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Projecting the future: strategies based on scenario planning for a metalworking company

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Abstract

Objective of the study: This article aims to construct and analyze prospective scenarios for a metallurgical industry located in Franca, São Paulo, covering the period from 2023 to 2028.
Methodology/approach: The research adopts a qualitative, bibliographical, and exploratory methodology. The main stages for constructing the scenarios use the Blanning and Reinig Method to define possible future scenarios, the Cross-Impact Matrix, and the Delphi Method, which assist in identifying and analyzing the probabilities of future events.
Originality/Relevance: Strategic planning is essential for business success, and the prospecting of future scenarios stands out as a tool that provides strategic vision and security for decision-making. This article applies these methodologies to a small company, demonstrating effective strategies to address threats and seize opportunities. Thus, the study contributes to the economic development of the analyzed company and can serve as a model for other businesses and academic studies.
Main results: The research presents three future scenarios — optimistic, pessimistic, and realistic — which will serve as the foundation for the strategic planning of the studied industry.
Theoretical/methodological and social contributions: This work introduces the use of the scenario prospecting tool in different business contexts, promoting financial and social stability. Consequently, it enhances employee security through more efficient strategic planning.

Keywords: scenario prospecting, strategic planning, future events, metallurgical industry

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Resumo

Projetando o futuro: estratégias baseadas em cenários prospectivos para uma empresa metalúrgica

Objetivo do estudo: Este artigo busca construir e analisar cenários prospectivos para uma indústria metalúrgica localizada em Franca, São Paulo, abrangendo o período de 2023 a 2028.
Metodologia/abordagem: A pesquisa adota uma metodologia qualitativa, bibliográfica e exploratória. As principais etapas para a construção dos cenários utilizam o Método de Blanning e Reinig, para a definição dos possíveis cenários futuros, a Matriz de Impactos Cruzados e o Método Delphi, que auxiliam no levantamento e análise das probabilidades de ocorrência de eventos futuros.
Originalidade/Relevância: O planejamento estratégico é essencial para o sucesso empresarial, e a prospecção de cenários futuros se destaca como uma ferramenta que oferece visão estratégica e segurança para a tomada de decisões. Este artigo aplica essas metodologias em uma pequena empresa, demonstrando estratégias eficazes para enfrentar ameaças e aproveitar oportunidades. Assim, o estudo contribui para o desenvolvimento econômico da empresa analisada e pode servir de modelo para outras empresas e trabalhos acadêmicos.
Principais resultados: A pesquisa apresenta três cenários futuros — otimista, pessimista e realista —, que servirão como base para o planejamento estratégico da indústria estudada.
Contribuições teóricas/metodológicas e sociais: Este trabalho introduz o uso da ferramenta de prospecção de cenários em diferentes contextos empresariais, promovendo estabilidade financeira e social. Assim, reforça a segurança dos colaboradores por meio de um planejamento estratégico mais eficiente.

Palavras-chave: prospecção de cenários, planejamento estratégico, eventos futuros, indústria metalúrgica

Resumen

Proyectando el futuro: estrategias basadas en escenarios prospectivos para una empresa metalúrgica

Objetivo del estudio: Este artículo tiene como objetivo construir y analizar escenarios prospectivos para una industria metalúrgica ubicada en Franca, São Paulo, abarcando el período de 2023 a 2028.
Metodología/enfoque: La investigación adopta una metodología cualitativa, bibliográfica y exploratoria. Las principales etapas para la construcción de los escenarios utilizan el Método de Blanning y Reinig para definir posibles escenarios futuros, la Matriz de Impactos Cruzados y el Método Delphi, que ayudan a identificar y analizar las probabilidades de eventos futuros.
Originalidad/Relevancia: La planificación estratégica es esencial para el éxito empresarial, y la prospectiva de escenarios futuros se destaca como una herramienta que proporciona visión estratégica y seguridad para la toma de decisiones. Este artículo aplica estas metodologías en una pequeña empresa, demostrando estrategias efectivas para enfrentar amenazas y aprovechar oportunidades. Así, el estudio contribuye al desarrollo económico de la empresa analizada y puede servir como modelo para otras empresas y estudios académicos.
Principales resultados: La investigación presenta tres escenarios futuros — optimista, pesimista y realista — que servirán como base para la planificación estratégica de la industria estudiada.

Contribuciones teóricas/metodológicas y sociales: Este trabajo introduce el uso de la herramienta de prospectiva de escenarios en diferentes contextos empresariales, promoviendo la estabilidad financiera y social. En consecuencia, refuerza la seguridad de los empleados mediante una planificación estratégica más eficiente.

Palabras clave: prospectiva de escenarios, planificación estratégica, eventos futuros, industria metalúrgica

1 Introduction

"Think ahead," "visualize the future," "plan ahead," "what if." These expressions are commonly heard in any company. People involved in a company's strategic department know they need to focus on the key aspects of the business—those that, in some way, can affect the corporation's competitiveness. Issues such as profitability, ensuring customer satisfaction, and achieving set goals are central concerns. The idea is to focus on questions beyond the present moment, allowing directors and managers to anticipate what the future may hold for their organization (Wade, 2013).

In today's fully globalized world, where actions taken anywhere on the planet can influence us, defining strategies for future success is no easy task for a corporation. Thus, prospective scenario analysis becomes fundamental to achieving this success (Marcial & Grumbach, 2005). Scenario analysis is essential to reducing uncertainties in the business environment through probabilistic analyses of a future reality yet to come.

Brazil is undergoing a premature process of deindustrialization, which poses above-average challenges and demands for the Brazilian industry as a whole. This makes the need for prospective scenario analysis even more urgent (Ribeiro, Cardozo, & Martins, 2021).

In 2015, under the coordination of the United Nations (UN) and with global participation from governments, societies, private institutions, and research organizations, the formation of the 2030 Agenda for Sustainable Development began, involving 193 UN member states. Following the Millennium Development Goals Agenda (2000–2015), the current agenda aims to cover 17 sustainable development goals across all aspects of progress. In the context of establishing an agenda with objectives to be achieved over 15 years, prospective scenario analysis is invaluable in effectively planning for the accomplishment of these goals (ODS Brasil, 2022).

The objective of this research is to construct and analyze prospective scenarios for a metallurgical industry located in Franca, a city in the interior of São Paulo State, covering the period from 2023 to 2028. This study highlights the importance of applying prospective scenarios in a company, demonstrating, through a case study of the metallurgical industry in Franca, the effectiveness of this tool in looking beyond current events, setting long-term objectives, and maintaining resources to face inevitable turbulence (Schwartz, 2003).

The methodology of this article includes the use of questionnaires for qualitative analysis and bibliographical and exploratory research to provide the necessary theoretical foundation for its application.

The research involved six participants who were tasked with analyzing and leading the completion of questionnaires to identify events that could impact the future of the company under study. Among these six individuals, one was a founding partner of the company, four were master's students from the interdisciplinary postgraduate program in regional development at Uni-FACEF, two of whom held decision-making positions within the company, and the sixth participant was a professor from the same postgraduate program, serving directly as a facilitator—an essential role for scenario analysis.

The research employed the Delphi Method to gather insights from both internal and external perspectives on the corporation, identifying probable future events that could affect the company over the next five years. The goal was to define at least twenty events, analyze the likelihood of their occurrence, and evaluate the extent to which each event would be favorable or unfavorable to the company. By cross-referencing this information, three scenarios were constructed: Optimistic, Pessimistic, and Realistic.

Subsequently, based on the probability of event occurrence, a Cross-Impact Matrix was developed to analyze the interdependencies among events and to identify the system's driving forces—those events that, if they occur, will influence all others (Marcial & Grumbach, 2005).

Finally, three potential future scenarios will be analyzed. The first scenario contextualizes events with a high probability of occurrence and favorable outcomes, referred to as the "Laminar Flow" scenario. The second scenario considers events with a high probability of occurrence but unfavorable outcomes, named the "Turbulent Flow" scenario. The last scenario analyzed is a realistic one, which takes into account only events with a high probability of occurrence, regardless of their favorability, and is called the "Transition Flow" scenario.

The terminology "Laminar Flow," "Turbulent Flow," and "Transition Flow" was chosen to classify the scenarios, drawing from hydraulic flow classifications. Given that the case study company is directly involved in hydraulic machinery projects, this terminology aligns with the

technical concepts familiar to those within the organization, facilitating a clearer understanding of each scenario.

The content of this article is structured and developed through six sections, including this Introduction. The second section presents the theoretical framework, which is essential for guiding and supporting the understanding of prospective scenarios. The third section introduces the metallurgical company located in Franca, São Paulo, which serves as the case study for this research.

The fourth section details the methodology employed, which includes the scenario planning method by Blanning and Reinig, the Delphi Method for identifying events that will comprise the scenarios, and the Cross-Impact Method, used to analyze the impact that the occurrence (or non-occurrence) of each event has on others, aiming to identify the system's "driving forces."

Finally, the fifth and sixth sections discuss the study's results and present the final considerations, offering relevant and impactful strategies derived from the application of prospective scenarios in the metallurgical industry under analysis.

2 Theoretical Framework – Prospective Scenarios

Humanity's interest in predicting the future, as evidenced by historical figures such as biblical prophets, magicians, and sorcerers, has significantly evolved with the development of science and military strategy (Marcial & Grumbach, 2005). After World War II, the U.S. Air Force extensively adopted scenario formation to anticipate potential combat situations with enemies, hiring specialists to develop strategic and tactical analyses that considered various future possibilities instead of focusing on a single outcome (Schwartz, 2000; Marcial & Grumbach, 2005).

The term "prospective," which replaced "forecasting," was popularized by Pierre Wack, who worked in the planning department of Royal Dutch Shell during the 1970s. In 1988, Wack joined Peter Schwartz to establish the Global Business Network (GBN), a company dedicated to using scenarios as a tool for corporate strategic planning (Marcial & Grumbach, 2005).

In Brazil, the practice of scenario prospecting emerged more recently, during the 1980s, and was adopted by governmental companies such as BNDES, Eletrobrás, Petrobrás, and Eletronorte (Buarque, 1998).

2.1 Turbulence and Uncertainties in the Process

It is essential to recognize, before beginning any scenario analysis or even the development of future events, that turbulent moments will inevitably arise, bringing surprises

that must be addressed. The success of planning lies in preparing for unexpected surprises (Schwartz, 2003).

According to Schwartz (2003), it is crucial to remain vigilant and guard against two natural reactions when confronted with surprises: denial and defensiveness. Both can lead to immeasurable damage to a company's operations. Denial of an event can result in a complete "blindness" within an institution, hindering preparations for the event's arrival. Defensiveness, although the opposite of denial, can cause similar harm. It is human nature to want to protect oneself by cutting costs and investments, which can disrupt the market as a whole and lead to missed opportunities. During turbulent times, uncertainty is the only apparent certainty, showing that inaction in response to an event is the riskiest decision possible.

Similar to Schwartz (2003), Wucker (2021) also warns of the danger of denial in the face of imminent events. According to Wucker (2021), when facing a charging rhinoceros, doing nothing is rarely the best choice. Yet, in many cases, this is precisely what happens. The author argues that danger rarely arises unexpectedly. On the contrary, before an attack, there are numerous opportunities to take precautions, understand, and react to warning signs. Overcoming the impulse to remain still is difficult, and in some situations, denial is so strong that people do nothing or, even worse, act self-destructively, as seen in many market bubbles that eventually burst.

The future is filled with events that can be foreseen, but there will also undoubtedly be entirely unexpected events—events that few people would consider. These rare events, with an extremely low probability of occurrence, are known as "Black Swans." If they occur, they will have profound and possibly irreversible impacts. According to Taleb (2008), the term "Black Swans," associated with the rarity and silent appearance of an event, dates back to the late 19th century. At that time, the global belief was that all swans were white, and the existence of a "non-white" swan was considered entirely improbable. However, when a black swan was discovered in Australia, it was concluded that the improbable had indeed occurred.

It is important to note that not all "Black Swans" are negative. Rare, unpredictable events with positive characteristics can also occur, potentially benefiting a single company uniquely (Taleb, 2008).

According to Taleb (2008), it is common for people to view a "Black Swan" event as obvious and predictable after it occurs. This is a complex assertion, as while such events are deemed unpredictable, it is possible to prepare for them by analyzing future situations that seem unimaginable but have some probability of occurring.

A clear example of this is the September 11, 2001, terrorist attacks in the United States, often regarded as the most significant "Black Swan" event in history. Despite its rare and improbable nature, retrospective analysis revealed that the U.S. internal security system was flawed and that the attack could have been anticipated. Reports indicate that it was, in fact, projected by the Global Business Network (GBN), a scenario planning firm, in work shared with the U.S. government (Schwartz, 2003).

In this context, it becomes evident that relying solely on an exceptional tool like prospective scenario planning is insufficient. It is essential to overcome deeply ingrained paradigms in daily life. These paradigms shape our actions, and the belief that we are on the "right path" or that there is a "single way" to act can blind us to alternative perspectives and new ideas, leading to missed critical opportunities for success (Vasconcellos, 2013).

Vasconcellos (2013) further states that when we exclusively adhere to our own paradigms, we risk falling victim to a dangerous "paradigm paralysis" or "fatal certainty syndrome," which distorts our perception of the world (Vasconcellos, 2013, p.33). Imagine the planning errors that could arise in a company if the department leader fails to overcome their own paradigm.

Planning for a constantly changing and accelerating world is essential. As Harari (2018) points out, a thousand years ago, an upper-class Chinese father prepared his son for the future by teaching him to read, write, or ride a horse, with the assurance that these skills would remain useful in an era when the spread of information was slow.

However, today, with any information available within seconds, human daily life moves at a frenetic pace, creating challenging scenarios such as preparing a child for a profession that might not exist in the future. The extinction of a profession can be unexpected, but it can be anticipated through scenario analysis, enabling strategies to address such eventualities. Certainties about the future no longer exist; change is the only constant (Harari, 2018).

2.2 The Trend of Strategic Planning

Preparing for the future is essential for an industry, and planning prospective scenarios is one of the most efficient ways to prepare a company for facing the various possibilities that may occur. Prospective scenario planning is not about projecting the current reality into the future. This planning tool seeks to broaden the company’s vision and, above all, make decision-making more assertive, as there will never be just one certain future. As a result of this well-executed work, the company may encounter different visions of various futures in varied events—not only global events but also those specific to the company, such as the emergence

of new competitors, products, clients, suppliers, among others. From this analysis, the planning team must be flexible and prepared for all possible future scenarios they might face, ensuring agility, resilience, and coherent decision-making. Even unforeseen events, or those not previously discussed, can be managed effectively if the planning team has an open perspective and is accustomed to working with scenario prospecting, demonstrating adaptability and acceptance for confronting challenges (Wade, 2013).

A planning department skeptical of hidden forces, which assumes that all events will follow a constant evolution—meaning it views the future as merely an extrapolation of the present—is likely to encounter unpleasant surprises. Two forms of extrapolation stand out: the first is **numerical extrapolation**, a mathematical process that builds future planning by merely altering numbers from previous years, creating scenarios with events similar to the present. The second is **mental extrapolation**, which, like the first, frames the future entirely within the present, leaving the situation extremely comfortable due to the absence of surprises (Wade, 2013).

Understanding the present to plan for the future, also according to Wade (2013), will always be important and essential. However, it is fundamental to go beyond; it is necessary to aim for the unforeseen, the imaginable, that event that everyone in the company knows could occur but is never considered. A clear example is the strong entry of a new competitor.

A challenging mission in good scenario prospecting is defining the events to start effective work, and to do so, analyzing existing trends is an important step for this primary listing. It is essential to clear the mind, accept the unknown, recognize that not everything is known, and finally, achieve a vision of the future and existing trends without any prejudice or influence. It is necessary to focus on all possible changes, so as not to fail to detect the simplest events that occur right in front of us, as changes can be very complex and long-lasting, making them difficult to notice, or even too normal and small to be perceived (Lindkvist, 2010).

Trends can be divided into three classifications, according to their dimension: **microtrends**, which last for short periods, from one to five years; **macrotrends**, which can last from one to two decades; and **megatrends**, which usually last more than two decades. Each one will be analyzed and valued according to the horizon of the applied scenario (Lindkvist, 2010).

When analyzing the degree of importance of one trend compared to another and asking which trend is more important, Wade (2013) points out that practically anything can be significant, especially because the purpose of the exercise is to encourage creativity. In this sense, it is useful to examine less obvious cause-and-effect relationships, as the future will be

shaped by various forces that exert an indirect impact. At this stage, it is essential to reflect on what these forces might be.

Still according to Wade (2013), a good manager can bring leadership to its essence by focusing the team on a realistic vision, helping and inspiring them to face the unforeseen, clearly guiding scenario planning.

Finally, it is indispensable to keep in mind that even the best-executed forecast or scenario prospecting will not present all future impacts. However, companies that work on a future event will certainly be better prepared to face it (Wade, 2013).

3 The Company Under Study

The case study was conducted in a small metallurgical company currently employing a team of thirty collaborators, located in the city of Franca, in the interior of São Paulo state. A family-owned business founded in 1984, the company began its activities by manufacturing micro hydraulic turbines for generating electricity in isolated rural areas.

Fourteen years later, it revolutionized the market with the implementation of the first hydraulic turbine driving a positive displacement pump (piston), focused on water pumping for agricultural and irrigation markets. In 2002, recognizing the need to have full control over its production, the company expanded its operations by inaugurating an iron foundry unit. This expansion facilitated the production of its components and opened the market for other items, such as third-party and agricultural parts, with the commercialization of these products starting in 2022.

With the intention of adopting a distribution system through resellers and achieving serialized production, the company launched a standardized product line for water pumping in 2010. Starting with this product and others subsequently introduced, the company expanded its sales through resellers across the country.

Thus, operating in various segments, the corporation currently focuses on five main areas of activity, outlined below:

- **Sustainable water pumping line with zero energy cost**, meaning water pumping water. This line is currently the company's flagship, accounting for a large portion of the industry’s daily production;
- **Micro hydraulic turbines for electricity generation**, with a power limit of 500kW (kilowatts). This is the company’s pioneering product line;
- **Solar-powered water pumping systems**;

- **Pressure-reducing turbines**, a product aimed at the water sanitation sector, designed to control and monitor water distribution networks while also generating sustainable electricity; and
- **Agricultural parts for the replacement market**.

With approximately 95% of the components for its equipment manufactured in-house, the company demonstrates a verticalized structure, sourcing its primary raw materials directly from iron mills and selling directly to the end consumer. A self-funded company, it is 100% national, with the majority of its products characterized by sustainability.

The company and its products align with several United Nations Sustainable Development Goals (SDGs): **SDG 6** (Clean Water and Sanitation), **SDG 7** (Affordable and Clean Energy), **SDG 8** (Decent Work and Economic Growth), and **SDG 9** (Industry, Innovation, and Infrastructure). Additionally, the company indirectly contributes to Smart Cities initiatives, linking to **SDG 11** (Sustainable Cities and Communities) and supporting **SDG 13** (Climate Action) with its non-polluting products (ODSBrasil, 2022).

4 Methodology

Currently, the prospecting of future scenarios is an increasingly important tool for developing and analyzing the performance of organizations in dynamic situations. The potential of strategic planning, utilizing prospective scenarios, is remarkable in numerous aspects, provided the method is applied correctly and sensibly. This tool motivates teams, enhances knowledge, and, most importantly, is fundamental for decision-making (Junior, Oliveira, Kilimnik, 2010).

It is rarely known whether a company will face a chaotic scenario in the coming years. However, if such a scenario arises, a company that has planned with the help of scenario prospecting may even benefit from certain aspects of the chaos, particularly those triggered by political and economic movements (Kotler, Caslione, 2009).

The Delphi Methodology was used to identify probable future events that could impact the company.

For the prospecting and construction of future scenarios, the methodology proposed by Blanning and Reinig (1998) was applied. This approach involves group analysis aimed at aligning the team's different perspectives and minimizing opinion conflicts. According to Marcial and Grumbach (2005), in group analysis, opinions or ideologies related to various aspects can cause divergences and, consequently, conflicts. However, this method aims to eliminate such issues by following three premises:

- **Anonymity** – Seeks to eliminate group influences that might overshadow individual perspectives;
- **Statistical disposition of the data**;
- **Feedback on the reasoning developed**.

Thus, the team is divided into two groups: one consisting of experts who conduct the analysis and facilitate logical reasoning, and another group of analysts who review and interpret the results (Marcial & Grumbach, 2005).

For this research, five people worked as analysts and one as an expert and facilitator. Of the five analysts, three are directly connected to the company under study, and of these three, two are master's students in the Interdisciplinary Postgraduate Program in Regional Development at Uni-FACEF. The other two analysts are also members of the same program but have no connection with the industry studied. The expert and facilitator of the study is a professor with a Ph.D. in the same program and extensive knowledge of the application of prospective scenarios.

5 Results – Prospective Scenarios

Initially, the team selected twenty events from a total of forty previously described events. This selection was primarily based on the impact that each event could have on the company under study. In addition to the impact rate, another criterion used was diversity of sector, meaning that events were chosen from various areas to broaden the perspective to cover nearly all issues relevant to the company.

In Table 1 below, it is possible to see the selection of the twenty events along with their percentages of probability and favorability.

Entry of competitors into the energy market for basic sanitation.

Table 1

Probability x Favorability Matrix

Scenarios for the Metal Industry in Francia - 2023/2028 **Probability x Favorability Matrix**			
n°	**Events**	**Prob.**	**Favorab.**
1	Reduction in Water Flow Available on Rural Properties	8,0	1,0
2	Changes in national government for the coming years	8,0	3,0
3	Increase in energy tariffs	8,5	6,5
4	Launch of new products with serial production	8,0	8,0
5	Hiring a third-party company to evaluate and manage commercial operations	6,5	9,0
6	Prospect of lower interest rates	8,5	7,5
7	Growth in food demand	7,5	7,0
8	Expansion of the solar energy market	9,0	4,0
9	Reduction in environmental bureaucracy	4,0	9,0
10	Creation of a private corporation to attract investors	8,0	7,5
11	Growth in the market for artesian well pumping	7,0	4,0
12	Strengthening the company's Brand (*Branding*)	7,0	9,0
13	Reduction in local skilled labor availability	8,0	1,5
14	Entry of competitors into the energy market for basic sanitation	7,0	1,0
15	Approval of pressure reducing turbines by water utilities	8,0	10,0
16	Development of tax planning and search for tax incentives	7,5	9,0
17	Significant reduction in global consumption of animal protein	4,0	4,0
18	Searching for external capital	6,0	7,5
19	Difficulty in direct importation due to high costs and low demand	9,0	2,0
20	Outsourcing to China (quantitative and non-quantitative products under a different brand)	7,0	8,0

Source: Prepared by the authors

In Table 2 below, all events are described and clarified to ensure there is no doubt regarding their focus.

n°	Events	Event description
1	Reduction in water flow available on rural properties	With the reduction in water flow in the springs, there may not be enough flow to move the equipment.
2	Changes in the national government for the coming years	Former president Lula's entry as president in 2023.
3	Increase energy tariffs	Increase in the amount of energy charged by electricity companies.
4	Launch of new products with mass production	Development of new products with serial manufacturing, i.e. manufacturing with greater productivity.
5	Hiring a third-party company to evaluate and manage the sales department	Hire an expert consultancy with commercial knowledge.
6	The prospect of lower interest rates	Falling bank interest rates
7	Growth in food demand	Increased consumption of food in general.
8	Expansion of the solar energy market	The growth of solar energy in Brazil.
9	Reduction of Environmental Bureaucracy	More agile environmental intervention permits.
10	Opening a closed joint stock company attracting investors	Make a corporate arrangement for a possible shareholder agreement, attracting investors.
11	Growth in the artesian well pumping market	Rural pumping more geared towards the use of artesian wells.
12	Strengthening the company's brand (*Branding*)	Create campaigns to intensify the brand.
13	Decrease in the local skilled workforce	Declining supply of electrical and mechanical engineers and technicians in the region.
14	Entry of competitors in the sanitation energy market	Entry of new players.
15	Approval of pressure reducing turbines in sanitation companies	Permission from the basic sanitation companies to install the equipment without bureaucracy.
16	Do tax planning and look for tax incentives	Analyze possible tax incentives for sustainable equipment.
17	Significant reduction in global consumption of animal protein	Significant growth in the number of vegans and/or vegetarians.
18	Search for external capital	Entry of external investors.
19	Difficult to import directly due to high cost and low demand	Not being able to import products or parts due to low consumption.
20	Outsourcing China (quantitative and non-quantitative products with another brand)	Bring in new Chinese products, create a new brand and launch it on the market, even competing with current products manufactured domestically.

Source: Prepared by the authors

To better understand these events, they were divided into five groups as described below.

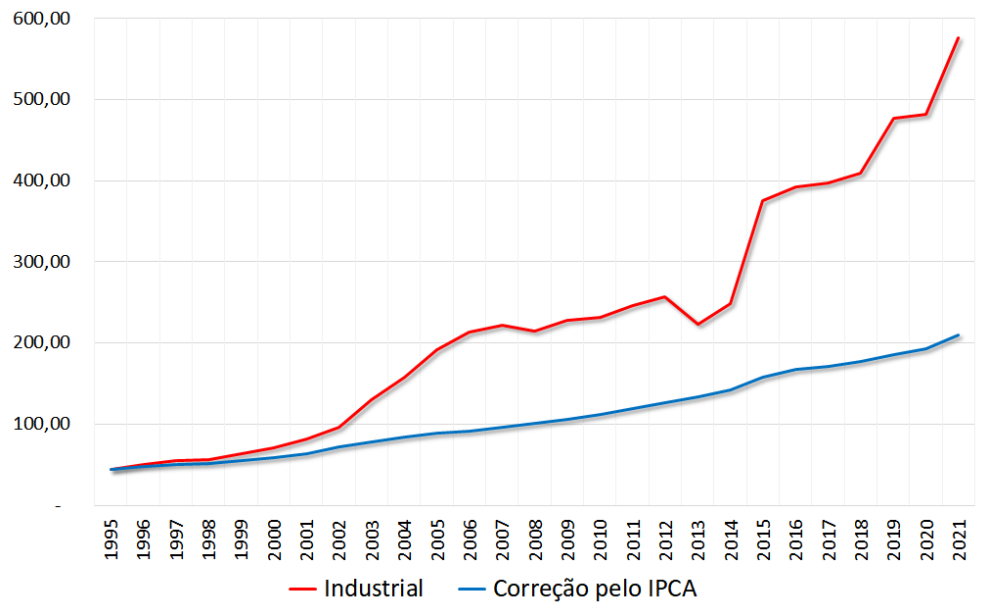
Events 1, 3, 8, and 9 are directly linked to the environment and the energy sector, two key areas of the company's operations, given that its products are closely related to the use of water resources for electricity generation. The highlight of this group of events is "Reduction in Water Flow Available on Rural Properties" (1), emphasized by a significant number of

participants. According to Modeli (2021), a study conducted by scientists and environmentalists through "MapBiomas" revealed a 15.7% reduction in the surface area of Brazilian freshwater over the past 30 years, indicating a high probability of occurrence for event 1. Another important aspect of this event comes from internal information provided by the company under study, which highlights the significant concern of rural producers regarding the reduction in water flow in their springs, as well as a growing shift or preference for equipment that requires less water flow for operation.

As shown in **Graph 1** below, the trend of event 3, "Increase in Energy Tariffs," can be observed. The graph illustrates a constant upward trend in these tariffs, with price adjustments exceeding inflation, as evidenced by the increasing divergence from the initial value (from 1995), adjusted only by the IPCA (D'Araujo, 2022).

Graph 1

Evolution of average tariffs (R$/MWh) for the industrial sector, compared to the price evolution of the 1995 tariff, corrected for the IPCA

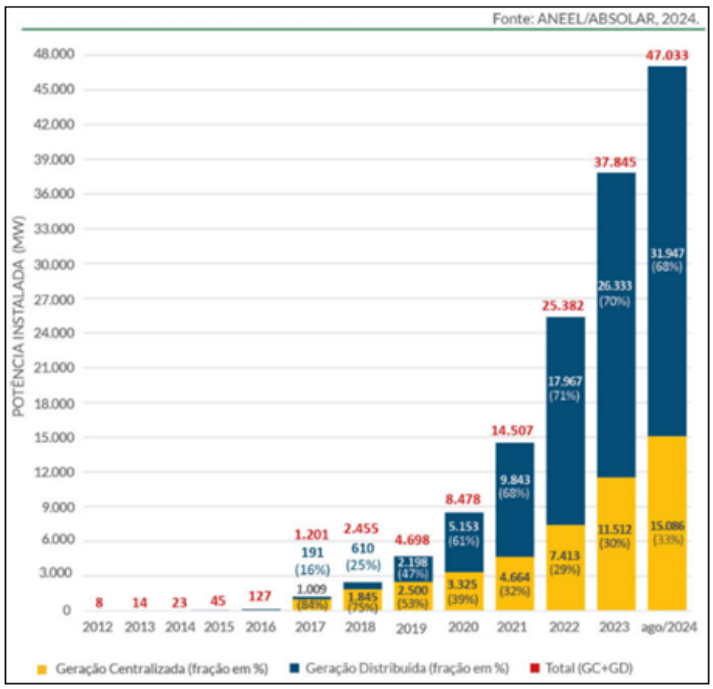


Source: D'ARAUJO, 2022

Highlighted in event 8, the growth of solar energy in Brazil is notable and a consistent trend in any projection, with a minimum expectation of maintaining the growth curve, as shown below in Graph 2. However, despite all indicators pointing toward this trajectory, it is necessary to consider potential government interventions, such as new regulations, which could positively or negatively impact this sector (Energia Solar Fotovoltaica, 2021).

Graph 2

Growth of solar energy



Source: ABSOLAR, 2024

Focusing on the political sphere, events 2, 6, and 15, although distinct, are entirely dependent on governmental bodies. The highlight of this group is the event "Change in Government for the Coming Years" (2), which is the most relevant. However, the "Approval of Pressure-Reducing Turbines (a product recently invented and launched by the company) by Water Utilities" (15) could have a significant impact on the company's sales.

The political factor is always prominent in scenario prospecting, largely due to the policies a government might adopt. Thus, it is important to note that if event 2 materializes, it would bring considerable uncertainty to the Brazilian agro-industrial market, especially following some negative statements made by candidate Luiz Inácio Lula da Silva about the sector (Tosi, 2022).

When the analysis focuses on the market, events 4, 11, 14, 19, and 20 could be decisive for the industry's future. Among these, "Entry of Competitors into the Energy Market for Basic Sanitation" (14) deserves particular attention, as its occurrence could impact the company's fastest-growing sector. In addition to this, events 19 and 20, which directly address the importation of parts/products from Asia, are also considered extremely relevant.

The internal organization of any corporation is always a matter to be analyzed, studied, and adjusted when necessary. For this reason, five events are directed toward this group: events 5, 10, 12, 16, and 18. The "Creation of a Private Corporation to Attract Investors" (10) stands

out as one of the most transformative or impactful events among those considered, potentially being a determinant for the organization's future.

Finally, events with global and regional impacts can affect the company under study, as seen in events 7, 17, and 13 in the probability and favorability matrix. The "Growth in Food Demand" (7) and a "Significant Reduction in Global Consumption of Animal Protein" (17) are events with global impact and are directly linked to the main segments of the metallurgical company's flagship product. Meanwhile, event 13, "Reduction in Local Skilled Labor," is highlighted as a local event but can be considered a nationwide issue, impacting any Brazilian company, regardless of its industry.

With all the events qualified and listed, the process of constructing possible scenarios can proceed through their classifications.

As previously described in this research, three possible scenarios will be explored: Optimistic, Pessimistic, and Realistic. For this, it is necessary to establish and define the boundaries for separating these scenarios. In Table 3 below, the selection of these boundaries can be identified.

Table 3

Table of limits for each scenario

Limits		
Probability		
Maximum	Minimum	Realistic
10,0	6,0	7,6
Optimistic Favorability		
Maximum	Minimum	
10,0	5,5	
Favorability Pessimistic		
Maximum	Minimum	
5,4	0,0	

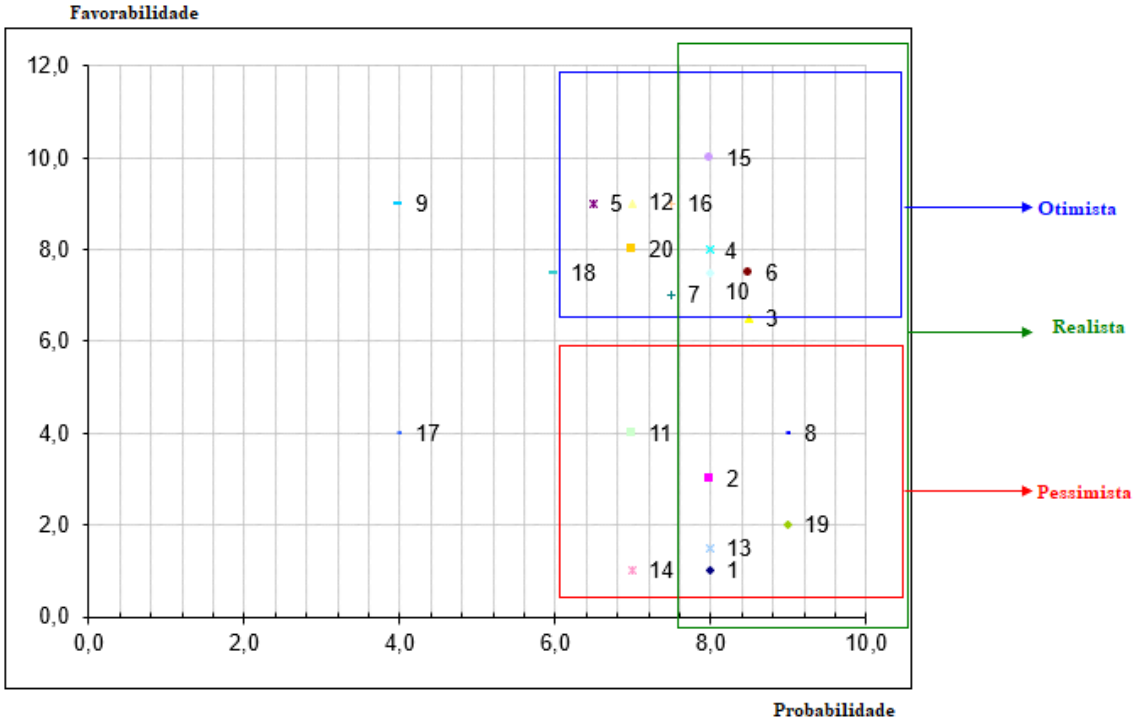
Source: Prepared by the authors

Thus, according to Table 3, the following boundaries can be observed:

- Optimistic Scenario – Probability Range: 6.0 to 10.0 and Favorability Range: 5.5 to 10.0;
- Pessimistic Scenario – Probability Range: 6.0 to 10.0 and Favorability Range: 0.0 to 5.4;
- Realistic Scenario – Probability Range: 7.6 to 10.0.
- With these premises established, it is possible to visually analyze this separation through Graph 3 below.

Graph 3

Optimistic, Pessimistic and Realistic Scenarios



Source: Prepared by the authors

Through the scenario graph, the Optimistic, Pessimistic, and Realistic scenarios will be analyzed. According to Wade (2013), naming a scenario facilitates its identification and association by participants, enhancing its memorization and purpose. Therefore, the scenarios will be named based on a hydraulic fluid flow concept, chosen due to the company's involvement in this segment.

The identified **Optimistic Scenario** will be named **"Laminar Flow"** because laminar flows are smooth and uniform, requiring no concern as there is likely little chance of problems occurring. The **Pessimistic Scenario** will be named **"Turbulent Flow"** because, as the name suggests, turbulent flows are irregular and unpredictable, offering no ease in their analysis. The **Realistic Scenario** will be named **"Transition Flow"**, representing a flow that transitions between the two previous types, bringing both turbulence and calmness to its analysis.

The boundary parameters between Pessimistic, Optimistic, and Realistic scenarios can be adjusted according to the results of the selected events. However, they follow a logical structure: events with a high probability of occurrence and high favorability will fall into the Optimistic Scenario, while events with a high probability of occurrence but low favorability

will be directed to the Pessimistic Scenario. The Realistic Scenario will include only events with a high probability of occurrence, regardless of their favorability.

Thus, it is possible to identify the listed events divided among each scenario in Tables 4, 5, and 6.

Table 4

Events included in the Laminar Flow scenario

Optimistic Scenario	
n°	**Events**
3	Rising energy tariffs
4	Launch of new products with mass production
5	Hiring a third-party company to evaluate and manage the sales department
6	The prospect of lower interest rates
7	Growing demand for food
10	Opening a closed joint stock company attracting investors
12	Strengthening the company's brand (*Branding*)
15	Approval of pressure reducing turbines in sanitation companies
16	Do tax planning and look for tax incentives
18	Searching for external capital
20	Outsourcing China (quantitative and non-quantitative products with another brand)

Source: Prepared by the authors

Table 5

Events included in the Turbulent Flow scenario

Pessimistic Scenario	
n°	**Events**
1	Reduction in the amount of water available on rural properties
8	Expansion of the solar energy market
11	Growth in the artesian well pumping market
13	Decrease in the local skilled workforce
14	Entry of competitors in the sanitation energy market
19	Difficult to import directly due to high cost and low demand

Source: Prepared by the authors

Table 6

Events included in the Transient Flow scenario

Realistic Scenario	
n°	**Events**
1	Reduction in the amount of water available on rural properties
2	Changes in the national government for the coming years
3	Increase in energy tariffs
4	Launch of new products with mass production
6	The prospect of lower interest rates
8	Expansion of the solar energy market
10	Opening a closed joint stock company attracting investors
13	Decrease in the local skilled workforce
15	Approval of pressure reducing turbines in sanitation companies
19	Difficult to import directly due to high cost and low demand

Source: Prepared by the authors

In addition to listing and categorizing the events, it is necessary to analyze them individually and within the context of each scenario.

"Laminar Flow" Scenario – An Optimistic Scenario

This scenario contains events with medium to high probabilities of occurrence and medium to high favorability if the events occur. Among the twenty events, eleven are part of this scenario:

- Increase in Energy Tariffs – A positive impact, as rising energy tariffs make investments in energy production more profitable and attractive to the investor market.
- Launch of New Products with Serial Production – New products, when accepted by the market, are highly valuable. When produced on a scalable basis, they bring significant gains in cost, productivity, and quality.
- Hiring of a Third-Party Company to Evaluate and Manage Commercial Operations – As a technology-focused industry, the commercial department does not receive as much emphasis. The inclusion of skilled professionals in this department could lead to significant growth in sales.
- Prospect of Lower Interest Rates – Lower interest rates can be positive, as investors shift their capital toward more profitable ventures and gain access to financing at reduced rates.

- Growth in Food Demand – A widely discussed topic. If this event occurs, it would necessitate greater investment in food productivity and, consequently, sustainable high-production equipment.
- Creation of a Private Corporation to Attract Investors – Perhaps the most complex and bold event, but if it occurs, it would completely transform the company's trajectory.
- Strengthening of the Company's Brand (Branding) – Although well-known in its field, the company's brand needs better promotion.
- Approval of Pressure-Reducing Turbines by Water Utilities – Currently, the main barrier to the company's entry into the basic sanitation sector is bureaucracy and company paradigms. This event would expedite its consolidation in this market.
- Development of Tax Planning and Search for Tax Incentives – Tax planning is essential for any company and may bring new subsidies, particularly related to sustainable products.
- Search for External Capital – Attracting external capital is a desirable scenario for any small business.
- Outsourcing to China (Quantitative and Non-Qualitative Products with Another Brand) – A potentially complex but feasible event that would place the company in more intense competition with its rivals.

"Turbulent Flow" Scenario – A Pessimistic Scenario

This scenario includes events with medium to high probabilities of occurrence but medium to low favorability. Among the twenty events, seven are part of this scenario:

- **Reduction in Water Flow Available on Rural Properties** – A situation already occurring that negatively affects, and could increasingly hinder, products dependent on water resource utilization.
- **Change in National Government for the Coming Years** – The return of former President Luiz Inácio Lula da Silva to the presidency is not viewed favorably by a significant portion of the agribusiness market.
- **Expansion of the Solar Energy Market** – Currently, perhaps the sector most competing with the company's products. Analyzing its growth, which appears imminent, is highly valuable for the company's planning.
- **Growth in the Market for Artesian Well Pumping** – Another highly relevant competing market, particularly when linked to solar-powered pumping systems.

- **Reduction in Local Skilled Labor** – An issue already influencing the company and expected to worsen due to the low availability or lack of interest among professionals in vocational courses related to mechanical and electrical engineering. The growth of online education (EAD) is also a concern due to the potential decline in the qualification of future professionals.
- **Entry of Competitors into the Energy Market for Basic Sanitation** – In a restricted and promising market, the entry of competition is worrisome. While it may bring some benefits, it is crucial to prepare for the potential consequences this competition could bring.
- **Difficulty in Direct Importation Due to High Costs and Low Demand** – With globalization, importing is currently necessary to keep any product competitive in a tight market. It is essential to find alternatives to mitigate and overcome the high costs of importing.

"Transition Flow" Scenario – A Realistic Scenario

This scenario includes only events with a high probability of occurrence, regardless of their favorability. Among the twenty events, ten are part of this scenario, four from the pessimistic scenario and six from the optimistic scenario. They are:

- Reduction in Water Flow Available on Rural Properties
- Change in National Government for the Coming Years
- Increase in Energy Tariffs
- Launch of New Products with Serial Production
- Prospect of Lower Interest Rates
- Expansion of the Solar Energy Market
- Creation of a Private Corporation to Attract Investors
- Reduction in Local Skilled Labor
- Approval of Pressure-Reducing Turbines by Water Utilities

Following the scenario analysis, assembling and utilizing the **Cross-Impact Matrix**, as shown in Table 7, is highly valuable.

Table 7

Cross-Impact Matrix

Eventos	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	Depend. (Média)
1		3	1	0	0	0	4	2	6	0	0	0	0	0	0	0	7	0	0	0	1,2
2	0		0	0	0	5	2	1	3	0	0	0	0	0	0	0	0	0	0	0	0,6
3	9	6		0	0	5	0	7	6	0	0	0	0	2	0	0	0	0	0	0	1,8
4	4	1	3		8	4	7	7	2	6	9	9	9	7	6	8	7	6	8	8	6,3
5	6	5	1	2		2	7	7	1	7	8	7	8	9	7	6	6	2	8	8	5,6
6	2	7	5	0	0		4	4	0	0	0	0	0	0	0	0	0	0	0	0	1,2
7	0	4	0	0	0	7		0	0	0	0	0	0	0	0	0	5	0	0	0	0,8
8	8	1	9	0	0	8	6		4	0	8	0	7	0	0	0	0	0	0	0	2,7
9	3	8	0	0	0	0	7	4		0	3	0	0	0	0	0	0	0	0	0	1,3
10	0	8	4	3	6	8	2	3	0		0	10	7	5	8	8	0	9	3	5	4,7
11	8	4	5	0	0	8	7	8	5	0		0	5	0	0	0	0	0	0	0	2,6
12	0	1	0	3	9	2	1	2	0	9	0		4	6	8	2	0	9	0	7	3,3
13	0	3	0	0	0	0	0	0	0	0	0	0		0	0	0	0	0	0	0	0,2
14	1	1	3	0	1	2	0	5	0	6	0	8	0		10	0	0	3	0	0	2,1
15	0	2	5	0	5	0	0	0	0	9	0	6	0	8		0	0	4	0	0	2,1
16	2	1	0	2	4	1	0	4	0	9	0	1	0	4	7		0	7	7	9	3,1
17	2	4	0	0	0	0	2	0	0	0	0	0	0	0	0	0		0	0	0	0,4
18	1	5	3	2	1	8	2	3	7	9	0	10	4	8	7	2	0		5	8	4,5
19	0	2	4	0	5	0	0	8	1	9	0	3	0	6	6	5	0	0		7	2,9
20	7	4	4	7	7	2	5	8	5	9	1	3	5	5	6	8	0	7	7		5,3
Motric. (Média)	**2,8**	**3,7**	**2,5**	**1,0**	**2,4**	**3,3**	**2,9**	**3,8**	**2,1**	**3,8**	**1,5**	**3,0**	**2,6**	**3,2**	**3,4**	**2,1**	**1,3**	**2,5**	**2,0**	**2,7**	

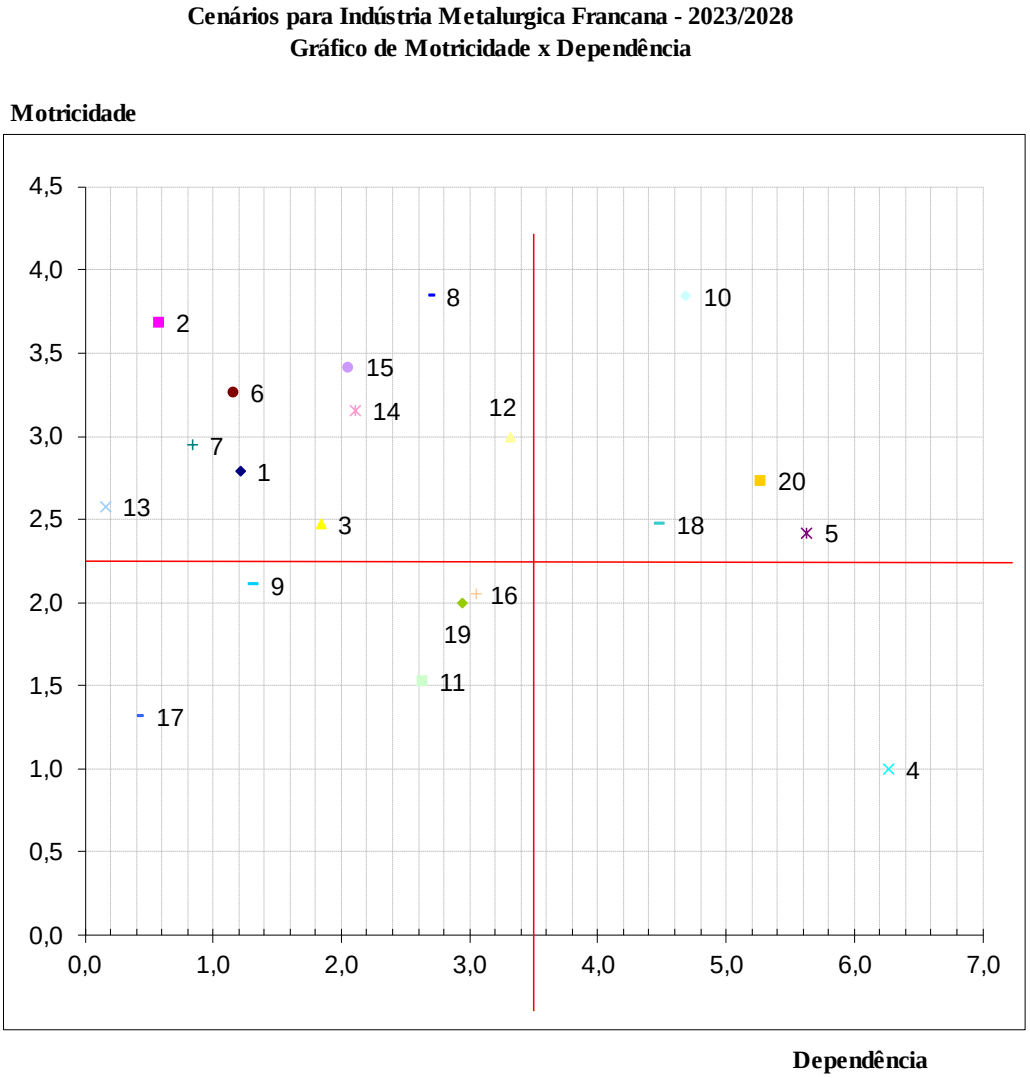
Source: Prepared by the authors

The Cross-Impact Matrix establishes the relationship between events, identifying driving forces and dependent events. This allows for the analysis of how the occurrence (or non-occurrence) of one event impacts the occurrence (or non-occurrence) of others (Marcial & Grumbach, 2005).

Through this analysis, it is possible to determine which events are driving forces and understand their consequences on dependent events. This makes the analysis more comprehensive, relevant, and clear, as illustrated in Graph 4 below.

Graph 4

Driving Forces vs. Dependency



The Driving Forces vs. Dependency Graph can be the most straightforward tool to identify which events a company should prioritize for preparation or to anticipate an event that will occur as a result of its dependency on another event.

Driving forces consist of events that may or may not be controlled by the company. If these events can be controlled, it is essential for the company to strategically plan actions to promote favorable events and avoid undesirable ones. For events that are beyond the institution's control, it is crucial to prepare for their occurrence and for the occurrence of their dependent events.

As illustrated in Graph 4, half of the events are driving forces, meaning they are located in the first quadrant, characterized by high driving force and low dependency. Driving forces are of utmost importance because, in addition to not relying on any other events, they have the capacity to trigger their dependent events.

In Table 8 below, all events with this characteristic of high driving force are listed.

Table 8

High motricity and low events

n°	Events
1	Reduction in the amount of water available on rural properties
2	Changes in the national government for the coming years
3	Rising energy tariffs
6	The prospect of lower interest rates
7	Growing demand for food
8	Expansion of the solar energy market
12	Strengthening the company's brand (*Branding*)
13	Decrease in the local skilled workforce
14	Entry of competitors in the sanitation energy market
15	Approval of pressure reducing turbines in sanitation companies

Source: Prepared by the authors

By relating these events to the previously selected scenarios, it is observed that events 1, 2, 8, 13, and 14 are present in the pessimistic scenario, and except for event 14, all others also appear in the realistic scenario. This demonstrates their extreme relevance, although all of them are beyond the company's control, making their management challenging or even impossible.

With the scenarios defined and their events interconnected, it becomes feasible to develop planning strategies focused on the system's driving forces. Thus, by utilizing the Cross-Impact Matrix in correlation with the developed scenarios, it is possible to formulate strategies and even action plans. Some of these events are a source of significant concern because they are negative, influential, and part of the realistic scenario. Therefore, the following actions are proposed to address them within the specified period:

➢ **Reduction in Water Flow Available on Rural Properties (1)**

- Development of more efficient products that require minimal water flow to operate;
- Strong entry into the solar pumping segment, expanding the product range;
- Exploration of new markets unrelated to rural areas to reduce dependency on this sector.

➢ **Change in National Government for the Coming Years (2)**

- Prepare by controlling expenses and investments to weather a potential recession in the agribusiness market;
- Exploration of new markets unrelated to rural areas to reduce dependency on this sector;
- Invest time in seeking strong partnerships.

➢ **Expansion of the Solar Energy Market (8)**

- Strong entry into the solar pumping segment, expanding the product range;
- Seek partnerships in the sector to facilitate direct importation of related products;
- Pursue incentives for the development of new products related to this field.

➢ **Reduction in Local Skilled Labor (13)**

- Invest in internal training and value the current workforce.
- Contribute to and encourage educational institutions to offer courses directly related to the sector.
- Seek partnerships with recruitment companies, keeping positions preemptively open for areas of interest to the company.

Thus, it is evident that the construction of future scenarios, as proposed by Blanning and Reinig (1998), provided a rigorous methodology with clearly defined steps. This approach enables the company's strategic planning to be developed in a solid and effective manner, establishing a consistent foundation for decision-making.

In this context, actions aimed at addressing the negative driving forces mentioned earlier are crucial for the success of strategic planning. It is essential for the team to focus its efforts primarily on the driving forces present in the realistic scenario, ensuring that the strategies adopted are aligned with the identified challenges and opportunities.

6 Final Considerations

The global focus is on sustainable development, based on the Sustainable Development Goals (SDGs) proposed by the United Nations (UN) in the 2030 Agenda. These goals aim to eradicate poverty, protect the environment and climate, and ensure that people worldwide can enjoy peace and prosperity. The use of future scenario prospecting as an auxiliary tool for strategic planning can contribute to achieving these objectives.

In the case study of the metallurgical industry, scenario prospecting is directly linked to SDG 8 - Decent Work and Economic Growth and SDG 9 - Industry, Innovation, and Infrastructure. Additionally, the company's products are directly connected to other SDGs, as highlighted in section 3 (ODSBrasil, 2022).

As demonstrated in the methodology and theoretical framework of this article, the tool of future scenario prospecting is highly valuable for any institution. Its use is not intended to predict the future but rather to prepare for the various probabilities of future events that may occur. A visionary company that seeks success and values its continuity must analyze, plan, and prepare for the future, whether it is desirable or not.

Due to the uncertainties and trend disruptions that characterize the business environment, companies that do not utilize such planning may face difficulties in remaining stable and healthy in today's world. For this reason, it can be affirmed that the application of prospective scenarios is crucial for a company's future and even present success.

Thus, it is concluded that the methodology proposed by Blanning and Reinig (1998), through the Delphi Method combined with the Cross-Impact Method, as demonstrated, are straightforward methods to apply and can yield insightful results. The analysis of the prospective scenarios designed for the metallurgical company studied will allow its managers time to organize the company at all levels.

It was observed that a range of scenarios was developed, which, if well-analyzed and utilized by the company, will contribute to its success in both the near and distant future. This will allow the adoption of actions, in addition to those presented here, in line with the expectations identified, whether favorable or unfavorable to the company.

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