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Consulting Model in Industry 5.0 in the Pulp and Paper Segment

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Abstract
This study proposes to develop a consultancy model to assess the maturity level of Industry 5.0 (I 5.0) practices in the pulp and paper segment. Value Proposition Canvas (VPC) as a framework and business model to identify needs and create a value proposition for customers through Industry 5.0 practices consultancy. A five-level maturity scale was applied to the dimensions that characterize the diagnostic checklist model for Industry 5.0 practices. The Judge Validation research method was used to evaluate the content of the Industry 5.0 practices diagnostic checklist. As a result, a hypothetical consultancy called CoMind Solutions Consulting Ltd. was created, constituted through the creation of the social contract, creation of the mission, vision and values, in addition to the development of a business model based on the strategic management tool VPC. A checklist model was also created to diagnose Industry 5.0 practices and their respective level of maturity.

Keywords: Consulting; Industry 5.0; Maturity models.

Resumo
Este estudo propõe desenvolver um modelo de consultoria para avaliar o nível de maturidade das práticas da Indústria 5.0 (I 5.0) no segmento de celulose e papel. *Value Proposition Canvas* (VPC) como *framework* e modelo de negócios para identificar necessidades e criar uma proposta de valor para clientes por meio de consultoria em práticas da Indústria 5.0. Uma escala de maturidade de cinco níveis foi aplicada às dimensões que caracterizam o modelo de *checklist* de diagnóstico para práticas da Indústria 5.0. O método de pesquisa de Validação por Juízes foi utilizado para avaliar o conteúdo do *checklist* de diagnóstico para práticas da Indústria 5.0. Como resultado, foi criada uma consultoria hipotética chamada *CoMind Solutions* Consultoria Ltda., constituída por meio da criação do contrato social, criação da missão, visão e valores, além do desenvolvimento de um modelo de negócio baseado na ferramenta de gestão estratégica VPC. Também foi criado um modelo de *checklist* para diagnosticar as práticas da Indústria 5.0 e seus respectivos níveis de maturidade.

Palavras-chave: Consultoria; Indústria 5.0; Modelos de maturidade.

1. Introduction.

Industries play an active role in providing solutions to societal challenges, including resource conservation, technological development and social stability. This is a path that transforms both business and society (CARS; WEST, 2015; POPOVA, 2020; SKLAREW, 2022). In order to support the transformation of business and society to simplify this journey, according to Davim and Machado (2023), there is a need to use more practical and innovative approaches, integrating themes that encompass the operability and well-being of employees at all stages of the business.

Industry 5.0 (I5.0), in this context, becomes a resilient provider of more sustainable operational processes, aiming at a complete synergy, for greater productivity and efficiency, between human beings and technology, machines and robots, integral parts of this evolutionary process (ELY et al., 2024; DAVIM; MACHADO, 2023). According to the authors, I5.0 seeks to restore people's leading role in business processes, thus benefiting the industry, workers and society together.

To facilitate the adoption of Industry 5.0 practices in the pulp and paper sector, Burmester et al. (2007) defend the need for a contemporary management model, capable of optimizing organizational policies, processes and practices, defining appropriate models to assess maturity stages and determine points for improvement. Thus, Essmann (2009) and Kirrane (2009) propose the use of maturity models, which allow measuring the organizational status quo and guiding continuous improvement processes, aligned with good practices. Used as benchmarking, change management and organizational learning tools, maturity models promote a balance between theory and practice (CARVALHO, 2016; KOLUKISA TARHAN et al., 2020) and contribute to identifying gaps, guiding the transition between maturity stages and supporting strategic decisions (ARTA et al., 2024; CRONEMYR; DANIELSSON, 2013; OLESŃÓW-SZŁAPKA et al., 2024).

In view of this, Pena (2016) mentions that many organizations do not have the necessary knowledge to implement and deploy certain corporate practices, mainly due to the considerable growth of the organization and the lack of recruitment of qualified professionals or the absence of necessary skills to be able to master certain concepts, such as the concepts involving Industry 5.0, thus requiring advice from specialized consultancies, in order to simplify the process of understanding, deployment and implementation. According to Oliveira (2019), consulting, conceived as an interactive process to support decision-making, contributes significantly to overcoming conceptual and operational gaps, in addition to aggregating know-how and disseminating consolidated market practices, through specialized consultants, facilitating the cultural and structural transition in organizations (KINGMA, 2019).

It is worth noting that the global Industry 5.0 market is estimated at US$93.39 billion in 2025 and is forecast to reach approximately US$987.11 billion by 2034, representing a compound annual growth rate of 30.08% from 2025 to 2034. Market sizing and forecasts are based on revenue (US$ million/billion), with 2024 as the base year. The advancement of Industry 5.0 has been driven by the demand for large-scale personalization and the increasing connectivity provided by Internet of Things (IoT) technologies. By 2023, around 70% of global manufacturers were already using artificial intelligence for predictive maintenance and process optimization, while collaborative robots were present in 18% of industrial operations, with projected annual growth of over 20%. The adoption of digital twins reached 25% of industries by 2024, contributing to reduced downtime and greater production efficiency. Furthermore, it is estimated that more than 60 billion IoT devices will be connected globally by 2024, reinforcing the capacity for real-time decision-making in production environments (GLOBAL FORECAST, 2024; MARKETS, 2024).

In the context of the pulp and paper industry in Brazil, it can be highlighted as one of the most important in the world, being the second largest global producer of pulp and the ninth in paper production. In 2023, the segment generated around 128 thousand direct jobs and 640 thousand indirect jobs in 540 Brazilian municipalities. Representing 11% of global pulp production, the sector contributes significantly to Brazil's trade balance, with exports destined mainly for North America, Europe and Asia. Furthermore, its share of Brazilian GDP is significant, and sustainable practices include the management of 9.9 million hectares of forests, of which 6.7 million are native vegetation conservation areas, and the increasing use of decarbonization and energy innovation technologies (ABTCP, 2024).

Given the growing adoption of Industry 5.0, which promotes collaboration between humans and intelligent machines, it becomes essential to expand scientific research that deepens the understanding

of this symbiotic relationship in the industrial environment. Although authors such as Adel (2022) recognize the efficiency gains provided by this integration, the appropriate levels of interaction between humans and cyber-physical systems still remain undefined. Recent studies reveal significant gaps in the literature, indicating the need to advance empirical research that explores how human-centered practices can be effectively integrated with collaborative technologies, as well as the technical and organizational obstacles that limit this synergy (LOIZAGA et al., 2023; MADDIKUNTA et al., 2022; NAHAVANDI, 2019).

From this perspective, the following research question is proposed: how to develop a consultancy model to assess the level of maturity of Industry 5.0 practices in the pulp and paper segment?

According to Weiss (2017), hiring a consultancy allows the expansion of the organization's strategic capacity to the point of making it capable of success, through changing traditional business models; ensuring continuous improvement of processes and activities, promoting self-assessment and offering guidelines for actions related to best practices (ELMAALLAM; KRIOUILE, 2013); through Industry 5.0 practices, which foresee the integration of human characteristics (such as subjectivity, creativity and intelligence) with physical characteristics of machines (such as precision) and logical capabilities of artificial intelligence algorithms for the same common goal of productivity (CAGGIANO et al., 2023).

This document is structured as follows: the second section presents the literature review, the third demonstrates the methodological procedures, the fourth section highlights the research results and, finally, the conclusions and recommendations.

2. Literature Review.

This chapter comprises a literature review on the concepts of business model, VPC, business consulting, Industry 5.0 and, finally, maturity models.

2.1. Business Model.

A business model describes how an organization generates economic value, whether for itself or for third parties, highlighting elements related to supply, market, strategy, internal capabilities, competition and investors (RIGO et al., 2022).

The concept of a business model, although implicitly and informally, was already discussed by Peter Drucker in the 1950s as a strategy to guarantee consistent financial returns for organizations, through the creation of value for customers. The expression gained prominence in the 1990s, driven by the popularization of the internet, consolidating itself as a recurring term in corporate management (COOMBES; NICHOLSON, 2013). The term combines the idea of “model” — a simplified representation of complex processes — with the notion of “business”, which refers to the activities of buying and selling goods and services with the aim of obtaining financial gains (OSTERWALDER, 2004).

In corporate environments characterized by complexity and uncertainty, well-defined and up-to-date business models play a crucial role. They integrate strategies, processes and information systems, promoting more efficient communication between these elements and facilitating the dissemination of knowledge, which, in turn, contributes to generating competitive advantage for the organization (OSTERWALDER; PIGNEUR, 2010).

According to Foss and Saebi (2017), there is still no consensus on the concept of business model, however Wirtz et al. (2016) mentions that the concept has been evolving over the decades. In this research, the concept of business model created by Brandão (2021, p. 34) will be used, which considers a business model as an “organizational architecture of the company, structured in an interdependent, dynamic, flexible and cyclical way; by simple, relevant elements capable of generating value that goes beyond its borders and guarantees competitive advantage”.

According to Drucker (2008), a good business model must answer the following questions: What is our mission? Who is our customer? What does the customer value? What are our results? and What is our plan?

In this sense, Shafer et al. (2005) developed an affinity diagram to group the components belonging to a business model into four distinct categories, namely: strategic choices (customer; value proposition; competencies; strategies: brand; mission), value creation (resources; processes), value network (suppliers; information and customer relations; flow of information, products and services) and value capture (revenue; costs; financial aspects). For the authors, the term business model can be defined as a representation of the logic underlying strategic choices for creating and capturing value, within a value network.

The design of a business model cannot be restricted to a specific segment, and can be made up of both organizations established in the market and newly created organizations (DORNELAS, 2023).

Each organization has its own characteristics and purposes, distinct adversities and a process in constant development, which means that a business model is unique to each organization, with no similarity in relation to the steps to be followed. It is up to each organization to provide the necessary direction and adaptations during its establishment and longevity (OROFINO, 2011). According to Orofino (2011) and Osterwalder and Pigneur (2010), the following stages make up the development of a business model: mobilization; understanding; design; implementation; management; and feedback.

Business models, according to Guldmann et al. (2019) and Henike et al. (2020), manifest themselves through predefined structures, which precisely indicate their components and interrelationships. In this way, these structures offer information for those who undertake to restructure or create new businesses, thus adding greater value to the enterprise.

Different structural models can be observed in the literature that deal with various aspects of value creation, such as: the Hedman and Kalling model; Resources, Competencies, Organization and Value Proposition (RCOV) model; Customer-Integrated Business Model (CIBM); Johnson, Chistensen and Kagermann model; and the Business Model Canvas (BMC) and the Value Proposition Canvas (VPC).

Lopes et al. (2023) describes that a business model must be based on management practices, as well as theoretical constructs, thus reflecting the way leaders manage their organizations, thus constituting well-defined value propositions and articulated with other essential components of the business model. According to the authors, the best framework that meets these specifications is the combination of the Business Model Canvas (BMC) and the Value Proposition Canvas (VPC).

2.2. Value Proposition Canvas.

Different frameworks have been created to help entrepreneurs, including the Business Model Canvas (BMC), which essentially differs from other frameworks due to the involvement of administrators and entrepreneurs in the process of developing functionalities and structures, in order to create an effective management practice instrument to map the main components of a business model (TAIPALE-ERÄVALA et al., 2021).

As a continuation of the work initiated with Business Model Canvas (BMC) by the Swiss Alexander Osterwalder, based on his doctoral thesis in 2004, the Value Proposition Canvas (VPC) was developed as a complementary tool, designed to help entrepreneurs and companies better understand their customers and align their value proposition with the needs and desires of the target audience (BELLEFLAMME; NEYSEN, 2020; DORNELAS, 2023).

However, unlike the Business Model Canvas (BMC), which addresses four pillars and nine dimensions, the Value Proposition Canvas (VPC) delves into two of these dimensions: Value Proposition; and Customer Segment (Figure 1). The purpose of the Value Proposition Canvas (VPC) is to help entrepreneurs and companies design excellent value propositions that correspond to the needs and tasks to be performed by their customers and help them solve their problems (OSTERWALDER et al., 2014).

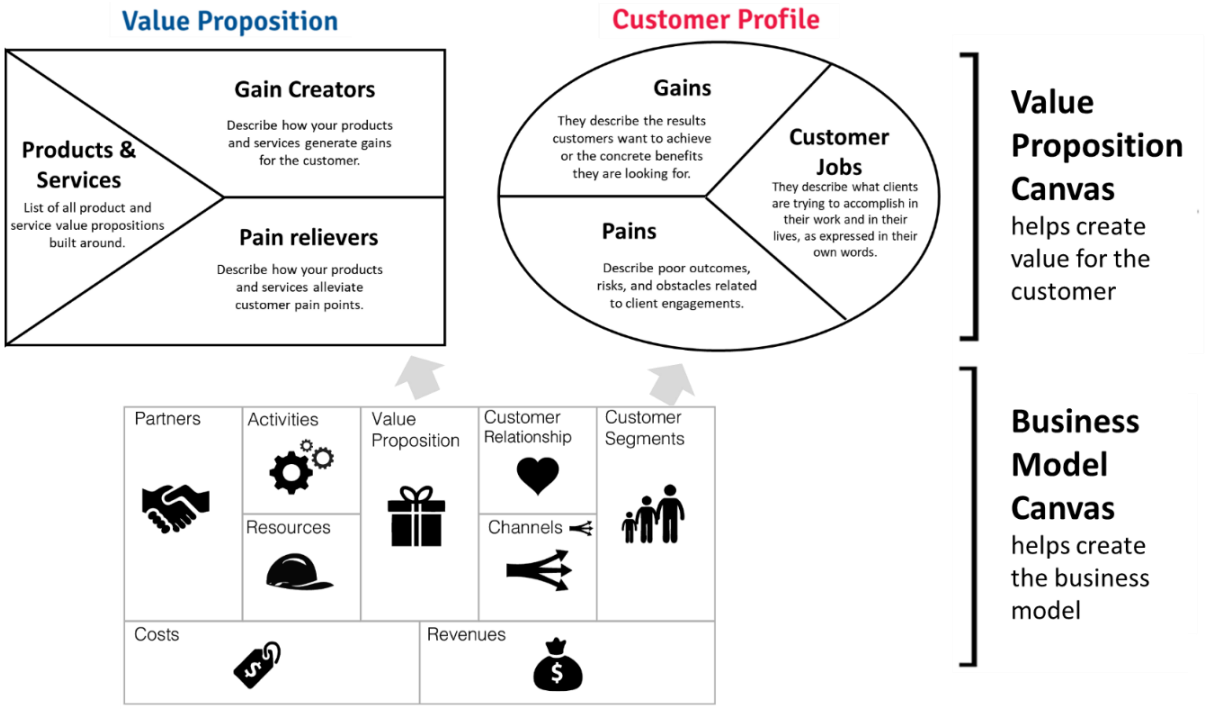

Figure 1 - Graphical representation of the Value Proposition Canvas. Source: Adapted from Osterwalder and Pigneur (2010) and Osterwalder et al. (2014, p. 8-9).

The two dimensions supporting the VPC are broken down into a set of six interrelated blocks that comprise a value proposition, namely: a) Value Map Dimension: comprises the representation of the products and services that the company offers to meet the customer's needs, composed of three blocks: Products and Services; Painkillers; and Gain Creators; and b) Customer Profile Dimension: involves a set of information regarding the customer profile based on market characteristics and the customer segment subdivided into three blocks: Customer Tasks; Pains; and Gains (OSTERWALDER et al., 2014).

In this study, the adoption of the Value Proposition Canvas (VPC) is considered more appropriate than other frameworks because of its focus on deepening the understanding of the relationship between organizations and their customers. While instruments such as the Business Model Canvas (BMC) provide a broader overview of strategic and operational elements (TAIPALE-ERÄVALA et al., 2021), they tend to dilute the emphasis on how value is effectively created, delivered, and perceived. The VPC, in contrast, concentrates on two fundamental dimensions (Value Proposition and Customer Segment) allowing the design of solutions that directly address customer pains, gains, and tasks (OSTERWALDER et al., 2014). This sharper analytical focus makes it particularly suitable for consulting processes in complex industries, such as pulp and paper, where differentiation depends not only on structural arrangements but also on the ability to translate technological innovations into tangible value for stakeholders (BELLEFLAMME; NEYSEN, 2020; DORNELAS, 2023).

In addition, the VPC is directly aligned with the guiding principles of Industry 5.0, which emphasize human-centricity, sustainability, personalization, and resilience as essential drivers of competitiveness. By explicitly mapping how technological advances (such as cobots, biotechnologies, or green technologies) can alleviate customer pains or generate new gains, the framework reinforces the integration of innovation with social and environmental responsibility. This perspective is supported by Osterwalder and Pigneur (2010), who highlight the centrality of value creation in strategic design, and by Maradita and Aprirachman (2024), who point out the effectiveness of the VPC in enhancing differentiation in competitive contexts. In this sense, the VPC emerges not only as a managerial tool for value design, but also as a methodological bridge between emerging Industry 5.0 practices and their capacity to generate meaningful and sustainable value propositions.

In view of this, the Value Proposition Canvas (VPC) can be considered a valuable tool in the development of products and services, and can be used both for new launches and to improve existing offerings. Companies that want to differentiate themselves from the competition find in this structured approach an effective way to understand and communicate the benefits offered to customers (MARADITA; APRIRACHMAN, 2024).

2.3. Business Consultancy.

Business consulting has attracted many professionals over time, largely due to the high demand for goods and services by organizations that progressively need to update themselves regarding business management methodologies and techniques (MOTA et al., 2019).

Consulting firms that currently surround the service provision market, according to Donadone et al. (2012), emerged between the 1850s and 1920s. Considered by many to be the oldest business consultancy in the world, Arthur D. Little, Inc. was founded in 1886 by a professor at the Massachusetts Institute of Technology (MIT) named Arthur Dehon Little and his business partner Roger B. Griffin, which remains in full operation to this day, known for being at the forefront of innovation, revealing new growth opportunities to transform organizations (MIT LIBRARIES, 2023).

In the process of organizational transformation, business consultancy is considered a contribution to help improve the management of an organization, offering solutions for all sizes of companies in different areas, both in good and bad times for a business. Considered as a type of service provided, business consultancy aims to analyze, diagnose and suggest the resolution of possible adversities regarding a specific subject or segment (FIA/USP, 2018).

Ramos and Santos (2021) show that business consultancy should be considered as a process of interaction and mutuality, dissociated from the adversities in question, leading the organization along a more assertive path, in order to achieve the initially planned objectives. With the help of business consultancy, it is possible to reduce costs, make processes more efficient, plan business expansions and improve the activities of different organizational sectors, among others (ALVES et al., 2015; FIA/USP, 2018).

Weiss (2017) explains the existence of two main spheres of activity in the area of business consulting, that is, internal consulting and external consulting, prioritized according to organizational objectives. The main difference between the two main spheres, according to the author, is the existence or not of the consultants' link with the organization. For Ramos and Santos (2021) mention that both spheres of business consultancy, internal consultancy or external consultancy, bring advantages and disadvantages for the development of the organization.

Figure 2 presents some attributes of internal and external consultancy, as well as their advantages and disadvantages.

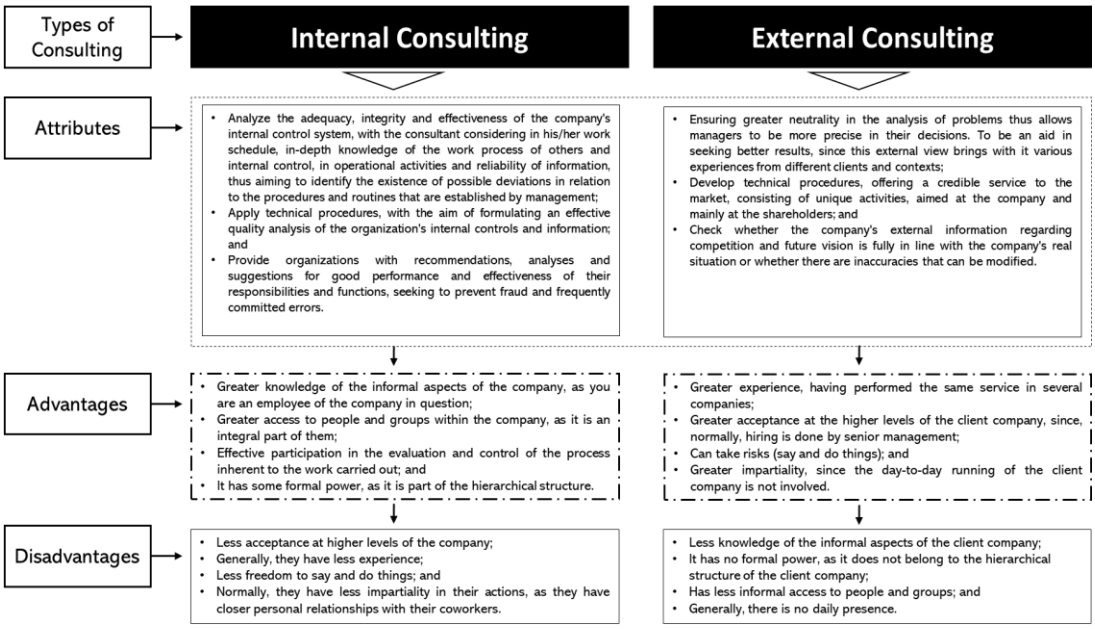

Figure 2 - Attributes, advantages and disadvantages of internal and external consulting. Source: adapted from Oliveira (2019, p. 54-55), Ramos and Santos (2021, p. 6-8) and Sardo et al. (2018, p. 102-104).

Regardless of the type, area of mediation and scope of business consultancy, for a consultancy to be successful in providing the strategic responses and results desired by client organizations, whether in a specific area of their business or flawed processes (COSTA, 2020), it is necessary to measure the practices, processes and methods used in contrast to a set of elements that determine the reference parameters in accordance with the organization's objectives (MAIER et al., 2011). According to Carvalho (2016) and Trentin (2021), these elements portray best practices and can bring together regulations or a set of conduct that are significant in a given area of mediation and scope of action.

In view of this, in addition to an effective and ethical relationship between business consultancy and client organization, in order to create a successful result (WANDABWA; YUSUF, 2018), it becomes necessary for business consultancy to establish what the levels of organizational skill and maturity are, encompassing the sum of all characteristics, attributes, indicators, or standards that portray the evolution and achievement of the stage of maturity in which the client organization's processes are found (CRONEMYR; DANIELSSON, 2013).

2.3.1 Organizational Diagnosis Method Applied to Business Consulting.

When the organization understands that rapid and fundamental changes in the business environment can threaten the sustainable growth of the organization, according to Deloitte (2023), hiring a specialized business consultancy can play a fundamental role in the process of changing organizations. For Tedlow (2018), in this transition process, between the status quo and the organizational objectives to be achieved, it is necessary to review the current context, using the organizational diagnosis method.

Organizational diagnosis is considered a method used to recognize the possible operational and results limitations of organizations so that they can be neutralized by elaborate and organized changes (SENGE, 2018; TEDLOW, 2018). The objective of the diagnosis is to interpret the current situation of the organization, with the purpose of modifying and improving it; it is a unique way of detailed analysis focused on the act of implementing change in order to improve organizational performance (PAUL; CADLE, 2020); organizational diagnosis can be considered an instrument that helps in the process of breaking with organizational defensiveness, expanding the capacity to measure and modify an organization's culture (MENDONÇA et al., 2020).

One of the purposes of organizational diagnosis is to identify possible gaps in the functioning of activities, in people's behavior and in the performance of processes with a view to certain purposes that are intended to be achieved (CECIN et al., 2022). The gaps between the current and desired scenario

are the essence of the diagnostic process and are regularly demonstrated through non-existent activity and/or inefficient performance (SCHUMPETER, 2017).

The use of the diagnostic method through business consultancy can provide good information on Industry 5.0 practices, in order to resolve and correct possible existing and potential adversities, ensuring the necessary changes.

The diagnostic method is basically composed of three questions, as described in Table 1.

Table 1 - Basic diagnostic method.

QUESTIONS	DESCRIPTION
(1) Why? (the causes of change)	Why should the company be changed? What should the content of the change include, that is, what should be changed in the organization?
(2) How? (the process of change)	The execution of the diagnosis is concerned with three aspects: a) the development of diagnostic models; b) the choice of procedures and methods for collecting data in the diagnosis; and c) the choice of data analysis methods and techniques.
(3) And what (the content of change)	It is the subject of recommendations for the intervention of consultancy projects to support change.

Source: adapted from Schumpeter (2017).

Mendonça et al. (2020) explain that the diagnosis is equivalent to the first phase of a business consultancy project, providing essential information to better understand the current stage of maturity of the internal processes critical to the execution of the organization's strategic objectives. Maturity models are known as essential instruments for measuring the stage at which the organization is in relation to each Industry 5.0 practice, providing a guideline for activities related to best market practices (ESSMANN, 2009; ELMAALLAM; KRIOUILE, 2013).

As the diagnostic process is completed and the gaps identified in the diagnostic intervention are known and recorded, this information must be made available to all members of the organization (STONE et al., 2018), as the objectives and practices of Industry 5.0 to be implemented must be materialized together with the strategic objectives of the organization (KHAN et al., 2024).

Subsequently, to the initial process of business diagnosis and identification of maturity levels, Tedlow (2018) stands out, which declares the need to consolidate the data and information obtained in a corporate report, highlighting the main qualities observed, the elementary adversities, and finally suggesting possible solutions and directing probable actions, including the establishment of objectives and goals, through a distinct and planned project, always based on organizational strategies (KAPLAN; NORTON, 2006).

In view of this, business consultancy in Industry 5.0 can suggest to senior management the formation of a multidisciplinary team, formed by the main leaders involved in the change process and other key employees involved in current practices (PARIKH, 2015). Cecin et al. (2022) highlight that business consultancy must emphasize during the process of implementing Industry 5.0 practices, that senior management must: a) start first with the strategy and then move on to a complex understanding of the problems; and b) continue to act as facilitators of an open and active dialogue to deliberate on actions to be taken, minimizing unfavorable impacts during implementation.

Lisiński (2013) states that despite all the expertise accumulated by business consultancy, during the implementation and deployment of policies, processes and practices it is not possible to follow all the stages of this process due to its multidimensionality, which is why preference must be given to a certain perspective, or part of reality, and the organization observed through this. Berti (2023) explains that the success or failure of a business consultancy in the process of implementing and implementing any type of service provided will determine the termination and/or continuity of the established partnership, an essential part of the provision of services in the sustainability of business relationships.

2.4. Industry 5.0.

Key issues such as sustainability and workforce empowerment are under debate in the manufacturing sector. This change drives Industry 5.0, which is already a reality and is significantly transforming companies, marking the next stage in the evolution of manufacturing (EFESO, 2025).

Aimed at finding harmony between human beings and intelligent machines, Industry 5.0 is the evolution of Industry 4.0. Unlike full automation, it prioritizes personalization, creativity and sustainability in production processes. Its objective is to balance technological efficiency with human values, promoting a more integrated and safe work environment (GHOBAKHLOO et al., 2024).

Industry 5.0 is not only concerned with increasing production efficiency but also seeks to strengthen the resilience of production chains in the face of global crises. Currently, as we move towards the Industry 5.0 era, it is essential to assess the degree of maturity of this concept, especially with regard to the human factor and sustainability (VERMA, 2024).

The concept of Industry 5.0 gained prominence through initiatives by the European Commission, which formalized the idea in a report, published in 2021, called Industry 5.0 - Towards a sustainable, human-centric and resilient European industry, highlighting the trends discussed by experts in innovation, automation and sustainability, incorporating principles such as collaboration between humans and machines, mass customization and environmental responsibility (EUROPEAN COMMISSION, 2021).

According to the European Commission (2021, p. 14) the purpose of Industry 5.0 is to recognize "the power of industry to achieve social goals beyond jobs and growth, becoming a resilient provider of prosperity, making production respectful of the limits of our planet and placing the well-being of the industry worker at the center of the production process". This broader purpose constitutes three main elements: human-centered approach, sustainability and resilience (Figure 3).

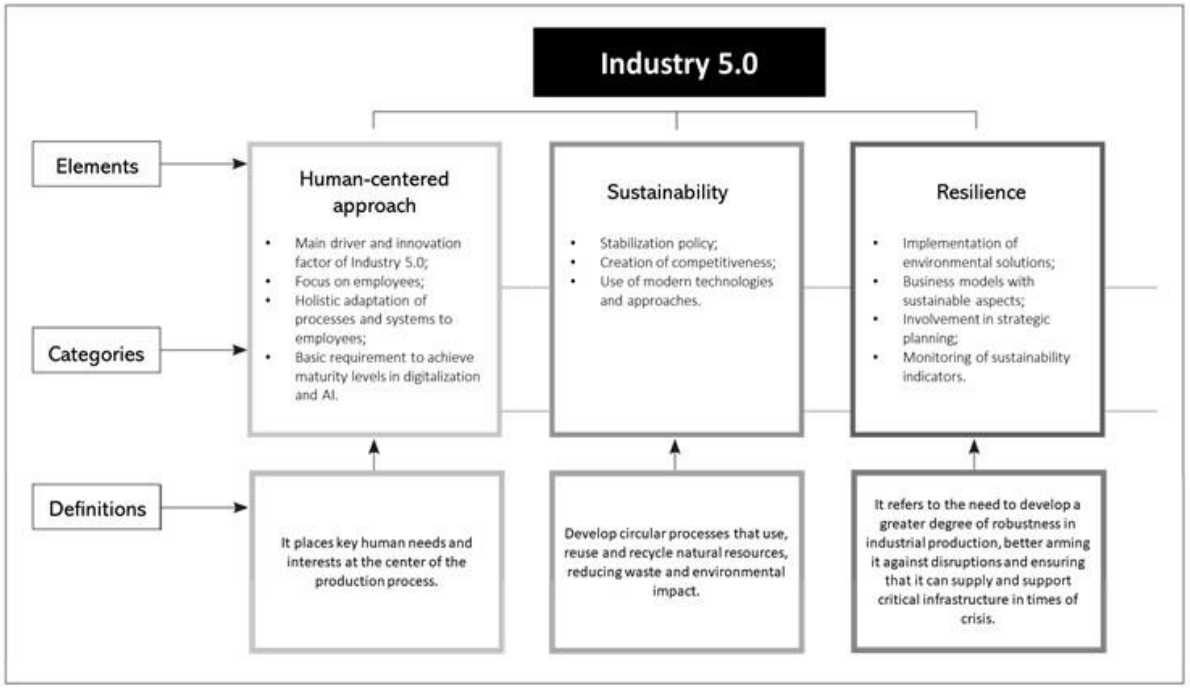

Figure 3 - Elements of Industry 5.0. Source: adapted from European Commission (2021, pp. 13-14) and Hein-Pensel et al. (2023, p. 202).

Elangovan (2021) highlights that Industry 5.0 is a dynamic and constantly evolving concept, serving as a basis for the advancement of a collaborative and co-creative approach in the industry. According to the author, the association of human intelligence with machine intelligence promotes a more balanced interaction between the use of technology to perform tasks and human intervention, thus favoring the implementation of different Industry 5.0 practices in operational and organizational processes.

Among the main practices of Industry 5.0, we can highlight human-centered design, which seeks integration between employees and intelligent machines, ensuring greater ergonomics, safety and personalization in production (DEMIR et al., 2019). Furthermore, sustainability is an essential pillar, with the adoption of renewable energy, circular economy and strategies to minimize environmental

impacts. Another fundamental aspect is resilience, which involves creating more adaptable production chains, capable of predicting and mitigating risks through technologies such as artificial intelligence and digital twins (ÇIÇEKLER; TUTUŞ, 2023; PÄTÄRI et al., 2016; ZHANG et al., 2023).

Table 2 shows the main practices of Industry 5.0.

Table 2 - Practices of Industry 5.0.

PRACTICES IN	DESCRIPTION	REFERENCE
Biotechnology	It is characterized by the use of enzymes, microorganisms and bioprocesses to reduce chemical inputs, enhance waste and generate bioproducts.	Amândio et al. (2022); Foelkel (2013); Ma et al. (2011).
Advanced Cybersecurity	Aims to protect cyber-physical ecosystems and ensure operational resilience against digital threats.	Hein-Pensel et al. (2023); Kumar et al. (2021).
Human-Robot Collaboration	Promotes safe interaction between operators and machines in handling, inspection and movement tasks of inputs, raw materials and finished products.	Chinnathai; Alkan, (2023); Engelberger (1989); Shah; Breazeal (2010).
Advanced 3D Printing	It is configured as a resource for rapid prototyping for on-demand production, customization and reduction of environmental impact.	Bajpai (2015); Muduli et al. (2023).
Brain-Computer Interfaces	Defends the potential of neurotechnology to improve ergonomics, accessibility and human-machine interaction.	Bandyopadhyay; Bose (2019); Nicolelis (2011).
Mass Customization	Establishes flexible production configurations for customized packaging and papers at scale as a strategic Industry 5.0 innovation.	Bruno (2014); Pine II (1999).
Augmented Reality (AR) and Virtual Reality (VR)	Emphasizes applications in training, immersive design, and safe simulation in industrial environments.	Bergquist; Söderholm (2018); Shah; Breazeal (2010).
Sustainability	Consolidates circular economy actions, energy efficiency and reuse of by-products.	Branquinho; Branquinho (2022); European Commission (2021).
Smart and Adaptive Manufacturing Technologies	Discusses flexible and adaptable systems supported by IoT, artificial intelligence and advanced automation.	Amândio et al. (2022); Muduli et al. (2023).
Green Technologies	Reinforces the use of clean energy and sustainable processes as a competitive advantage and alignment with global goals.	European Commission (2021); Gamboa-Rosales; López-Robles (2023).

Source: Prepared by the authors (2025).

Technological advancement, according to Aslam et al. (2020), drives Industry 5.0 through the use of the Internet of Things (IoT) for real-time monitoring, 3D printing for customized manufacturing, and blockchain to ensure transparency in the process of transforming raw materials into final products, from extraction to distribution. Furthermore, Archer (2024) and Puzzonia (2018) mention that business models are increasingly based on Environmental, Social and Governance (ESG) principles, reinforcing industries' commitment to sustainable governance. Monitoring environmental and social indicators has become essential for strategic decision-making, ensuring that technological innovation is aligned with human well-being and environmental preservation (BRESCIANI et al., 2016; SHAIKH, 2022). Thus, Industry 5.0 establishes itself as a more humane, sustainable and innovative production model.

2.5. Maturity Models.

Stage maturity models, according to Chandler Jr. (1962) and Haire (1959), are not so contemporary in the literature of organizations. From a historical perspective, since the 1950s, it has been observed that maturity models based on stages are defined based on their own characteristics (SMITH et al., 1985). Haire (1959) can be recognized as one of the precursors to propose the concept that organizations mature in stages, following a specific uniform pattern. Chandler Jr. (1962), similarly, established the idea of stages in the life cycle of organizations in a structured model, in which the stages

evolved and adapted to organizational structures and strategies. The first publications of the term maturity model, still in the 1950s, essentially addressed human needs, economic growth and progression of information technology in organizations (RÖGLINGER et al., 2012).

The maturity model proposed by Philip B. Crosby in 1979 was a precursor to current maturity models (BARRA; LADEIRA, 2017). The Quality Management Maturity Grid (QMMG) is an organizational maturity matrix designed by Crosby, first published in his book Quality is Free, also in 1979. This model was one of the first maturity models for assessing quality maturity, containing five stages (uncertainty; awakening; enlightenment; wisdom; and certainty) of maturity and six measurement categories (management understanding and attitude; company quality status; problem solving; cost of quality as a percentage of sales; quality improvement measures; and summary of the company's possibilities in the quality sector) that help the user to identify his own situation in relation to maturity. This model recognizes the importance of human factors such as leadership, attitude and collaborative work (CROSBY, 1979).

The principles developed in the maturity matrix proposed by Crosby were adapted in 1986 by the Software Engineering Institute (SEI) at Carnegie Mellon University with the aim of creating the Capability Maturity Model (CMM) as a methodology used to develop and refine an organization's software development process. The model describes an evolutionary path in five levels of increasingly organized and systematically more mature processes (HUMPHREY, 1999).

Since the concept has spread, maturity models have been widely used and can be found in several areas of knowledge (CARALLI et al., 2012), such as: process area (Business Process Maturity Model - BPMM); project area (Organizational Project Maturity Management Model - OPM3); product development (Product Development Process - PDP); among others.

Regardless of the number of models developed, according to Fraser et al. (2002), maturity models may contain the following elements: (a) number of levels; (b) level descriptor; (c) generic description of the characteristics of each level; (d) number of dimensions or process areas; (e) number of elements or activities in each process area; and (f) a description of each activity that could be performed at each maturity level.

The joint term “maturity model” usually refers to a theoretical model that reports the evolution of individual and organizational competencies (PAULK et al., 1993). By integrating standards or requirements into likely improvement activities, the model helps to elucidate an evolutionary path conducive to “maturity”. In this way, “maturity” refers to evolutionary evidence in the demonstration of specific competencies (FRASER et al., 2002). Maturity model allows measuring the maturity of a given competence based on a grouping of relatively comprehensive criteria (DE BRUIN et al., 2005).

Maturity models allow the status quo to be measured, as well as enabling the improvement process that best adapts to the organization, remaining within the established criteria of good practices required in the specific scope (ESSMANN, 2009). Elmaallam and Kriouile (2013) define maturity models as essential instruments to ensure the continuous improvement of systems and activities, enabling self-assessment and providing a guideline for activities related to best practices.

Maturity models have the function of equipping organizations in order to mix elements to homogenize benefits related to the practices and knowledge experienced by the organization and interest groups (TRENTIN, 2021). Using a maturity model, according to Caralli et al. (2012), as support for improving processes, practices and performance, should provide organizations and stakeholders where they are established with the capacity for internal reference performance, how to catalyze improvements in the performance of interest groups and, finally, how to create and develop a common language.

3. Methodology.

In this research, we propose the use of the Value Proposition Canvas (VPC) as a more assertive framework for creating a value proposition focused on Industry 5.0 consulting services in the pulp and paper segment. According to Osterwalder and Pigneur (2010) and Osterwalder et al. (2014), the Value Proposition Canvas (VPC) represents parts of the planned strategy to align services with customer needs.

The construct, developed for this study, includes the macro dimension Industry 5.0 Practices (IP 5.0) in the pulp and paper segment, which was divided into 10 dimensions, to measure the maturity of organizations in the management of Industry 5.0 praxis through 40 statements (Table 2).

The dimensions that make up the Industry Practices 5.0 (IP 5.0) construct were created based on the following theoretical framework: Amândio et al. (2022); Bajpai (2015); Bandyopadhyay and Bose (2019); Bergquist and Söderholm (2018); Branquinho and Branquinho (2022); Bruno (2014); Chinnathai and Alkan (2023); Engelberger (1989); European Commission (2021); Foelkel (2013); Hein-Pensel et al. (2023); Kumar et al. (2021); Ma et al. (2011); Muduli et al. (2023); Nicolelis (2011); Pine II (1999); and Shah and Breazeal (2010).

Table 3 presents the macro dimensions, dimensions and number of established statements.

Table 3 - Industry 5.0 Practices Construct in the Pulp and Paper Segment.

MACRO DIMENSION	DIMENSION	AFFIRMATIVES
Industry 5.0 Practices	Biotechnology	A1 – A4
	Advanced Cybersecurity	A5 – A8
	Human-Robot Collaboration (Cobots, or collaborative robots)	A9 – A12
	Advanced 3D Printing	A13 – A16
	Brain-Computer Interfaces	A17 – A20
	Mass Customization	A21 – A24
	Augmented Reality (AR) and Virtual Reality (VR)	A25 – A28
	Sustainability	A29 – A32
	Smart and Adaptive Manufacturing Technologies	A33 – A36
	Green Technologies	A37 – A40

Source: Created by the authors (2025).

To ensure methodological rigor, the identification of the ten dimensions was not limited to a simple review of the selected references. Initially, a thematic analysis was carried out, in which recurring concepts, practices and technologies associated with Industry 5.0 were mapped in the literature. These elements were subsequently subjected to a conceptual clustering process, whereby related ideas were grouped into broader categories that represent coherent practices within the pulp and paper context. This procedure resulted in the definition of ten consolidated dimensions, which synthesize the contributions of multiple authors into a structured construct aligned with the practical challenges of the pulp and paper industry. The grouping ensured that each dimension was theoretically grounded and empirically recognizable, thus reinforcing the transparency and replicability of the instrument. In this sense, the methodology followed the logic of qualitative content analysis (BARDIN, 2011), considering theoretical saturation criteria, adapted to the purpose of building a maturity assessment framework and providing robustness to the formulation of the statements that make up the diagnostic checklist model of I 5.0 practices in the pulp and paper segment.

In order to identify the level of maturity assessed by the respondent, a five-level maturity scale will be applied to the dimensions that characterize the diagnostic checklist model of I 5.0 practices in the pulp and paper segment, according to the proposed assessment model. The maturity levels were adapted to the needs of this study and follow the criteria established in the work of Ehms and Langen (2002); Kerzner (2001); Paulk et al. (1993); Paulzen et al. (2002); Rosemann et al., (2007); Trentin (2021); and Türetken and Demirörs (2004).

The variation in the maturity scale interval, as shown in Table 4, has the following interpretation:

Table 4 - Five-level maturity scale.

LEVEL	DESCRIPTION
Level 5	Established, systemic and optimized: fully implemented, has established indicators, has effective results and shows continuous improvement over the last 12 months.
Level 4	Established and systemic: fully implemented in one or more areas and with established indicators. Planned results are achieved.
Level 3	Formally established: formally implemented (documented), but there are some gaps in execution.
Level 2	Informal or in implementation phase: Implementation has been initiated by the organization. There is an implementation schedule.
Level 1	Lack of practices and standards: not yet implemented or being implemented informally, with unstable results.

Source: adapted from Trentin (2021, p. 135).

Figure 4 presents the systemic view of the research construct, allowing us to visualize the interrelationships between the maturity levels, dimensions and the organization's objective in relation to Industry 5.0 Practices in the pulp and paper segment.

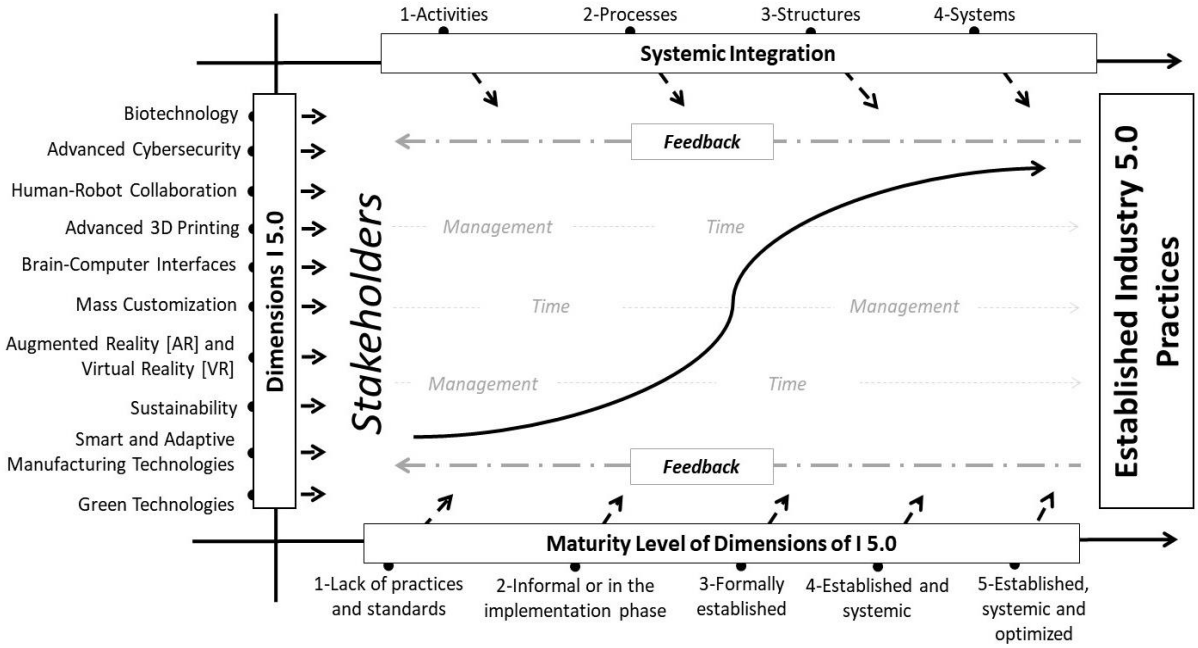

Figure 4 - Graphical representation of the systemic view of the Industry 5.0 Practices construct in the pulp and paper segment. Source: Prepared by the authors (2025).

To assess the content of the diagnostic checklist model for Industry 5.0 practices in the pulp and paper segment, the Validation by Judges research method (or analysis by experts) will be used. Considered a prestigious research technique, the Judge Validation method according to Lawshe (1975) and Messick (1995), allows bringing together a set of points of view from a group of experts, called Judges, essential to guarantee the quality of scientific and practical instruments.

The Judge Validation method is defined as a method of evaluating the instrument by a committee of experts whose objective is to evaluate the instrument regarding its clarity, relevance of the questions and whether they fulfill their objective (OSTERLIND, 1997). It is a method that proposes an in-depth analysis of the contents that make up the research instrument, with the aim of ensuring that the items of an instrument adequately represent the relevant aspects of a construct (CONTANDRIOPOULOS et al., 1997; LAWSHE, 1975; HAYNES et al., 1995).

It is worth highlighting that the selection of Judges was carried out carefully, considering aspects such as academic background, technical experience accumulated throughout their professional careers

and practical experience in the pulp and paper segment. The choice was based on the diversity of expertise, including industrial managers, specialized consultants and teaching researchers, in order to ensure a broad, critical and consistent evaluation of the instrument. This criterion aimed to ensure that the evaluators possessed not only theoretical knowledge, but also applied experience in operational and people management, in production processes and in the strategic dimensions of Industry 5.0, ensuring robustness and legitimacy to the validation carried out.

As a rule, it translates into a set of statements that are answered, in a sequenced manner, particularly by the judges (Table 5), summarizing the information about the standardized responses and fields for free writing of comments, in order to analyze the evaluation criteria, such as appearance, clarity, content, efficiency and consistency (PASQUALI, 1998; TORLIG et al., 2022).

Table 5 - Reviewer of the diagnostic checklist model for Industry 5.0 practices in the pulp and paper segment.

JUDGE	AREA OF ACTIVITY
Judge 1	Industrial Manager Specialist in Pulp and Paper Technology, Wood Science and Production Engineering with over 25 years of experience in the pulp and paper production and paper conversion segment.
Judge 2	Industrial Manager Specialist in Pulp and Paper and Chemical Engineer with over 25 years of experience in the pulp and paper segment.
Judge 3	Specialized Consultant in Processes and Engineering, Specialist in Pulp and Paper Technology and Industrial Management with over 30 years of experience in the pulp and paper production segment.
Judge 4	Consultant specialized in structural adequacy and strategic analysis, Specialist in Statistics and Control and Automation Engineer with over 25 years of experience in the pulp and paper production and paper conversion segment.
Judge 5	Professor with a PhD in Accounting and Administration, specific scientific research in the areas of People Management, Operations Management and ESG. Master's Degree in Production Engineering with over 15 years of experience in the pulp and paper production and paper conversion segment.

Source: Created by the authors (2025).

Initially, the instrument must be evaluated in its entirety, determining its scope. In other words, whether each domain or concept was adequately covered by the set of statements and whether all dimensions were included. At this stage, you can suggest the inclusion or elimination of statements. Next, it is necessary to analyze the statements individually, checking their clarity, relevance, adequacy and representativeness. With regard to clarity, the wording of the statements must be assessed, whether they were written in an objective and understandable way for the respondents. As for relevance, it should be observed whether the question contributes significantly to achieving the objectives defined in the research. Adequacy verifies whether the formulation of the statement really captures the theoretical or practical concept that one wishes to evaluate. Regarding representativeness, it is necessary to verify whether the set of items is comprehensive enough to cover all aspects of the construct or research objective. This process consists of several steps (Table 6) and can be repeated, when necessary, until agreement is reached (VARANDA et al., 2019; VAZZOLER-MENDONÇA et al., 2023).

Table 6 - Implementation steps of the Judge Validation method.

STEPS	DESCRIPTION OF STEPS
Step 1	Selection of the group of judges
Step 2	Construction of questionnaire 1
Step 3	First contact with the judges and invitation to participate in the research
Step 4	Submission of questionnaire 1
Step 5	Receiving responses to the questionnaire
Step 6	Qualitative and quantitative analysis of responses
Step 7	Construction of questionnaire 2 with feedback
Step 8	End of the process and writing of the final questionnaire
	Note: The process can be iterative until the instrument is validated.

Source: Created by the authors (2025).

Each of these steps must be carefully prepared and implemented, and the entire process must be recorded and described.

To evaluate each statement in the checklist model for diagnosing Industry 5.0 practices in the pulp and paper segment, it will be verified using a five-point Likert scale, where, 1 – Not important; 2 – Slightly important; 3 – Reasonably important; 4 – Important; and 5 – Very important.

- Clarity: assesses whether items are presented in an objective, understandable and unambiguous manner;
- Relevance: verifies whether the content is pertinent and significant to the context or purpose of the assessment;
- Adequacy: measures the degree of compliance of the information with the established criteria, standards or needs; and
- Representativeness: analyzes whether the items really reflect the concepts involved, whether they are relevant and whether they are adequate to achieve the proposed objectives.

To calculate the consensus among the judges, the statistical measure called Fleiss' kappa will be used. The kappa coefficient is a statistical procedure that considers the probability of agreement by chance in its calculation (CROCKER; ALGINA, 2006). Thus, the coefficient can be defined as the proportion of agreement between judges after removing the proportion of agreement due to chance (FONSECA et al., 2007). The Fleiss scale consists of (FLEISS, 1981):

- If $| k | < 0.4$, the agreement is regular;
- If $0.40 < | k | < 0.75$, the agreement is good;
- If $| k | > 0.75$, the agreement is excellent.

A diagram of the instrument evaluation form model for completion by judges can be seen in Figure 5.

Question	Text of the Statement	Clarity	Relevance	Adequacy	Representativeness	Suggestion
		1 | 2 | 3 | 4 | 5	1 | 2 | 3 | 4 | 5	1 | 2 | 3 | 4 | 5	1 | 2 | 3 | 4 | 5	
1	Text of statement 1	grade	grade	grade	grade	Judge's Commentary...
2	Text of statement 2	grade	grade	grade	grade	Judge's Commentary...
3	Text of statement 3	grade	grade	grade	grade	Judge's Commentary...
n	Text of statement *n*	grade	grade	grade	grade	Judge's Commentary...

Figure 5 - Instrument Evaluation Form Template. Source: adapted from Alexandre and Coluci (2011, p. 3064-3066).

Although specific theories and techniques were defined for this study, a preliminary version of the diagnostic checklist model for Industry 5.0 practices in the pulp and paper segment provides an opportunity to better understand the model in real-world conditions, that is, through feedback from professionals, including leaders and technicians responsible for Industry 5.0 practices in pulp production and paper converting. Based on research by Fink (2024), an evaluation of this diagnostic model was conducted with 30 professionals (leaders and technicians) selected randomly for accessibility and convenience. The evaluation focused on three aspects: completeness, usefulness, and advancement. These aspects were assessed through the following questions:

1) Completeness: Is the model complete in terms of content?
2) Usefulness: Does it allow for a valid self-assessment?
3) Advancement: Does the model also reveal ways for improvement?

The preliminary version of the diagnostic checklist model for Industry 5.0 practices in the pulp and paper segment aims to validate its face and content under real application conditions, following the validation stage by expert judges. This phase sought to verify the clarity, practical relevance and applicability of the instrument with professionals working in the sector, allowing adjustments to the format and wording of the statements. It should be noted that this was not an external validation process, but an exploratory pre-test designed to improve the diagnostic checklist model before its use in broader studies, ensuring greater consistency and methodological robustness to the study.

4. Analysis and Interpretation of Results.

This chapter presents the analysis and interpretation of the results obtained, in order to respond to the research objectives.

4.1. Consulting Model Developed.

As for the consultancy model developed, the legal form of Sociedade Comercial Ltd. was chosen Ltda. is the most practical alternative and is often used by small and medium-sized companies in their initial stages. A Limited Company can only exist with two or more partners. It is constituted with the registration of the Articles of Association with the State Commercial Board. The Articles of Association will cover important matters such as the corporate purpose, the representation of the company and the transfer of shares, among others (MAMEDE; MAMEDE, 2013). Commercial companies are regulated in the Brazilian Civil Code (Articles 1,039 to 1,092), as well as in several laws in force in our system, for example, Decree No. 3,708, of January 1919, which regulates the formation of limited liability companies (BRASIL, 1919).

The following data was collected to prepare the Articles of Association of a Limited Liability Individual Company (Table 7), i.e., the Social Contract:

Table 7 - Data for preparing the Social Contract.

DATA	DESCRIPTION
Company Name	CoMind Solutions Consulting Ltd.
Address	140 - Itoupava Seca Street, Blumenau - SC, 89030-903
Corporate Purpose	Provide professional services in the areas of assessment, alignment, implementation, measurement and reporting of information on Industry 5.0 practices.
Administrator	Partner 1 - Brazilian, single, born on the 00th of month of the year, businessman, holder of ID number 00.000.000-00 SSP-SC, registered with CPF number 000.000.000-00, resident and domiciled at Antônio da Veiga Street, 140 - Itoupava Seca, Blumenau - SC, 89030-903
Share Capital	The share capital will be R$600,000.00 (Five hundred thousand reais), divided into 5 shares worth R$100,000.00 (One hundred thousand reais), each, subscribed and paid up, in this act, in the country's currency, by the partners and distributed as follows:

	Partner 1 – Three (3) shares worth R$300,000.00 (Three hundred thousand reais), representing 50% (Fifty percent) of the share capital. Partner 2 – Three (3) shares worth R$300,000.00 (Three hundred thousand reais), representing 50% (Fifty percent) of the share capital.
Fiscal Year	The fiscal year will close on December 31 of each year.
Owner's Responsibility	The liability of the company owner is limited to the paid-up capital (Art. 1,052 of the 2002 Civil Code), and he is not subsidiarily liable for the company's losses.

Source: Created by the authors (2025).

According to Art. 981 of the Civil Code (Law No. 10,406, of January 10, 2002), when entering into a partnership agreement, people are obliged to contribute, with goods or services, to the exercise of economic activity and, with this, to share the results among themselves (BRASIL, 2002).

Given the social constitution of the consultancy, according to Anjos (2017), it is necessary for the company to seek to understand what moves it and where it proposes to reach in the market environment in which it finds itself, a fundamental condition for taking more assertive steps. According to the author, a bridge must be established between the purpose and the purpose of the business, through the creation of a company mission, vision and values.

The purpose of the institutional mission is addressed by Drucker (1975) as an answer to the question "What is my business and what should it be?" It is the fundamental starting point for establishing objectives, priorities and strategies, where with a clear definition of the company's mission and purpose it becomes possible to develop them (TELES; LUNKES, 2011). Regarding vision, Laruccia (2014) mentions that vision is what the company seeks in the future, its desires, aspirations, goals and objectives. In general, it is essential to explain the company's position with reference to the market in which it operates, its main dream or general objective and what value it delivers to the different stakeholders. For Nakagawa (2012, p. 1) values "are the ideals of attitude, behavior and results that must be present in employees and in the company's relationships with its customers, suppliers and partners". Values give meaning to the lives of people and organizations. "When there is an alignment between individual and corporate values, people maximize their potential and express their best creativity" (CHÉR, 2016, p. 110).

Table 8 defines the mission, vision and values of the company CoMind Solutions Consulting Ltd.

Table 8 - Mission, Vision and Values of CoMind Solutions Consulting Ltd.

MISSION	VISION	VALUES
Engage high-performance professionals who help transform complexity into effective solutions, ensuring direct benefits for our clients.	We will build and maintain a reputation of integrity by providing opportunities for stakeholders to reach their full potential.	Respect Synergy Innovation Personalization

Source: Created by the authors (2025).

Regarding the creation of a business model, this research used the Business Model Canvas (BMC) as a framework for creating a business model with a focus on consulting services in established Industry 5.0 practices aimed at the pulp and paper segment. The Business Model Canvas is considered an effective management practice tool for mapping the main components of a business model (TAIPALE-ERÄVALA et al., 2021).

In Figure 6, it is possible to observe, in a practical and structured way, through the Business Model Canvas (BMC) tool, the business model of CoMind Solutions Consulting Ltd.

Figure 6 - Business model of CoMind Solutions Consulting Ltd. Source: Created by the authors (2025).

Developed based on the premises of Industry 5.0, the Value Proposition Canvas (VPC) was used in this study as a strategic tool, with the purpose of helping organizations in the pulp and paper segment to develop and improve value propositions aligned with the real needs of their customers. Through the Value Proposition Canvas (VPC), according to Osterwalder et al., 2014, it is possible to map probable gains for customers and establish a main value proposition, which can be disseminated to end users in the form of services.

In Figure 7, in a practical and structured way, one can observe the practical model of the Value Proposition Canvas (VPC), developed by CoMind Solutions Consulting Ltd. for the paper and pulp segment.

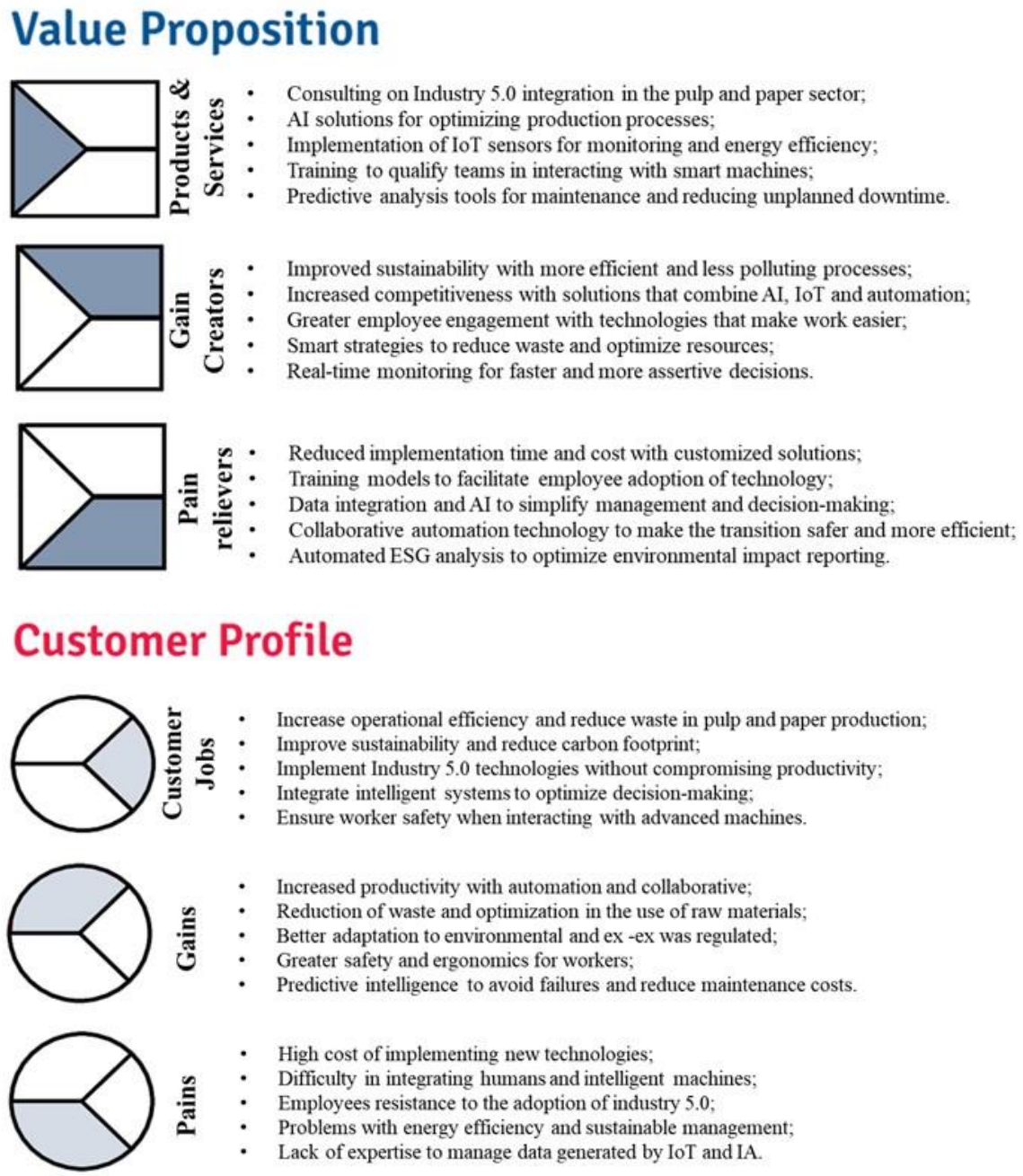

Figure 7 - Practical Model of the Value Proposition Canvas. Source: Created by the authors (2025).

The CoMind Solutions Consulting Ltd. model for diagnosing Industry 5.0 practices consists of six steps:

1. Benchmarking: is a strategy that seeks to optimize a company's performance by analyzing the best practices in the market in which it operates. In this first stage, the five pillars of benchmarking (diagnosis; research; analysis; interpretation; and optimization) are used to focus on the right points when analyzing the strategies and results of your competitors (FIA/USP, 2022);
2. Diagnosis: is, by definition, verifying a situation. It is a way of knowing what a company, institution or entity does and what it is or is not achieving with its activities. In this second stage,

the seven steps are used (defining questions; collecting responses; analyzing data; identifying problems and opportunities; providing feedback; implementing solutions; and monitoring and evaluation) to carry out an organizational diagnosis (FIA/USP, 2023);

3. Maturity Level: it is an essential instrument to ensure the continuous improvement of systems and activities, enabling self-assessment and providing a guideline for activities related to best practices (ELMAALLAM; KRIOUILE, 2013). At this stage, the five levels will be used (Level 1 - Absence of practices and standards; Level 2 - Informal or in the implementation phase; Level 3 - Formally established; Level 4 - Established and systemic; and Level 5 - Established, systemic and optimized) to assess the maturity of organizational practices;
4. Transformation: framework for transforming organizational culture through awareness (perception of reality) and acculturation (adaptation process), involving all areas of the organization in adapting to a more humanized, sustainable and technologically advanced model, ensuring that leaders and employees understand the importance of human-machine collaboration, continuous innovation and socio-environmental responsibility (COELHO JUNIOR, 2003; DENISON et al., 2012).
5. Strategic Alignment: integration of Industry 5.0 into business strategy (ensuring that all aspects related to Industry 5.0 are synchronized with strategic objectives, where all activities, processes, goals and resources must be aligned with the organization's mission and vision) (KAPLAN; NORTON, 2006);
6. Recommendations: summarizes progress, results and challenges over a given period of time. It serves to communicate to stakeholders, such as customers, sponsors, managers and staff, what has been done, what is being done and what needs to be done. Indicates risks, changes, lessons learned and recommendations for project success (, 2025).

Figure 8 shows the CoMind Solutions six-step model for implementing Industry 5.0 practices.

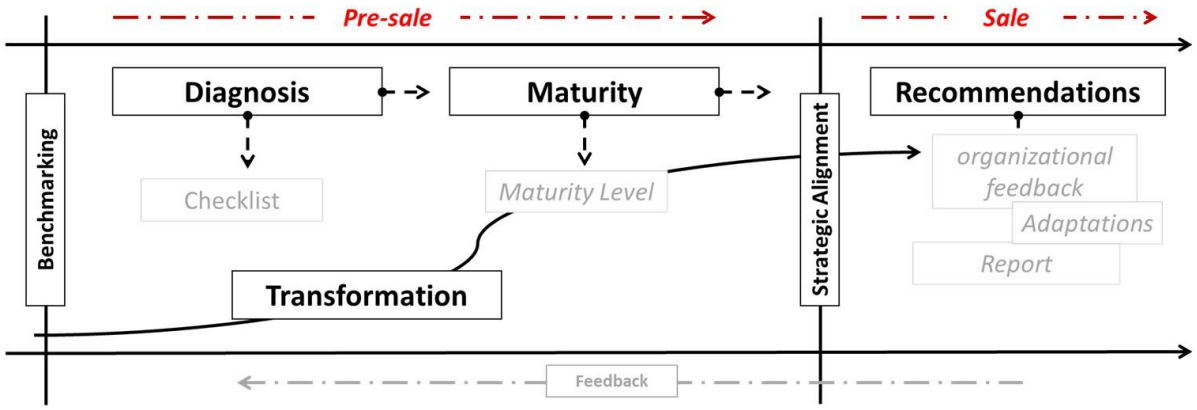

Figure 8 - CoMind Solutions model for implementing Industry 5.0 practices. Source: Created by the authors (2025).

4.2. Evaluation of the Content of the Checklist Model – Validation Method by Judges (Or Analysis by Experts).

The first version of the Industry 5.0 Practices diagnostic checklist model was sent via email to the five judges. The first round of reflection and reports of the checklist model was analyzed by the judges. Dissonant trends and opinions were observed, as well as their justifications, systematizing and compiling them to later send them back to the group. Thus, the judges had the opportunity to refine, change or defend their responses and send the second round of reflection and responses of the aforementioned model back to the researchers. In this research, the implementation of the Judge Validation Method involved two rounds, thus reaching a consensus among the judges.

Table 9 presents a matrix of the proportion of agreement between judges based on the statistical measure called Fleiss' kappa. Fleiss's Kappa was calculated for each variable considering all the evaluations of the five judges, that is, for each question, the scores of the five judges on the variable in question were used. In this analysis, the values can vary from (-1 to 1). A value of (-1) suggests agreement worse than chance (systematic disagreement between judges), a value of (0) indicates agreement equivalent to chance (no reliability), and (1) indicates perfect agreement between judges (FLEISS, 1981).

Table 9 - Agreement proportion matrix.

VARIABLES	*KAPPA OF FLEISS*
Clarity	0.7025
Relevance	0.7534
Adequacy	0.6866
Representativeness	0.7185

Source: Created by the authors (2025).

Based on Fleiss (1981), we can consider that the Fleiss Kappa values for the Clarity, Adequacy and Representativeness variables are considered to have good agreement (If $0.40 < | k | < 0.75$, the agreement is good) and the Relevance variable was classified as excellent agreement (If $| k | > 0.75$, the agreement is excellent).

In Table 10, one can see the judges' recommendations to improve understanding of the statements, review the relevance of some questions, reformulate technical terms or ambiguities, thus ensuring that they address all aspects of the content evaluated in a balanced manner.

Table 10 - Judges' recommendations (1st and 2nd rounds) to improve the wording of the statements.

Affirmative	Recommendation
A-3	I suggest including in the item: second generation ethanol - E2G; and generation of biogas from sludge from effluent treatment.
A-4	I suggest including in the item: modified lignin and bioactives extracted from cellulose.
A-5	I suggest including the succinct concept of the term Zero Trust Security (a network security strategy that trusts no one by default).
A-6	I suggest partially rephrasing the statement and including in the item: use of Security Information and Event Management SIEM systems (monitors and detects threats in real time, protecting industrial networks and automation).
A-7	I suggest including in the item: external connections, such as the internet (air-gapped).
A-8	I suggest partially rephrasing the statement and including the meaning of Social engineering and phishing in the item Ex.: (Social engineering and phishing: cybercriminal techniques to manipulate users and obtain confidential information).
A-9	I suggest including the word palletization in the item text; and at the end of the sentence: identify defects in paper and packaging.
A-10	I suggest including in the wording of the item, at the end of the sentence: immediate interruption mechanisms, which detect unexpected touches and pause the operation to avoid accidents.
A-11	I would like to replace the word employees with employees and outsourced companies.
A-12	I suggest changing the term “remote monitoring” to “real-time monitoring” in the item and including at the end of the sentence, and analysis of efficiency, cycle times and production failures.
A-13	I suggest changing the term “molded cardboard” to “molded pulp”.
A-14	I suggest including practical examples in the wording of the item: (for cosmetics and food); (biodegradable disposable cutlery); (light and resistant automotive parts).
A-17	I suggest including in the wording of the item, at the end of the sentence, the description: (technology that allows direct communication between the human brain and a computer or electronic device, without the need for physical interaction).
A-18	I suggest including the description at the end of the sentence in the item's wording: reducing operational risks and ensuring safer and more efficient industrial processes.

A-22	I suggest including in the wording of the item: practical example, weight, texture and coating of the paper; and at the end of the sentence: reducing waste and ensuring high efficiency in the customization of products.
A-25	I suggest including a practical example in the item's text: (performing tasks such as adjusting and moving paper rolls).
A-27	I suggest including the description at the end of the sentence in the item's text: (virtually explore factories, learn about the production process and interact with new solutions in paper and packaging).
A-29	I suggest changing the term “carbon footprint” to “greenhouse gas emissions” in the item and including it at the end of the sentence, reducing electricity and steam consumption.
A-30	I suggest including in the wording of the item: (biodegradable and compostable packaging).
A-31	I suggest replacing the question in its entirety, as it is similar to question A-39.
A-32	I suggest including in the wording of the item, at the end of the sentence: or the incorporation of the Sustainable Development Goals (SDGs) into existing business processes and reports.
A-33	I suggest inserting the meaning of the acronym IoT in the reaction to the aforementioned question (IoT - Internet of Things).
A-34	I suggest including practical examples in the item's wording: (automatically switching between different weights, coatings or paper and packaging formats); and (packaging and palletizing).
A-40	I suggest including in the wording of the item: transformation of effluents into valuable by-products, such as organic fertilizers or bioplastics.

Source: Created by the authors (2025).

According to Fonseca et al. (2007), the process of reflection and responses to the checklist model analyzed by the researchers ends when the desired levels of agreement by the judges in the responses are reached. In general, there is agreement when there is low disagreement than expected by chance for a given statement around an average response. Regarding stability, it can be defined as the absence of new contributions and little change in the panel's responses between rounds (FREITAS et al., 2013).

It should be noted that the evaluation of the content of the Industry 5.0 Practices diagnostic checklist model promotes theoretical discussions by transforming abstract Industry 5.0 principles into operational dimensions that can be systematically assessed. By integrating technological, organizational, and sustainability-oriented practices into a maturity model, the instrument provides a framework that connects conceptual debates and empirical investigation. Such an approach aligns with the perspective of Crosby (1979), who emphasized maturity models as tools for structuring organizational improvement, and resonates with Becker et al. (2009), who argue that maturity models promote theoretical clarity by translating complex constructs into measurable practices. In this sense, the checklist strengthens the academic debate by positioning Industry 5.0 not only as an emerging paradigm, but also as a measurable construct that allows for consistent theoretical and empirical analyses.

Furthermore, the checklist offers implications for future research, enabling comparative and longitudinal studies that can reveal maturity patterns, technology adoption trajectories, and the interaction between human-centered and technology-driven practices. Its structured design allows scholars to examine the interdependencies between the ten dimensions, fostering deeper insights into how organizations internalize Industry 5.0 principles. This perspective is aligned with Kerzner (2011; 2025), who highlights the importance of structured evaluation for the advancement of project management and innovation, and with Schuh et al. (2020), who emphasize maturity-based approaches to digital and industrial transformation. Thus, the instrument extends beyond diagnostic purposes, supporting the development of theoretical models that explain the dynamics of transformation in knowledge-intensive and sustainability-oriented industries.

4.3. Industry Practices Diagnostic Checklist Template 5.0.

In this study, the checklist model for diagnosing Industry 5.0 practices was composed of an elaborate set of 40 assertions, with closed questions, divided into ten dimensions: Biotechnology; Advanced Cybersecurity; Human-Robot Collaboration (Cobots, or collaborative robots); Advanced 3D Printing; Brain-Computer Interfaces (BCI); Mass Customization; Augmented Reality (AR) and Virtual Reality (VR); Sustainability; Intelligent and Adaptive Manufacturing Technologies; and Green Technologies.

In order to identify the level of maturity assessed by respondents, a five-level maturity scale will be applied: Level 1 - Absence of practices and standards; Level 2 - Informal or in the implementation phase; Level 3 - Formally established; Level 4 - Established and systemic; and Level 5 - Established, systemic and optimized, for the dimensions that characterize the management model of Industry Practices 5.0 (IP 5.0).

The statements/practices broken down by dimension, in addition to the five levels defined for measuring maturity, used to establish the maturity level of Industry Practices 5.0 (IP 5.0) in pulp and paper segment organizations are available in Appendix A.

4.4. Pre-Test of Diagnostic Checklist for Industry Practices 5.0.

In summary, all 30 professionals interviewed positively evaluated the comprehensive functionality of the Industry Practices 5.0 (IP 5.0) diagnostic checklist. Regarding self-assessment, all professionals interviewed were able to naturally highlight the current situation of their company based on the model. All professionals interviewed noted the ability to identify necessary improvement steps based on the difference between their current position and the desired final stage of maturity. Although the model was considered complete, some of the professionals interviewed noted the need to make some linguistic adjustments (polysemy; elaborated words, etc.), rationalization of words and addition of practical examples, such as: ISO-14001; ISO 14064; ISO 50001; National Solid Waste Policy – Law 12.305/2010; ISEGA Certification; FSSC 22000. All professionals interviewed attributed an appropriate character to the diagnostic checklist model of Industry 5.0 practices.

5. Final Considerations.

The main objective of this research was to develop a consulting model to assess the maturity level of Industry Practices 5.0 (IP 5.0). As a result, a hypothetical consultancy called CoMind Solutions Consulting Ltd. was created, established through the creation of the social contract, creation of the mission, vision and values, in addition to the development of a business model based on the strategic management tools Business Model Canvas (BMC) and Value Proposition Canvas (VPC).

In two rounds of evaluation, a consensus was evident among experts on the content of the Industry 5.0 practices diagnostic checklist, in addition to a positive evaluation in the pre-test. This study contributed theoretically to the proposal of a consultancy model to assess the maturity level of Industry 5.0 practices in organizations in the pulp and paper segment.

The practical contribution lies in understanding the different practices that encompass the theme of Industry 5.0 based on the checklist model for diagnosing Industry 5.0 practices and the respective level of maturity, identifying strengths and points that demonstrate weaknesses in implementation or execution, in addition to providing a way of comparing the results (benchmarking) obtained between the areas and competing organizations in the manufacture of pulp and paper.

This study was treated with the necessary methodological rigor, although it is necessary to recognize some limitations. The first is related to the sample obtained, as it is a non-probabilistic sample and, therefore, the data cannot be generalized. The application of a longitudinal study to verify the phenomenon, using a timeline as a way of obtaining information that can attest to the gradual increase or not in the maturity of Industry 5.0 practices. In future studies, the validity of the results obtained in this research could be improved by extending the sample to a larger number of respondents. Finally, it is suggested to use a mixed research approach (quantitative and qualitative), allowing the researcher to explore different variables in different contexts, identify possible challenges in implementing the model and, therefore, be able to find different results.

In addition to these methodological limitations, it is also important to highlight practical challenges that may affect the implementation of the proposed model. Among them are cultural barriers within organizations, which can hinder the acceptance of disruptive technologies and human-centered approaches typical of Industry 5.0; high implementation costs, especially in sectors such as pulp and paper, which require intensive capital investment; and the readiness of leadership teams, which play a decisive role in aligning strategic vision, resource allocation and organizational culture with the principles of Industry 5.0. These limitations point to the need for future studies that also investigate

organizational dynamics and managerial capabilities as critical factors for the adoption and consolidation of the practices evaluated in this research.

The present study contributes to a significant literature review on the different Industry 5.0 practices and their level of maturity. Therefore, this research brings contributions to researchers, professionals, universities and consultancies, and provides an understanding for consultancies specialized in Industry 5.0 that wish to use a checklist model to diagnose Industry 5.0 practices.

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