the integration of information used in production decisions. The applications identified cover different dimensions of the operation, such as market, demand, production resources, supply chain and equipment. Leão et al. (2023) and Lunardi and Lima Junior (2021) highlight applications related to the supply chain, while Zaro and Webber (2023) direct the discussion to maintenance. This demonstrates that decision-making in the PPC can benefit from the integration of information from different areas of the organization.

The literature analyzed also allows us to identify a trend of evolution from predominantly reactive planning to approaches with greater predictive capacity. Demand forecasting, early analysis of equipment condition and evaluation of different scenarios can provide the PPC with conditions to act before certain problems occur. In this sense, the applications analyzed by Soares, Chiquetano and Kleina (2020), Mattos and Scur (2022), Moraes et al. (2023) and Zaro and Webber (2023) highlight different ways of using data to anticipate situations relevant to operations management.

With regard to the benefits associated with decision making, the works analyzed point to possibilities related to improving analysis capacity, greater use of organizational data, the development of forecasts and support for the optimization of resources. Pereira et al. (2024) highlight the perspectives of AI for the PPC, while Silva et al. (2022) highlight the need to consider decision-making during the selection and implementation process of Industry 4.0 technologies. These results show that AI can contribute to both operational decisions and decisions related to the technological transformation of organizations.

However, the results analyzed do not allow us to interpret Artificial Intelligence as an automatic solution to all industrial planning problems. The application of these technologies is conditioned on the existence of adequate data, compatible infrastructure and integration between systems and processes. The discussion by Silva et al. (2022) on the implementation of Industry 4.0 technologies reinforces the importance of considering organizational conditions in

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the technological adoption process. Therefore, the effectiveness of AI also depends on the company's ability to incorporate the tools into its routines and objectives.

The results indicate the need to maintain the participation of professionals in the decision-making process. AI tools can generate predictions, assessments and information that help choose between alternatives, but decisions need to be interpreted according to the specific conditions of each organization. In this sense, technology can be understood as a support mechanism, and not necessarily as a full replacement for human analysis. This interpretation is aligned with the perspective of implementing Industry 4.0 technologies discussed by Silva et al. (2022) and the trends identified for AI in the PPC by Pereira et al. (2024).

The synthesis of publications allows us to observe that the main applications identified can be grouped as shown in Table 1.

Table 1 – Summary of Artificial Intelligence applications identified in studies

Application	**Possible contribution to the PPC**	**Related studies**
Demand forecast	Support for defining production volumes, capacity and stocks	Soares, Chiquetano and Kleina (2020); Mattos and Scur (2022); Moraes et al. (2023); Sousa et al. (2024)
Demand planning	Data integration and planning improvement	Mattos and Correia (2023)
Line balancing	Adequacy of resources and organization of operations according to demand	Moraes and Corso (2022)
Supply chains	Optimization, performance evaluation and materials planning support	Lunardi and Lima Junior (2021); Leão et al. (2023)
Predictive maintenance	Anticipating interventions and reducing the impacts of downtime on production	Zaro and Webber (2023)
Management and decision-making in the PPC	Trend analysis and support for productive decisions	Pereira et al. (2024)
Industry 4.0 and digital transformation	Integration of AI into the production environment and modernization of processes	Telles, Barone and Silva (2020); Silva et al. (2022)

Source: Prepared based on the studies analyzed (2026).

In general, the results obtained respond to the research problem by showing that the use of Artificial Intelligence can contribute to decision-making in the PPC, mainly through

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prediction, analysis and integration of relevant information for planning operations. AI can support decisions related to demand, production capacity, resource organization, supply chain and equipment availability, expanding the informational support offered to professionals responsible for planning.

5. Final Considerations

The development of this study allowed us to analyze the use of Artificial Intelligence (AI) in the Production Planning and Control (PPC) sector, with emphasis on its contributions to decision-making in the industrial environment. From the analysis of the selected literature, it was found that digital transformation and the advancement of technologies associated with Industry 4.0 have been expanding the possibilities of using intelligent tools in operations management, allowing data from different processes to be used in a more structured way in planning production activities.

The analysis carried out showed that one of the main areas of application of Artificial Intelligence corresponds to demand forecasting. This activity has strategic importance for the PPC as it influences decisions related to production volumes, capacity sizing, material acquisition, stock formation and operations scheduling. The studies analyzed highlighted the use of artificial neural networks, genetic algorithms and other computational methods to generate estimates capable of helping to understand future demand behavior.

In addition to forecasting, it was found that AI presents possibilities for application in balancing production lines, allowing information on demand and capacity to be linked to the organization of production activities. This application demonstrates that the results generated by intelligent systems can be incorporated into operational decisions, contributing to a more appropriate use of available resources and the organization of production processes.

Another aspect identified refers to the application of Artificial Intelligence in supply chain management. The performance of suppliers, the availability of raw materials and logistics flows are directly related to the companies' ability to fulfill their production plans. In this context, AI techniques can contribute to the analysis of information in the chain, the evaluation of performance and the identification of situations capable of compromising planning, expanding the view of those responsible for the PPC on external factors that interfere in the industrial operation.

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Predictive maintenance was also identified as an application with relevant implications for Production Planning and Control. The availability of equipment is an essential condition for the scheduling to be carried out as planned. In this way, technologies capable of anticipating maintenance needs can provide important information so that adjustments can be made in advance, reducing the impacts caused by unexpected failures and increasing the predictability of operations.

Regarding the established objectives, it is considered that the general objective was achieved, since it was possible to analyze the use of Artificial Intelligence in the PPC as a tool to support industrial decision-making. Likewise, specific objectives were addressed by identifying the main applications of AI related to PPC activities, their possible contributions to information analysis and decision making, the benefits associated with operations planning and the main aspects to be considered during their implementation.

Among the benefits observed, the greatest use of data generated by production processes, the development of forecasts, the anticipation of certain problems, the integrated analysis of different variables and the provision of information for choosing between decision alternatives stand out. These elements can favor the transition from a predominantly reactive planning model to a more predictive approach, in which professionals are able to use information about possible future scenarios to organize the necessary resources in advance.

However, the results also demonstrated that the implementation of Artificial Intelligence should not be understood as an isolated solution to PPC challenges. The effectiveness of these technologies depends on factors such as data availability and quality, technological infrastructure, integration between systems, investments and professional qualifications. Therefore, the adoption of intelligent tools needs to be aligned with the organization's real needs and the strategic objectives defined for the production process.

Carrying out the study also allowed us to identify some limitations. As this is bibliographical research with a qualitative approach, the conclusions are linked to the characteristics of the selected publications and the established time frame. Furthermore, no investigation was conducted directly in industrial organizations to empirically verify how PPC professionals use Artificial Intelligence tools in their daily activities. Therefore, the results reflect a perspective based on literature and do not intend to represent all the different realities that exist in the industrial sector.

As a possibility for future research, it is recommended to develop case studies in companies that already use Artificial Intelligence resources in the PPC, allowing indicators and

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processes to be compared before and after their implementation. Interviews can also be conducted with managers, planners and Production Engineering professionals, in order to understand their perception of the benefits, difficulties and changes caused by the adoption of these tools. Quantitative research can also analyze indicators such as forecast accuracy, stock levels, service time, productivity, capacity utilization, occurrence of downtime and operational costs.

It is also suggested that future studies investigate issues related to the reliability and explainability of Artificial Intelligence models, governance and data quality, the integration of AI with ERP systems and other industrial technologies, the qualification of professionals and the impacts of generative Artificial Intelligence on planning activities. These themes tend to gain greater relevance as new solutions are incorporated into industrial management processes.

Thus, it appears that Artificial Intelligence has significant potential to contribute to Production Planning and Control, especially by expanding the ability to analyze, predict and use data in the decision-making process. Its application can favor decisions related to demand, capacity, productive resources, the supply chain and maintenance, contributing to a more integrated, predictive and information-driven PPC. However, obtaining these benefits requires planned implementation that is compatible with the characteristics of each organization.

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