

Original Article

## Assessment of business resilience abilities: the case of industry and commerce of Santa Maria – RS

Avaliação das habilidades de resiliência empresarial: o caso da indústria e comércio de Santa Maria - RS

Matheus Pedroso Valau Soares<sup>1</sup>, Marlon Soliman<sup>1</sup>

<sup>1</sup> Universidade Federal de Santa Maria, Santa Maria, RS, Brazil

### ABSTRACT

**Purpose:** This research aimed to evaluate the potential for resilient performance in the face of crises and adversities for companies located in the city of Santa Maria – RS (Brazil).

**Design/methodology/approach:** We adopted a quantitative approach. The research was carried out through five sequential steps: (i) construction and validation of the research instrument; (ii) definition of the sample size and sampling procedures; (iii) data collection; (iv) data analysis and interpretation of results; and (v) elaboration of recommendations. A research instrument containing 44 questions was built and distributed among potential respondents, obtaining 87 valid answers, which corresponds to a statistically representative sample for the parameters adopted.

**Findings:** Our sample was divided into two subsets, representing the Industrial and Commerce sectors. Resilience assessment accounted for four dimensions: the ability to respond, to anticipate, to monitor, and to learn. Results for both sectors showed scores ranging from 3.4 to 3.7 (out of 5) in the four dimensions evaluated. This reveals both sectors have been developing practices that positively contribute to the improvement of resilience, although there are opportunities for improvement.

**Originality/value:** This research sheds light on the resilience ability of the cases surveyed, enabling managers to take action to strengthen their organizations and overcome crises and adversities. Additionally, our findings demonstrate how resilience abilities can be assessed, considering the scope of an economic sector and a geographical area. This approach can be adopted by researchers, policymakers, and development agencies to assess the resilience abilities of firms within their sphere of influence.

**Keywords:** Organizational resilience; Industry; Commerce; Crisis; Adversities

### RESUMO

**Objetivo:** Esta pesquisa teve como objetivo avaliar o potencial de desempenho resiliente diante de crises e adversidades para empresas localizadas na cidade de Santa Maria – RS (Brasil).

**Design/metodologia/abordagem:** A abordagem quantitativa foi adotada. A pesquisa foi realizada em cinco etapas sequenciais, a saber: (i) construção e validação do instrumento de pesquisa; (ii) definição do tamanho da amostra e procedimentos de amostragem; (iii) coleta de dados; (iv) análise de dados e interpretação dos resultados; e (v) elaboração de recomendações. Um instrumento de pesquisa contendo 44 perguntas foi elaborado e distribuído entre potenciais respondentes, obtendo-se 87 respostas válidas, o que corresponde a uma amostra estatisticamente representativa para os parâmetros adotados.

**Resultados:** A amostra foi dividida em dois subconjuntos, representando os setores Industrial e de Comércio. A avaliação de resiliência considerou quatro dimensões: habilidade de responder, antecipar, monitorar e aprender. Os resultados para ambos os setores mostraram pontuações variando de 3,4 a 3,7 (escala de 5 pontos) nas quatro dimensões avaliadas. Isso revela que ambos os setores têm desenvolvido práticas que contribuem positivamente para o aprimoramento da resiliência, embora haja oportunidades para melhorias.

**Originalidade/valor:** Esta pesquisa lança luz sobre a capacidade de resiliência dos casos estudados, permitindo que os gestores atuem para fortalecer suas organizações para superar crises e adversidades. Além disso, nossos resultados demonstram como as habilidades de resiliência podem ser avaliadas considerando o escopo de setores econômicos e uma área geográfica, o que pode ser adotado por pesquisadores, formuladores de políticas e agências de desenvolvimento para avaliar as habilidades resilientes das empresas sob sua área de influência.

**Palavras-chave:** Resiliência organizacional; Indústria; Comércio; Crises; Adversidades

## 1 INTRODUCTION

The current business scenario has undergone several transformations over the years, where high competitiveness offers a wide range of competing products in each market. Branchi & Carrasco (2018) understand that rapid changes in business environments force everyone to assume new roles to deal with the economy, thus requiring different abilities from executives and managers. The industrial segment, for example, is under what is known as the 'fourth industrial revolution', with the advent of digital technologies such as the Internet of Things, Cloud computing, big data, and analytics (Frank et al., 2019). In the same line, retailing companies are experiencing rapid and severe changes with the advance of omnichannel business models, social media presence, mobile applications, chatbots, and virtual reality. These innovations make buying more convenient for consumers, but more complex for sellers (Souiden et al., 2019).

From this perspective, Llop et al. (2017) understand that managers and organizations cannot simply continue to do what they have always done to succeed and compete effectively. In a different and constantly changing environment, it is imperative to innovate. Floriano & Lozecky (2008) state the continuous development of companies and the increase in competitiveness require managers to know new tools that allow for implementing changes and obtaining positive results. Thus, the better an organization's abilities are developed to deal with crises and adversities, the more resilient the company will be.

Hollnagel et al. (2006) understand that resilience is the intrinsic ability of a system to adjust its functioning before, during, or after changes and disturbances so that it can sustain the necessary operations even after a serious accident or in the presence of continuous stress. Lengnick-Hall et al. (2011) go beyond and include under the concept of resilience the development of capabilities and expanded ability to follow or create new opportunities along with the restoration from adverse events, making organizations stronger and with a greater repertoire to face future challenges. The term 'resilience' has been used in the field of ecosystem analysis and management since the early 1970s with Holling (1973), who defined resilience as the persistence of interactions within a system, that is, a measure of the ability to absorb variable changes. Zhang et al. (2018) understand that resilience improves the system's ability to recover from disruptive events quickly and to deliver the desired level of performance, even if it is at a different level from the original after the interruption.

In this sense, a 'system' is understood as a set of interconnected elements that interact with each other with a common objective (Zhang et al., 2018). Thus, companies can be characterized as systems, due to the extensive and complex network of elements (i.e. people, equipment, procedures, policies, among others) that interact to achieve the desired business results. More specifically, this type of organization is classified as a 'sociotechnical system', due to the inherent characteristic of human and technological interactions that shape the business context. Woods (2015) notes that

the current sociotechnical systems have an extensive network of interdependencies (e.g. customer-supplier relationships). These interdependencies arise from the pervasive influence of technology and the growing pressures for faster, better, and cheaper performance. Assunção et al. (2020) acknowledge this drive for efficiency; however, they also recognize its side effects, including the exposure of companies to risks and unforeseen events of abrupt and sudden manifestation. Notable examples of this include the disruptions in supply chains caused by the COVID-19 pandemic in early 2020 and the grounding of the Ever Given at the Suez Canal in 2021 (Ibrahin, 2021). Therefore, it is essential to react to and prevent future adversities, ensuring that companies maintain their capacity for organizational resilience through appropriate management practices and policies.

The acknowledgment of resilience has compelled organizations to review their business process and capabilities (Bartuseviciene et al., 2022). Unavoidably, the concern about resilience also prompts the discussion of how it can be addressed and measured (Kantur & Iseri-Say, 2015; Santos & Spers, 2023). For Linnenluecke (2017), many companies will likely be unprepared for adverse events unless they explicitly approach resilience in a manageable way, being clear about how resilience is defined, described (variables), assessed, maintained, and improved. However, resilience is mainly approached conceptually in the literature, with scarce empirical evidence and limited evaluations of resilience across different business contexts (Rahi, 2019).

Thus, this research arises from the following question: to what extent are companies located in the city of Santa Maria – RS (Brazil) prepared to deal with crises and adversities? The primary objective of this study is to evaluate the potential for resilient performance in the face of crises and adversities for companies located in the city of Santa Maria – RS (Brazil). The scope of the research was delimited to contemplate only companies with their main economic activity classified under items 'C' and 'G' of the Brazilian National Register of Economic Activity (CNAE 2.0), representing 'Manufacturing Industries' and 'Commerce, repair of motor vehicles and motorcycles' (hereafter

referred to as 'Commerce', for the sake of simplification). This delimitation was due to the economic relevance of these sectors to the Gross Domestic Product (GDP) in the state of Rio Grande do Sul, as evidenced by recent results published by the Brazilian Institute of Geography and Statistics (IBGE, 2019). The geographic delimitation of the research, focusing solely on companies located in Santa Maria - RS, was motivated by the necessity to examine businesses within a relatively uniform socioeconomic context. Additionally, it was convenient for the researchers, who, being affiliated with an educational institution in the same city, maintained close relationships with these companies, thereby facilitating data collection.

The contribution of this research is twofold: first, we expect our results to serve as a starting point for the development of future studies and local development projects in collaboration with the researched (or similar companies) in the same territory. Our results provide evidence of aspects of resilience that are either underdeveloped or overdeveloped. Second, for a broader audience, our findings demonstrate how resilience abilities can be surveyed by considering the scope of an economic sector and a geographical area. We believe the methodology developed for this study can be adopted by researchers, policymakers, and development agencies to assess the resilience abilities of firms within their sphere of influence. This would enable them to formulate methods, models, and tools to enhance companies' abilities to respond to urgent situations, anticipate potential disruptions, monitor ongoing processes, and learn from both successful and failed experiences.

## **2 THEORETICAL BACKGROUND**

### **2.1 Organizational resilience**

Organizations across all economic segments are currently navigating ever-changing scenarios, presenting challenges and turbulences that demand the ability to cope with adversities. In this context, the concept of resilience emerges. Linnenluecke

& Griffiths (2010) define resilience as the capacity to absorb impact and recover. While this definition also applies to the use of the resilience concept to explain the behavior of natural systems and engineering materials, a more operational definition of resilience in the context of firms is required. Thus, the literature review conducted by Conz & Magnani (2020) screened 66 published articles, encompassing various definitions of resilience in the context of business management. As a result, the authors identified four main categories for the conceptualization of resilience: (i) resilience as a proactive attribute; (ii) resilience as absorptive and adaptive attributes; (iii) resilience as a reactive attribute; and (iv) resilience as a dynamic attribute. This classification clarifies that resilience manifests before, during, and after an adverse situation occurs.

The myriad of definitions and theories regarding organizational resilience poses challenges to research in this field, necessitating the adoption of a clear theoretical lens to address and assess resilience. For instance, the literature review conducted by Hillmann & Guenther (2021) revealed that resilience measures can be classified into four groups: (i) ecological ideas; (ii) positive psychology and organizational development; (iii) resilience engineering; and (iv) strategic management.

Therefore, in this study, we opted for a Resilience Engineering lens. Resilience Engineering (RE), as a theoretical field, is rooted in the seminal works of Hollnagel et al. (2006). The main concept of RE is that resilience can be engineered in organizations; that is, tools and methods can be designed to assess and strengthen resilience. In fact, the RE lens covers both proactive and reactive resilience (Peñaloza et al., 2020), or active and passive resilience, as it is more commonly referred to in the literature of organizational resilience (Lavarda & Leite, 2022).

The RE lens has been widely explored in literature recently, with both theoretical and practical applications in several domains, such as supply chain operations (Salehi et al., 2020), safety management (Peñaloza et al., 2020), as well as in many other sociotechnical systems (Naikar & Elix, 2021). Additionally, the main principles of RE encompass robustness, absorptive capacity, redundancy, awareness, restorative

capacity and interdependencies (Yu et al., 2020). These principles make it suitable for accounting for the abilities sociotechnical systems need to sustain their operations even under crisis and disruptions.

Under the RE lens, Woods (2015) asserts that today's sociotechnical systems exist within an extensive network due to the opportunities offered by new technologies and increasing pressures to become faster, better, and cheaper. The author defines resilience through four concepts, namely: (i) resilience as a rebound; (ii) resilience as robustness; (iii) resilience as graceful extensibility; and (iv) resilience as sustained adaptability. Resilience as rebound manifests itself when a system is able to recover from an unexpected (surprise) situation. In this type of resilience, the focus of the analysis should not be limited to the period in which the 'rebound' itself occurs. On the contrary, the primary focus should involve a detailed examination of the abilities and resources that could be mobilized to deal with the crisis. For example, the previous existence of multifunctional employees can serve as a 'rebound' if a class of workers goes on strike, thus minimizing the impact of the interruption of part of the workers on the company's operation.

Resilience as robustness, in turn, is characterized by a system's greater capacity to absorb disturbances. This type of resilience can be developed, for example, through the mapping and modeling of organizational processes and the use of structured methods for problem-solving, correction, and prevention of non-conformities. These efforts make the system increasingly robust. Another example of resilience as robustness can be observed in a scenario where a company, recognizing that the demand for a certain item has greater variability than initially expected, reformulates its inventory policy to reduce the risk of stockouts.

The concept of resilience as graceful extensibility, on the other hand, aims to understand how systems extend and adapt beyond normal operational limits to remain resilient, even considering the limitations and finitude of available resources. This concept seeks to comprehend how organizations adapt even before suffering



damage from crises and unexpected events. An example of this type of resilience is the case reported by Soliman & Saurin (2022), in which a missing spare part in a company's warehouse was urgently obtained outside working hours by an employee who had the contact of a supplier representative. Acting on his initiative, the employee sought the part using his private vehicle.

Finally, resilience as sustained adaptability refers to the company's ability to manage resources and capabilities to maintain the resilience of systems over time. To achieve this, it is necessary to challenge the system, maintaining a constant critical sense of the implicit and explicit assumptions in the design of physical and management systems. This ensures that decisions take into account the possible impacts on resilience.

Of the four types of resilience discussed, Woods (2015) highlights two implications for Resilience Engineering. The first implication is that, for scientific and engineering purposes, one needs to be explicit about which of the four senses of resilience is meant to be studied or modeled. The second implication underscores the importance of these concepts, which directly depends on how they are demonstrated and applied to the potential acquisition of data, knowledge, and new engineering techniques.

Hollnagel et al. (2012) argue that Resilience Engineering is a discipline not only concerned with what makes systems resilient or how to make them resilient but also with how to maintain or manage the resilience of a system. Thus, managing resilience can be seen as a type of control process, where the four main abilities of a resilient system are: (i) to respond; (ii) to monitor; (iii) to anticipate; and (iv) to learn.

The ability to respond is the system's capability to react to events, whether they are threats or opportunities. To respond effectively, the system must first detect that an event has occurred, and then recognize and classify the event based on its severity. Finally, the system must determine how, when, and to what extent it can respond (Anderson et al., 2020).



The ability to monitor is a system's capability to flexibly observe its performance as well as changes in the environment. Monitoring enables the system to address potential short-term threats and opportunities promptly. For monitoring to be flexible, its foundation must be evaluated and revised periodically (Furstenau et al., 2022).

While monitoring makes immediate sense, the ability to anticipate also involves looking to the more distant future. The purpose of anticipating the future is to identify possible events, conditions, or changes that could affect a system's ability to function (Provan et al., 2020).

Finally, it is indisputable that future performance can only be improved if something is learned from past performance. In this sense, the ability to learn is the resilience capacity through which the knowledge acquired, whether through successes or failures, is explored, analyzed, understood, and preserved. This process ensures that the organization becomes better prepared (i.e., resilient) to deal with crises and adversities. (Burnard & Bhamra, 2019; Hollnagel, 2017).

## **2.2 Crises, adversities, and disruptions in business management**

According to Napier et al. (2024), the changes taking place in the modern world are creating an environment of great volatility and unpredictability for companies, resulting in new levels of competition and higher expectations for executives' performance. Sheffi & Rice (2005) explain that any significant disruption has consequences on the company's performance, whether measured in sales, production levels, profits, services, or other relevant metrics. Indeed, recent crises such as the COVID-19 pandemic and natural catastrophes have highlighted the limitations of prevailing risk management approaches, which may have underestimated the rarity, impact, and complexity of unexpected events (Herrera et al., 2019).

The acknowledgment of the role played by crises, adversities, and disruptions in business scenarios is credited as the starting point for the study of resilience (Bergström et al., 2015). Roberts et al. (2007) define a crisis as an event that arises

from unknown causes with serious consequences. In the same way, Coombs (2014) asserts that a crisis is 'an unpredictable event that threatens important expectancies of stakeholders related to health, safety, environmental, and economic issues, which can seriously impact an organization's performance. Despite different perspectives, scholars and practitioners converge on the unpredictable and disruptive nature of what can be labeled as a crisis (Leta & Chan, 2021).

A similar and related term commonly used in the field of resilience is 'adversity.' Many scholars define resilience as the ability to overcome adversities; however, formal definitions of 'adversity' are not usually presented (Bullough & Renko, 2013; Galkina et al., 2023; Margolis & Stoltz, 2010). Even so, it can be inferred that there is an underlying acknowledgment of adversity as a situation or event that poses a threat or difficulty to business management.

Finally, the concept of 'disruption' frequently appears in the study of how companies bounce back from challenging situations. In the context of supply chain management, for example, disruptions are conceptualized as 'unplanned and unanticipated events that disrupt the normal flow of goods and materials within a supply chain' (Craighead et al., 2007). According to Sheffi & Rice (2005), disruptions can be classified as: (i) random, such as natural disasters or accidents; and (ii) intentional, such as terrorism or sabotage. The method for estimating the probability differs depending on the type of interruption. In the first case, the estimation of the probability of occurrence can be based on historical data, and in the case of accidents, it could also be estimated using the company's history. However, random outages, also known as adaptive threats, are more difficult to estimate the probability since, on the one hand, there is no historical data, and on the other hand, the probability of occurrence depends on the specific actions and decisions of each company.

In summary, the three concepts presented here (crisis, adversities, and disruption) can be seen as similar to the purpose of this research. All of them share the understanding of being an unexpected event that provokes a disturbance to the

regular operation of a business context. Thus, crises, adversities, and disruptions demand actions by business managers to restore the normal condition, which is known as resilience ability.

## **3 RESEARCH METHOD**

### **3.1 Methodological Approach**

This research adopted an exploratory and descriptive approach. The exploratory research aims to provide familiarity with the subject researched, while the descriptive research intends to describe the characteristics of a given population (Matias-Pereira, 2016). This is coherent with our research objective of evaluating the potential for resilient performance in the face of crises and adversities for companies located in the city of Santa Maria – RS (Brazil).

As a research strategy, we adopted a quantitative design, where descriptive statistics were used to process the data. Descriptive statistics are the part of statistics that works with organizing and presenting data. The main objective of descriptive statistics is to summarize data and provide measures that illustrate a particular dataset (Akamine & Yamamoto, 2009). The adoption of descriptive statistics is coherent with our research approach since this research does not intend to explain the underlying causes that make some organizations more resilient than others, as would be expected in explanatory research.

Given the inherent inability to investigate all companies that make up the research universe, the sampling method proved to be the most appropriate for the purposes of this study. After defining the scope of the research and calculating the sample size, we decided to use stratified probability sampling to increase the precision of the results obtained.

### 3.2 Scenario and unit of analysis

As unit of analysis, we established that respondents should answer the research instrument within the scope of the 'unit' of the company located in the geographical delimitation established as the study scenario (Santa Maria - RS). In this way, for example, the branch of a store or a unit from a multinational industrial company located within the geographical delimitation should respond considering only the reality of their 'unit,' and not of the company as a whole.

### 3.3 Research steps, data collection, and analysis

This research was carried out through five sequential steps, namely: (i) construction and validation of the research instrument; (ii) definition of the sample size and sampling procedures; (iii) data collection; (iv) data analysis and interpretation of results; and (v) elaboration of recommendations.

For step (i), the research instrument (questionnaire) was proposed by the authors based on the *Resilience Analysis Grid* (RAG) (Hollnagel et al., 2012), which is an appropriate tool for diagnosing organizational resilience. The RAG brings a series of probe questions capable of reflecting the level of adoption of practices associated with each of the four resilience abilities (i.e. to respond, to monitor, to anticipate, and to learn). The proposed instrument contains 44 objective questions. The objective questions allowed the statistical analysis of data so that the results could numerically express the situation of the companies evaluated.

The 44 questions of the research instrument were distributed into six sections. The first was dedicated to identifying the company profile and contains questions regarding the location, economic activity, size, and years of operation in the market. Sections two to five were devoted to assessing each of the four resilience abilities (i.e., to respond, anticipate, monitor, and learn). Each section comprised a series of statements and a five-point Likert scale related to the respective resilience ability. Respondents were required to mark one of the following options: (0) disagree; (1)

partially disagree; (2) neither agree nor disagree; (3) partially agree; and (4) totally agree. Finally, the sixth and last section was dedicated to identifying the respondent's profile, with questions related to their decision-making level in the organization (operational, tactical, or strategic), education level, and years of experience working in the company.

The research instrument's validation was conducted through a pre-test, which was sent to four individuals. Three of them were practitioners, sharing a profile similar to the target audience invited to respond to the survey. The fourth individual was a researcher (Doctor) with academic experience in the field. Feedback was solicited from this group regarding the time required to complete the questionnaire (whether they considered the time adequate or too long) and the clarity and understanding of the question's wording. In general, the experts indicated that the instrument was appropriate, suggesting only the inclusion of a few more examples in the question wording to enhance comprehension. Based on this feedback, the wording of the questions was revised, and additional examples were incorporated.

For step (ii) 'definition of the sample size and sampling procedures', we initially took as a basis the 'Table 6450 - Local units, total employed and salaried personnel, salaries and other remuneration by section, division, group, and class of the classification of activities (CNAE 2.0)' made available by the Brazilian Institute of Geography and Research (IBGE, 2019) to estimate the population size referring to the Manufacturing Industry ( $N_{\text{industry}} = 2,959$ ) and Commerce ( $N_{\text{commerce}} = 8,341$ ) from Santa Maria - RS. Subsequently, a stratified sampling procedure was adopted to stipulate the sample size of each stratum (Industry and Commerce).

To define the number of companies in each stratum, we carried out the following procedure: initially, we summed the populations of the Manufacturing Industry ( $N_{\text{industry}}$ ) and Commerce ( $N_{\text{commerce}}$ ) sectors ( $N_{\text{total}} = N_{\text{industry}} + N_{\text{commerce}}$ ). We then calculated the total sample size ( $n_{\text{total}}$ ) using the *STATS software*, following the method outlined by Sampieri et al. (2013). This calculation considered a confidence level of 90% and a maximum acceptable error of 10%, resulting in  $n_{\text{total}} = 68$  companies. Subsequently, the stratified

sample for the Industry sector ( $n_{\text{industry}} = 18$ ) and the Commerce sector ( $n_{\text{com}} = 50$ ) were determined using the following equations:

$$n_{\text{industry}} = \frac{N_{\text{industry}}}{N_{\text{total}}} \times n_{\text{total}} \quad (1)$$

$$n_{\text{commerce}} = \frac{N_{\text{commerce}}}{N_{\text{total}}} \times n_{\text{total}} \quad (2)$$

Where,

$n_{\text{industry}}$  = sample number for the 'Industry' stratum

$n_{\text{commerce}}$  = sample number for the 'Commerce' stratum

$n_{\text{total}}$  = total sample number

$N_{\text{industry}}$  = population size for the 'Industry' sector

$N_{\text{commerce}}$  = population size for the 'Commerce' sector

$N_{\text{total}} = N_{\text{industry}} + N_{\text{commerce}}$

Once the sample was defined, we proceeded with step (iii) 'data collection'. This step was carried out between 12/15/2021 and 02/01/2022, involving the distribution of the research instrument through the Google Forms electronic platform. Throughout this process, ethical principles and best research practices were strictly adhered to. This included measures for aggregating data, preserving the anonymity of respondents and participating companies, and ensuring the confidentiality of collected information. It's important to note that, prior to data collection, the research project underwent evaluation and received approval (CAAE 52917621.8.0000.5346) from the Ethics Committee of the institution where the researchers are affiliated.

For step (iv) 'data analysis and interpretation of results', we initially assessed the reliability of the adopted questionnaire using Cronbach's alpha test. Subsequently, descriptive statistical techniques were employed to characterize the sample and address the research objectives. In this context, radar charts were created to summarize results for each resilience ability (i.e., to respond, anticipate, monitor, and learn). The radar chart facilitated a comprehensive visualization of the mean results obtained for the dimensions assessed under each resilience ability. Additionally, a global assessment of resilience was provided.

Finally, in step (v), we presented recommendations to guide companies and organizations in prioritizing resilience dimensions and suggested strategies for improvement. These practical recommendations were derived from our research results, complemented by insights from the existing literature. They are detailed in the conclusion section, which also includes directions for future research.

## 4 RESULTS AND DISCUSSION

### 4.1 Sample characterization

After data collection, a total of 87 responses were obtained. The sample was split into 'Industry' and 'Commerce'. 20 valid responses were received for the 'Industry' stratum and 67 valid responses for the 'Commerce' stratum. It should be noted that, once the minimum sample size was achieved for the 'Industry' ( $n_{\text{industry}} = 18$ ) and 'Commerce' ( $n_{\text{com}} = 50$ ) samples, the effort of gathering new data was discontinued. This, along with the natural prevalence of more commercial companies than industries in the location, justifies the difference in the total number of responses obtained in each stratum. Nevertheless, in both cases, the minimum required number of respondents was exceeded. The additional responses gathered enabled us to increase the confidence level to 94.2% while maintaining an acceptable error rate of 10%.

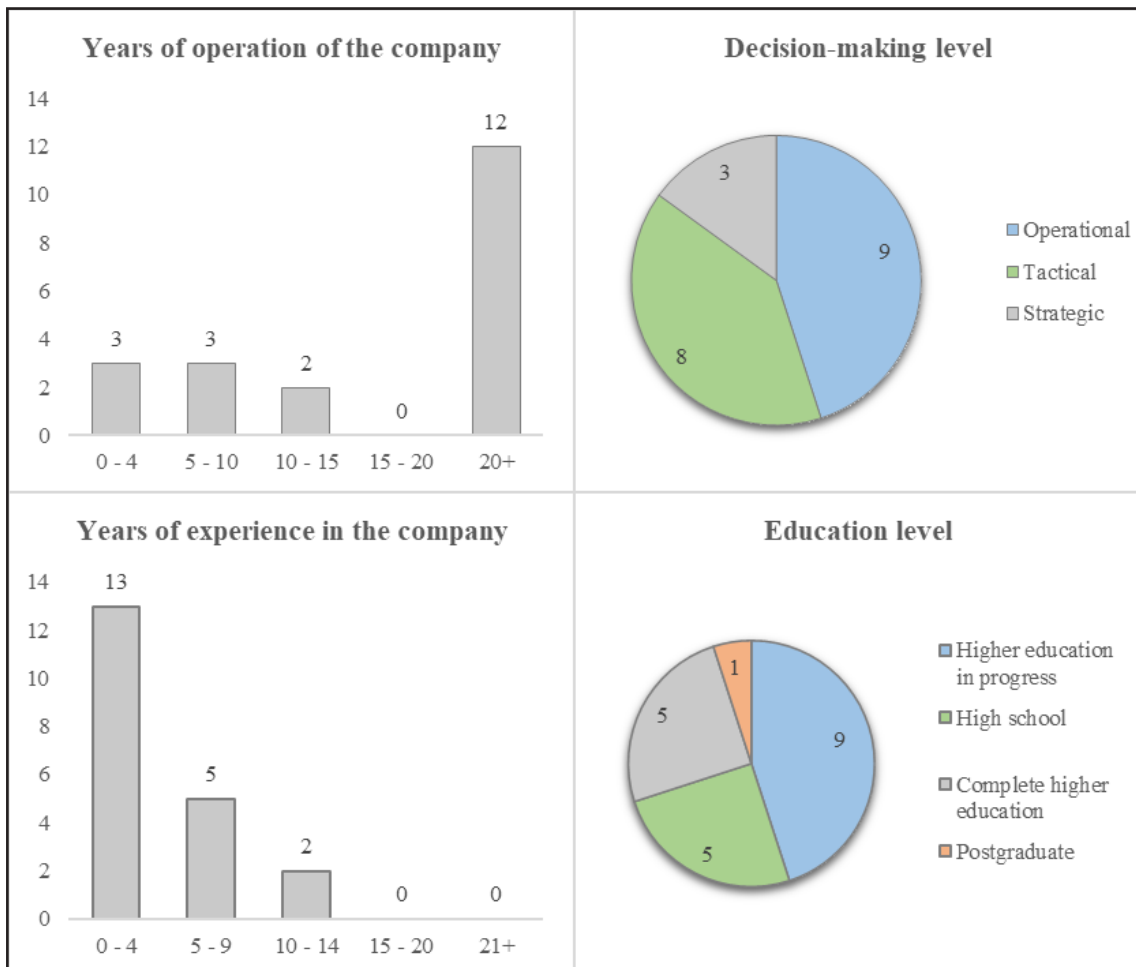
Initially, we conducted a reliability test (Cronbach's alpha) to ensure the internal consistency of the questionnaire. Data were imputed in the SPSS software, and Cronbach's alpha was found to be 0.970. This indicates the scale adopted was reliable and consistent (Hair et al., 2009).

After the reliability test, the sample profile was investigated, as shown in Figure 1 and Figure 2. As can be seen, the sample is mostly composed of recent professionals (65% for Industry; 69% for Commerce) working in well-established companies (60% of Industry companies with more than 20 years; 60% of Commerce



companies with more than 10 years). These are consolidated companies and businesses that have overcome several adversities over the years, and, therefore, they are expected to have high resilience abilities.

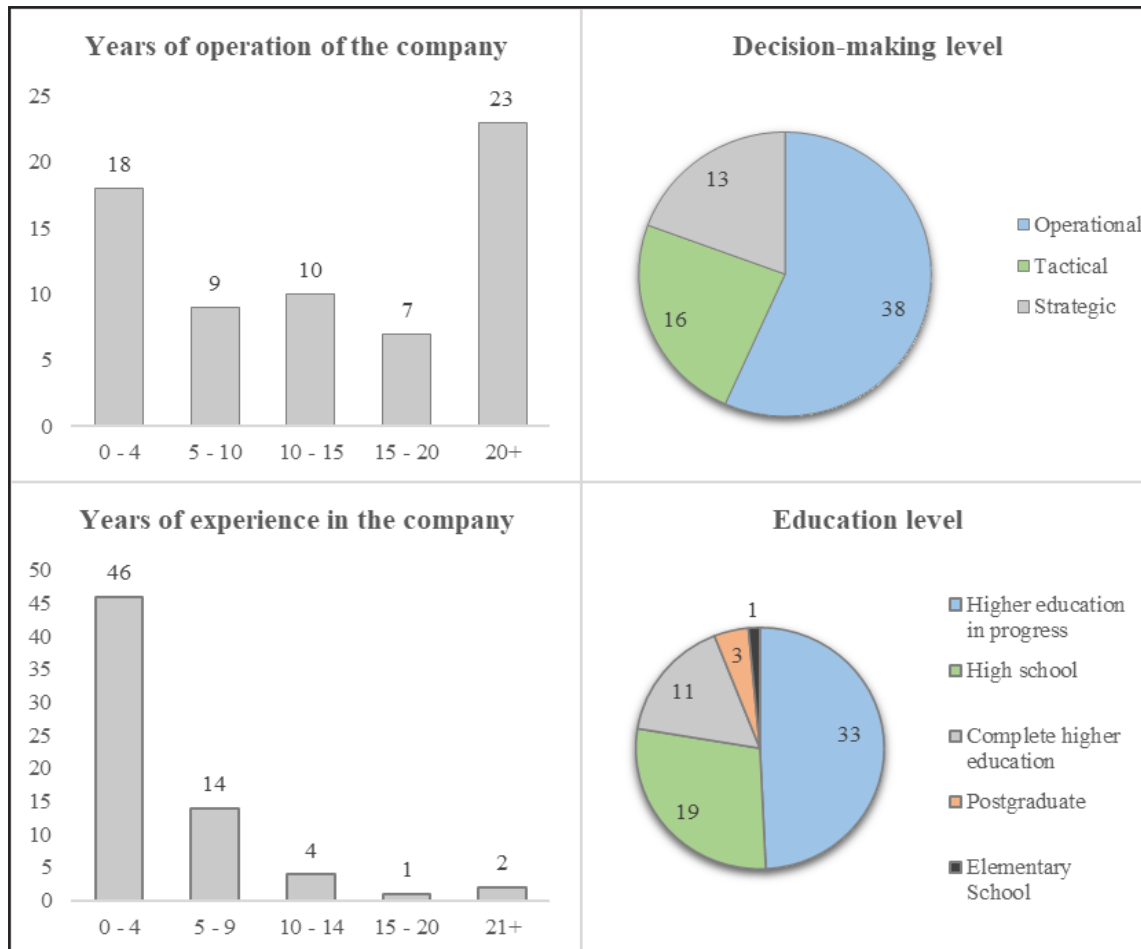
Figure 1 – Respondent profile for the 'Industry' stratum



Source: Authors (2022)

Regarding the professional background of respondents in the evaluated companies, the vast majority (68% of all respondents) had no more than four years of experience. Based on this, a potential bias is that these employees may not have experienced numerous economic cycles of crisis and resilience or a wide variety of disruptions, limiting their responses. On the other hand, younger employees tend to be critical as they bring external perspectives to the company, which can be beneficial for analyzing the actual level of resilience abilities.

Figure 2 – Respondent profile for the ‘Commerce’ stratum



Source: Authors (2022)

Regarding the decision levels occupied by respondents, our sample included individuals at the operational, tactical, and strategic levels. Naturally, there are more employees at the operational and tactical levels (82% of all respondents) than at the strategic level in companies, so it is expected that a greater volume of responses come from professionals at the operational and tactical levels.

As for the educational level, many respondents (48%) reported incomplete higher education (in progress). Indeed, at the operational level, this is a frequent and expected level of education for frontline employees. Additionally, there is a possibility that many respondents are interns at the companies, which is consistent with the predominance of respondents with little experience.

## 4.2 Results for the ability to respond

The section designed to assess the ability to 'respond' consisted of ten statements detailed in Table 1, adapted from the RAG (Hollnagel et al., 2012). A variable name was assigned to each statement.

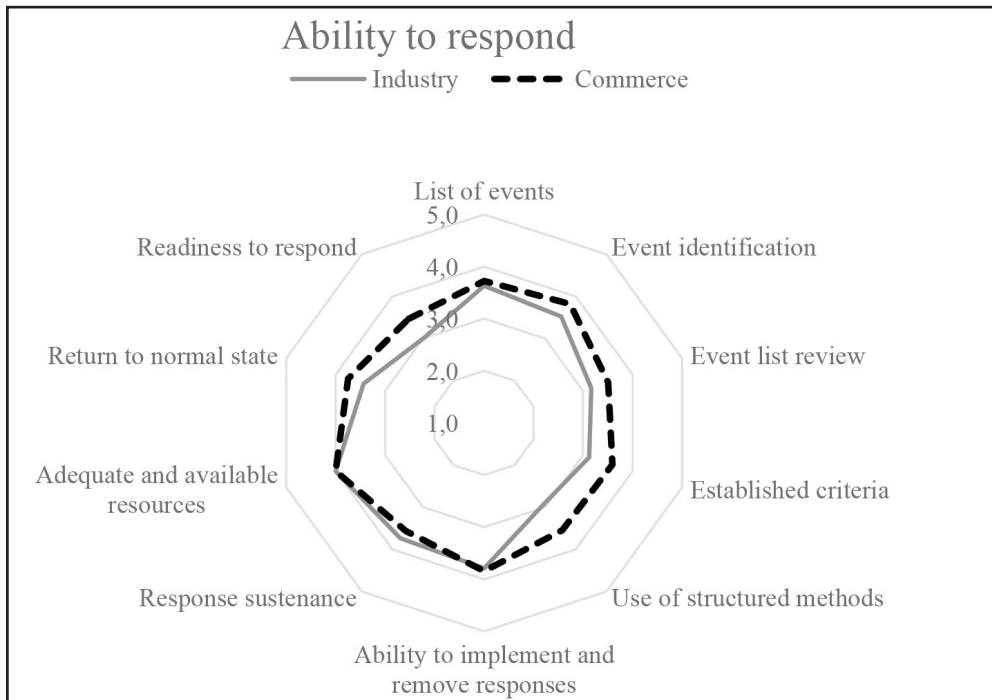
Table 1 – Variables and statements used in the questionnaire for the 'ability to respond'

Variable name	Statement used in the questionnaire
List of events	There is an appropriate list of events that the company is prepared to respond to (e.g. what to do if a delivery is delayed).
Event identification	There are clear criteria for identifying the events to which the organization must be prepared to respond.
Event list review	The list of events for which the company is prepared to respond is regularly reviewed based on pre-established guidelines.
Established criteria	There are clear criteria for triggering a response (e.g. a set value in a performance indicator).
Use of structured methods	Adequacy of event responses is determined using structured methods (e.g. models and statistics) rather than empiricism.
Ability to implement and remove responses	An effective response to adversities can be implemented quickly (e.g. temporary subcontracting of labor/services).
Response sustenance	Responses to adverse events can be sustained over a long period (e.g. an electrical generator with sufficient fuel until power is restored).
Adequate and available resources	There are adequate resources available to respond to adverse events (e.g. people, materials, experience, time).
Return to normal state	There is a clear criterion for returning to a 'normal' state after implementing a response to an adverse event (e.g. when an indicator returns to an acceptable performance, the response is demobilized).
Readiness to respond	Readiness to respond to adverse events is maintained and regularly verified (e.g. through auditing, testing, and simulations).

Source: Adapted from Hollnagel et al. (2012)

Based on the averages of the responses obtained for each statement presented to the respondents, the graph in Figure 3 was constructed, stratifying the results for the 'Industry' and 'Commerce' samples.

Figure 3 – Results for the ‘ability to respond’



Source: Authors (2022)

From Figure 3, there is a disparity in almost all dimensions when comparing the ‘Industry’ and ‘Commerce’ samples. The minimum value for ‘Industry’ was observed in the ‘Use of structured methods’ (mean = 2.9), followed by ‘Readiness to respond’ (mean = 3.0). This suggests that industrial firms surveyed may not have a strong command of technologies such as supply chain mapping, Enterprise Resource Planning (ERP) systems, or big data analytics, whose contributions to the ability to respond have already been demonstrated in previous studies (Furstenau et al., 2022; Mubarik et al., 2021; Spieske & Birkel, 2021). Additionally, firms may lack buffering and bridging capacity, which are principles for resilient performance. This may be the case when firms operate with long resupply times, maintain short inventory levels, and do not cultivate strong relationships with suppliers and other stakeholders. (Novak et al., 2021). As for ‘Commerce’, the minimum values (mean = 3.5) were found in the dimensions ‘Event list review’ and ‘Readiness to respond’. It draws attention that, for Commerce, the result for ‘Use of structured methods’ showed a mean equal to 3.6, which is 0.6 higher when

compared with the results for the Industry. One strategy that commerce firms may develop to enhance their ability to respond is through investments in new channels and processes, allowing them to scale up and alleviate demand constraints (Weber, 2021).

In summary, results for the ability to respond were higher for Commerce firms than for Industry companies in eight (out of ten) dimensions evaluated and equal in one dimension ('Adequate and available resources'). Industry companies only surpassed Commerce firms in the 'Response sustenance' dimension, although the difference was only 0.1 points.

### 4.3 Results for the ability to monitor

Table 2 presents the statements and the respective variable names used to collect data on the 'ability to monitor', which were adapted from the RAG (Hollnagel et al., 2012).

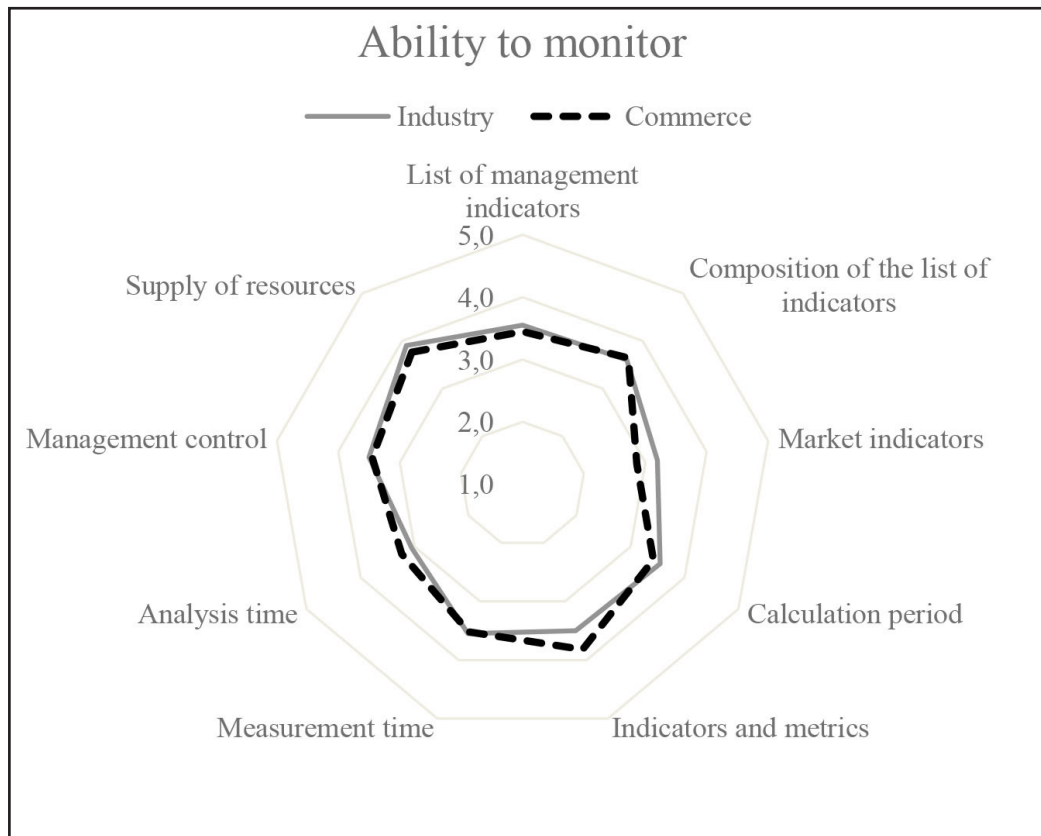
Table 2 – Variables and statements used in the questionnaire for the 'ability to monitor'

Variable name	Statement used in the questionnaire
List of management indicators	The list of management indicators used by the company is regularly reviewed based on pre-established criteria.
Composition of the list of indicators	The list of management indicators used is a mix of performance indicators (e.g. quality, productivity, efficiency) and market indicators (e.g. inflation, exchange rate, interest rates).
Market Indicators	Market indicators used are based on official sources, governmental agencies, or consulting reports.
Evaluation period	For performance indicators, the evaluation period represents a balance between precision (e.g. indicators evaluated every month) and responsiveness (e.g. indicators evaluated daily).
Indicators and metrics	An appropriate combination of quantitative and qualitative indicators is used, and the measurements are reliable.
Measurement time	Measurements take place on a regular time basis as set out in each indicator (e.g. hourly, once a day, once a week).
Analysis time	The time between measurement and analysis/interpretation and reporting of results is short (e.g. less than a week).
Management control	Measured effects (e.g. efficiency, quality, productivity, absenteeism) are kept under management control.
Supply of resources	Resources (e.g. time, personnel, equipment) are provided for performance measurements to be carried out.

Source: Adapted from Hollnagel et al. (2012)

Figure 4 presents the results for the averages of the responses obtained for each statement in Table 2.

Figure 4 – Results for the ‘ability to monitor’



Source: Authors (2022)

From Figure 4, it can be seen that the ability to monitor is primarily developed in the ‘Supply of Resources’ dimension for Industry (mean = 3.9). Similarly, for Commerce, the ‘Supply of Resources’ dimension is also the most developed (mean = 3.8). In fact, the accelerated digital transformation triggered by the COVID-19 pandemic may have increased the supply of resources for monitoring operations (Nkomo & Kalisz, 2023). Dimensions such as ‘Analysis Time’ and ‘Market Indicators’ showed inferior performance in both the Industry and Commerce samples and, therefore, managerial attention must be given to them.

According to Marcazzan et al. (2022), the ability to monitor includes the

discipline of looking forward to opportunities and potential sources of crises, recognizing threats and consequences in advance. Internal or external crises rarely appear without warning signals; however, detecting these signals is not easy due to the increasing amount of information and interdependencies in organizational systems (Tasic et al., 2020). In this sense, adverse and critical events may start with small disturbances in normal activities. Thus, firms must develop a 'state of alert' to identify potential disruptions. For our researched companies, the partially satisfactory results (average of 3.5) may come from well-established managerial practices, such as a balanced set of leading and lagging indicators (Andersen, 2007). In fact, non-financial key performance indicators (KPIs) such as the quality of delivered goods, consumer satisfaction, capacity utilization, supplier delivery efficiency, stock level, and other well-established KPIs in companies may serve as relevant sources for monitoring and identifying early signs of vulnerabilities (Werner et al., 2021). Nevertheless, there is potential for improvement in resilience by explicitly linking what is measured and how this contributes to the creation of the 'state of alert,' as mentioned before.

In general, the 'Industry' sample showed an advantage in six (out of nine) dimensions, being surpassed by 'Commerce' only in the 'Composition of the list of indicators,' 'Indicators and metrics,' and 'Analysis time' dimensions. The higher performance of the 'Industry' sample in the 'Market indicators' dimension may be an outcome of a management practice more aware of market and macroeconomic oscillations.

#### **4.4 Results for the ability to anticipate**

Table 3 presents the statements and the respective variable names used for data collection in the 'ability to anticipate', adapted from the RAG (Hollnagel et al., 2012).



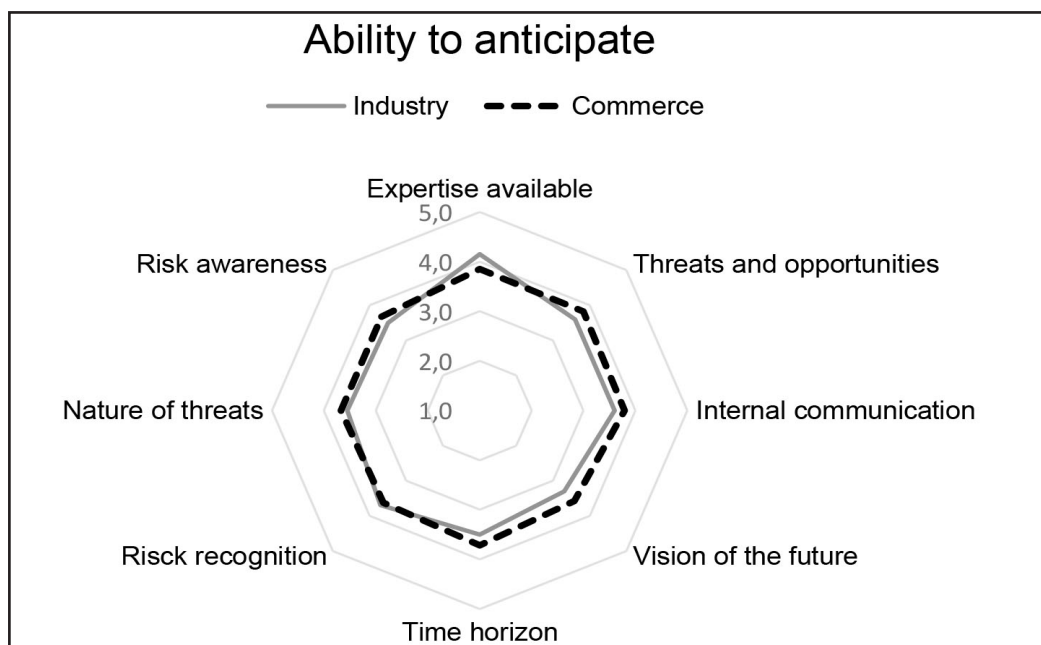
Table 3 – Variables and statements used in the questionnaire for the ‘ability to anticipate’

Variable name	Statement used in the questionnaire
Expertise available	There is expertise available (internal or external) to predict future situations (e.g. changes in market conditions).
Threats and opportunities	Threats and opportunities are evaluated on a quarterly frequency or less.
Internal communication	Expectations about future events (e.g. forecasting delays) are well communicated and shared within the organization.
Vision of the future	There is a clear vision of how the future will be shaped (e.g. forecast of recession or market expansion)
Time horizon	Business processes have an adequate planning time horizon (e.g. corporate strategy in years; commercial in months, production in weeks.)
Risk acknowledgment	There is an explicit acknowledgment of acceptable and unacceptable risks that have the potential to impact business.
Nature of threats	The nature of future threats and opportunities (what they are and how they develop) is known (e.g. legal, tax, exchange rates, and other market threats/ opportunities).
Risk awareness	Risk awareness is part of the organizational culture (e.g. decisions are made based on assessments of the risk involved).

Source: Adapted from Hollnagel et al. (2012)

Results for the averages obtained for each statement in Table 3 are shown in Figure 5.

Figure 5 – Results for the ‘ability to anticipate’



Source: Authors (2022)

Results depicted in Figure 5 show that the ability to anticipate situations is evenly developed in both the 'Industry' and 'Commerce' samples. The minimum values were found in the dimensions 'Vision on the future' (mean = 3.3 for 'Industry' and mean = 3.6 for 'Commerce'). The Commerce sector also presented a mean of 3.6 for the 'Risk acknowledgment' dimension. This should be a point of concern, as in the integrated model of organizational resilience proposed by Andersson et al. (2019), risk awareness is the foundational principle for resilience.

For the 'Industry' sample, it stands out in performance on the 'Expertise available' dimension, with an average of 4.2 points, representing the highest score for all dimensions in all evaluated resilience abilities in this study. This suggests that the industry sector invests in and values the development of internal capabilities or contracts consulting services that aid in forecasting future scenarios. This is consistent with the higher performance of the 'Industry' sample in the 'Market indicators' dimension, as previously seen in the results section for the 'ability to monitor'.

The availability of experts in organizations is highly contributive to resilience. Ali et al. (2023) argue that business continuity requires highly skilled and experienced top management to carry out organizational functions. However, resilience is multilayered within organizations, and thus, expertise does not necessarily come solely from top management. (Napier et al., 2024). This is the case when employees interact with each other to solve problems or disruptions, forming a network of social interactions. When this happens, the role of experts emerges as nodal points in the network (Bertoni et al., 2022). In fact, communication webs between groups are a resource for group cohesion that leads to agile, flexible, and responsive organizations (Morales et al., 2019). It is possible that, in our surveyed sample, a similar phenomenon occurs, which may underlie the highest scores for the dimension 'Expertise available'.

Although our results showed reasonable levels of development for both Industry and Commerce firms, they could still benefit from long- and short-term strategies to increase resilience through anticipation. This should include regionalization of sourcing,

supply chain collaboration, digital transformation, integrated risk management, and corporate social responsibility (Belhadi et al., 2021). In fact, supply chain integration (e.g., predictions made with suppliers and customers) has been proven to have positive effects on organizational resilience (Lin & Fan, 2024).

#### 4.5 Results for the ability to learn

For the analysis of the last resilience ability, the variables used, and the respective statements presented in the questionnaire are shown in Table 4, which were adapted from the RAG (Hollnagel et al., 2012).

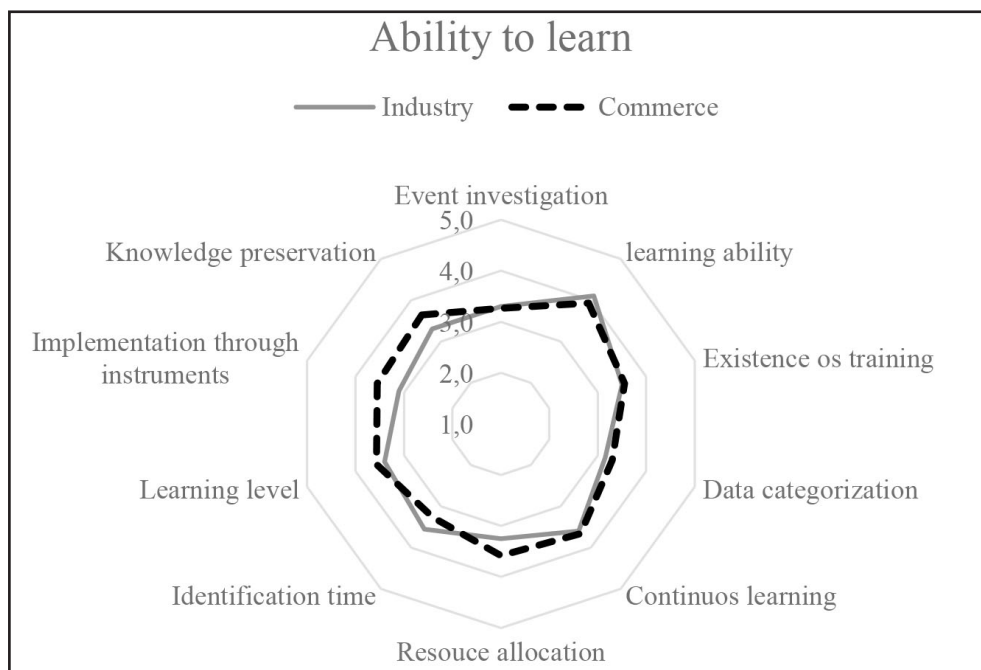
Table 4 – Variables and statements used in the questionnaire for the ‘ability to learn’

Variable name	Statement used in the questionnaire
Event investigation	There is a clear guideline for deciding which adverse events will be investigated in depth (e.g. adverse events with an impact on safety and quality must be investigated in depth).
Learning ability	The organization tries to learn from both the common (successes and things that go right) and the rare (failures and things that go wrong).
Existence of training	There is formal training and organizational support for data collection, analysis, and learning.
Data categorization	The data collected by the organization are categorized (e.g. priorities, severity, frequency, potential harm).
Continuous learning	Learning is a continuous activity, regardless of the occurrence of adverse events.
Resource allocation	Adequate resources are allocated for the investigation/analysis of adverse events, and the learning outcomes are disseminated throughout the organization.
Identification time	The time between identifying an adverse event, analyzing it, and learning from it is short.
Learning level	Learning from adverse events occurs at three levels: individual, collective and organizational.
Implementation through instruments	Lessons learned from adverse events are fully implemented through formal instruments (e.g. regulations, procedures, standards, training, instructions, redesign, reorganization).
Knowledge preservation	There are ways to preserve knowledge of what has been learned.

Source: Adapted from Hollnagel et al. (2012)

In Figure 6, the results for the averages of the answers obtained for each statement in the questionnaire are presented.

Figure 6 – Results for the ‘ability to learn’



Source: Authors (2022)

It can be seen from Figure 6 a higher performance for the Commerce sector in seven (out of ten) dimensions, with a highlight on ‘Implementation through instruments,’ where the difference from the Industry sector surpasses 0.5 points. However, the Industry showed a superior score for the ‘Identification time’ dimension, suggesting that these companies may be able to communicate and actuate fast over adverse situations. In fact, this aligns with common industrial practices, such as *Andon* systems and *Poka-Yoke* (Ciano et al., 2021). On the other hand, the Commerce sector seemed to have more adequate and available resources to develop the learning ability.

The contribution of learning to the development of resilience has been explored in the literature. Do et al. (2022) empirically demonstrated that organizational learning mediates the relationship between resource-based management initiatives and organizational resilience. Morales et al. (2019) state that continuous technical training

is a requirement to build a capable and competent workforce to address unexpected events. In this sense, learning can be developed through drills or simulated disruptions. These exercises allow organizations to assess the effectiveness of their practices in overcoming crises and adversities and gather lessons from the experience (Ali et al., 2023).

The role played by learning in the development of resilience has been empirically studied by Mao et al. (2023). The authors investigated the contribution of slack to organizational resilience and the moderating effect of exploitative learning in this relationship. The conclusion is that slack does promote organizational resilience; however, learning may increase or reduce the impact of slack on organizational resilience depending on the nature of the slack resource.

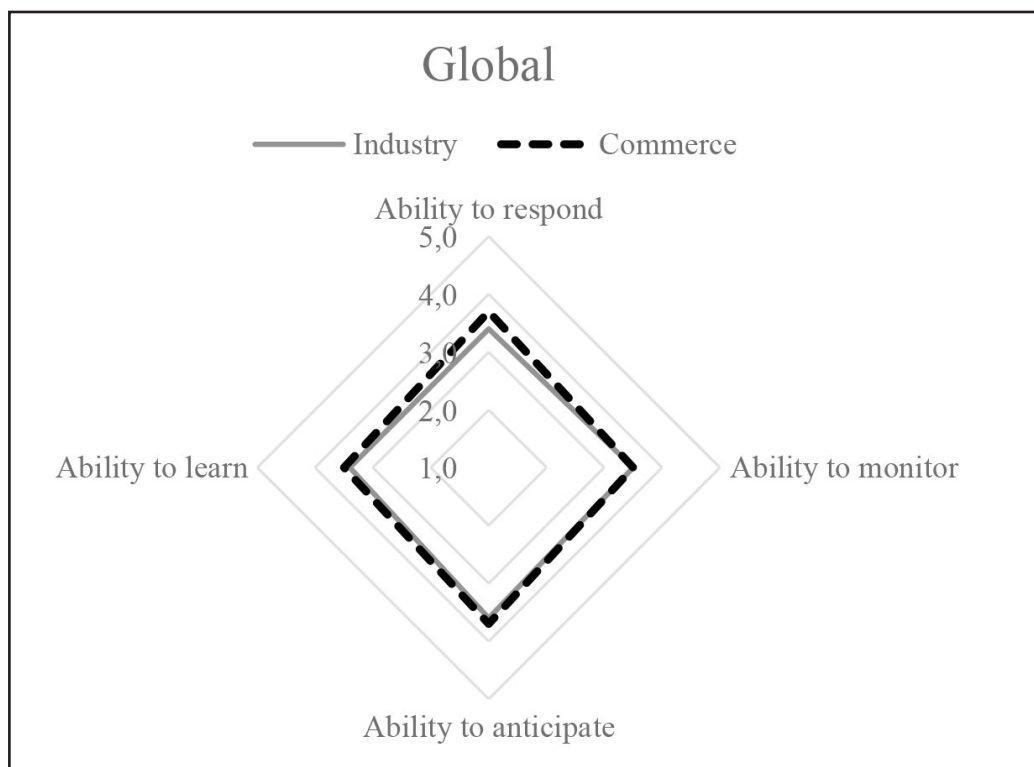
From this, a managerial message can be drawn for our surveyed companies: the allocation and availability of resources (e.g., capital, inventory, employees, and others), by itself, is not sufficient to improve resilience performance. It must address the role played by learning from both successes and failures to enhance resilience. Therefore, although results for the surveyed companies indicate satisfactory levels of learning ability (3.9 for Commerce, 4.1 for Industry), this potential could be further enhanced by adopting formal procedures to process learning and implement its outcomes.

#### **4.6 Global assessment of resilience abilities**

In this section, the development level of each resilience ability was assessed globally for both Industry and Commerce. The global result was calculated from the average of the means obtained for the dimensions belonging to each ability. The result of this global assessment is shown in Figure 7.

From Figure 7, we observed that the investigated companies from both sectors showed medium resilience abilities, ranging from 3.4 to 3.7. No relevant difference could be found between the scores for the Industry and Commerce strata. This result suggests that both sectors have opportunities to further develop their resilience abilities in all evaluated dimensions to be prepared to overcome crises and adversities in the future.

Figure 7 – Global results for the abilities of resilience



Source: Authors (2022)

To our advantage, the development of resilience abilities can be stimulated and improved. Business continuity management practices, such as risk assessments, recovery planning, incident response planning, testing and exercises, and communication and training programs, are examples of what companies can implement to enhance both proactive and reactive resilience, leading to sustained organizational performance (Ali et al., 2023). Additionally, researchers have found that resilience does not always require profound transformation, such as a business model shift, but rather resilience can be achieved by design (Grego et al., 2024). For the Industry and Commerce firms researched, this implies they can improve resilience abilities by maturing their business and operations rather than relying on radical measures when facing crises and adversities. Nonetheless, bouncing back from crises and adversities depends, to a great extent, on leaders capable of motivating and inspiring people (Morales et al., 2019).

## 5 CONCLUSION

This research aimed to evaluate the potential for resilient performance in the face of crises and adversities for companies located in the city of Santa Maria – RS (Brazil). Results from the analyzed sample suggest that both the Industry and Commerce sectors have been developing practices that positively contribute to the improvement of resilience abilities. In fact, the Industry sector stands out in the dimensions ‘Expertise available’ (in ‘Ability to Anticipate’) and ‘Learning Ability’ (in ‘Ability to Learn’), with averages of 4.2 and 4.1, respectively. This suggests that these companies have been developing internal and/or external resources to aid in the decision-making process, and they are prone to learning from both success and failure. On the other hand, the Industry sample presented a mean score of 2.9 in the dimension ‘Use of Structured Methods’ (in ‘Ability to Respond’). This suggests that most responses come from informal resilience, that is, the ability of a system to develop resilience through the emergent outcome of non-designed interactions (Gayer et al., 2022). Although informal resilience may perform well as a first-order response, in the long term, the adoption of structured methods is advised.

For the Commerce sample, it stands out in the dimensions ‘Adequate and Available Resources’ (in ‘Ability to Respond’), with an average of 4.0 points, and ‘Learning Ability’ (in ‘Ability to Learn’), with a score of 3.9 points. This suggests that the Commerce sector, although the nature of its operation is completely different from the industrial shop floor, shares some important features with the industry regarding the availability of resources able to respond to adverse events and promote resilience through learning and reflection. On the other hand, the Commerce sector needs to improve the adoption of market indicators to base strategic decisions. In this sense, monitoring sectorial and macroeconomic indicators (e.g., sales, market size, exports, inflation, employment, exchange rates) is advised.



This research has implications for both academics and practitioners. In the field of administration, this study demonstrated how resilience can be measured and assessed across different sectors. Additionally, this research can be considered an advancement in the development of the Organizational Resilience field, as early research reported the lack of quantitative studies and scarce empirical evidence on resilience measures as a gap to be filled (Kantur & Iseri-Say, 2015; Rahi, 2019; Santos & Spers, 2023). For practical applications, the procedures applied in our study resulted in a clear and objective diagnosis of the resilience of firms located in a specific geographic area. In fact, this study contributes by allowing organizations to evaluate how resilience is maintained over time, enabling them to be prepared to deal with crises and adversities. We believe these results can be used by managers, researchers, policymakers, and development agencies to propose effective measures to improve the resilience of the assessed firms, based on what firms most need at a given time.

The insights that emerged from the results, however, need to be examined under the limitations of this study. A relevant limitation is that we evaluated no more than 87 companies. Although this sample size was considered adequate for the research purpose, the estimate for the universe researched surpasses 11,000 companies within our geographical delimitation. Thus, additional perspectives were not assessed. Moreover, our data represents the respondents' perception at that specific moment when data was collected and, therefore, it may not reflect the actual situation in another period.

Finally, there is an opportunity for future studies to apply the Resilience Analysis Grid (RAG) (Hollnagel et al., 2012) in sectors different from those investigated by this research. Additionally, a quantitative explanatory research design that investigates the relationship between managerial practices and their impacts on resilience performance would be welcome. The quantitative approach could also be complemented by a qualitative approach, such as case studies, that could shed light on how resilient performance is achieved. In-depth interviews would be highly valuable, as they could

provide cues to understanding which factors or practices directly contribute to the resilient performance assessed using the RAG. Moreover, there is an opportunity to develop dashboards for monitoring indicators related to organizational resilience, both at the company, sectoral, or territorial levels. Dashboards for this purpose could assist companies in rapidly identifying and acting on decays in the performance of resilience abilities, thus improving their capabilities to overcome crises and adversities.

## ACKNOWLEDGEMENT

The authors acknowledge the Federal University of Santa Maria (UFSM) for the financial support and incentives received under the Research Assistance Program for Recent Doctors (FIPE – Júnior/UFSM).

## REFERENCES

- Akamine, C. T., & Yamamoto, R. K. (2009). *Estudo dirigido: Estatística descritiva* (3rd ed.). Editora Érica.
- Ali, Q. S. A., Hanafiah, M. H., & Mogindol, S. H. (2023). Systematic literature review of Business Continuity Management (BCM) practices: Integrating organisational resilience and performance in Small and medium enterprises (SMEs) BCM framework. *International Journal of Disaster Risk Reduction*, 99, 104135. <https://doi.org/10.1016/j.ijdrr.2023.104135>
- Andersen, B. (2007). *Business Process Improvement Toolbox* (2nd ed.). ASQ Quality Press.
- Anderson, J. E., Ross, A. J., Macrae, C., & Wiig, S. (2020). Defining adaptive capacity in healthcare: A new framework for researching resilient performance. *Applied Ergonomics*, 87. <https://doi.org/10.1016/j.apergo.2020.103111>
- Andersson, T., Cäker, M., Tengblad, S., & Wickelgren, M. (2019). Building traits for organizational resilience through balancing organizational structures. *Scandinavian Journal of Management*, 35(1), 36–45. <https://doi.org/10.1016/j.scaman.2019.01.001>
- Assunção, M. V. D. de, Medeiros, M., Moreira, L. N. R., Paiva, I. V. L., & Paes, D. C. A. de S. (2020). Resilience of the Brazilian supply chains due to the impacts of Covid-19. *HOLOS*, 5, 1–20. <https://doi.org/10.15628/holos.2020.10802>
- Bartuseviciene, I., Butkus, M., & Schiuma, G. (2022). Modelling organizational resilience structure: insights to assess resilience integrating bounce-back and bounce-forward. *European Journal of Innovation Management*, 27(1), 153–169. <https://doi.org/10.1108/EJIM-04-2022-0180>

- Belhadi, A., Kamble, S., Jabbour, C. J. C., Gunasekaran, A., Ndubisi, N. O., & Venkatesh, M. (2021). Manufacturing and service supply chain resilience to the COVID-19 outbreak: Lessons learned from the automobile and airline industries. *Technological Forecasting and Social Change*, 163. <https://doi.org/10.1016/j.techfore.2020.120447>
- Bergström, J., Van Winsen, R., & Henriqson, E. (2015). On the rationale of resilience in the domain of safety: A literature review. *Reliability Engineering and System Safety*, 141, 131–141. <https://doi.org/10.1016/j.ress.2015.03.008>
- Bertoni, V. B., Saurin, T. A., & Fogliatto, F. S. (2022). How to identify key players that contribute to resilient performance: A social network analysis perspective. *Safety Science*, 148. <https://doi.org/10.1016/j.ssci.2021.105648>
- Branchi, T. M., & Carrasco, C. da S. (2018). A influência do mundo vuca na contabilidade e nos modelos de negócios no Brasil / The influence of the vuca world in the accounting and in the models of necessities in Brazil. *Brazilian Journal of Development*, 5(1), 309–322. <https://doi.org/10.34117/bjdv5n1-919>
- Bullough, A., & Renko, M. (2013). Entrepreneurial resilience during challenging times. *Business Horizons*, 56(3), 343–350. <https://doi.org/10.1016/j.bushor.2013.01.001>
- Burnard, K. J., & Bhamra, R. (2019). Challenges for organisational resilience. *Continuity & Resilience Review*, 1(1), 17–25. <https://doi.org/10.1108/crr-01-2019-0008>
- Ciano, M. P., Dallasega, P., Orzes, G., & Rossi, T. (2021). One-to-one relationships between Industry 4.0 technologies and Lean Production techniques: a multiple case study. *International Journal of Production Research*, 59(5), 1386–1410. <https://doi.org/10.1080/00207543.2020.1821119>
- Conz, E., & Magnani, G. (2020). A dynamic perspective on the resilience of firms: A systematic literature review and a framework for future research. *European Management Journal*, 38(3), 400–412. <https://doi.org/10.1016/j.emj.2019.12.004>
- Coombs, W. T. (2014). *Ongoing Crisis Communication: Planning, Managing, and Responding* (4th ed.). Sage Publications.
- Craighead, C. W., Blackhurst, J., Rungtusanatham, M. J., & Handfield, R. B. (2007). The Severity of Supply Chain Disruptions: Design Characteristics and Mitigation Capabilities. *Decision Sciences*, 38(1), 131–156. <https://doi.org/10.1111/j.1540-5915.2007.00151.x>
- Do, H., Budhwar, P., Shipton, H., Nguyen, H. D., & Nguyen, B. (2022). Building organizational resilience, innovation through resource-based management initiatives, organizational learning and environmental dynamism. *Journal of Business Research*, 141, 808–821. <https://doi.org/10.1016/j.jbusres.2021.11.090>
- Floriano, J. C., & Lozecky, J. (2008). A Importância dos Instrumentos de Controle Interno para Gestão Empresarial. *UNICENTRO - Revista Eletrônica Lato Sensu*, 5(1), 1–8.

- Frank, A. G., Dalenogare, L. S., & Ayala, N. F. (2019). Industry 4.0 technologies: Implementation patterns in manufacturing companies. *International Journal of Production Economics*, 210, 15–26. <https://doi.org/10.1016/j.ijpe.2019.01.004>
- Furstenau, L. B., Zani, C., Terra, S. X., Sott, M. K., Choo, K. K. R., & Saurin, T. A. (2022). Resilience capabilities of healthcare supply chain and supportive digital technologies. *Technology in Society*, 71. <https://doi.org/10.1016/j.techsoc.2022.102095>
- Galkina, T., Atkova, I., & Gabrielsson, P. (2023). Business modeling under adversity: Resilience in international firms. *Strategic Entrepreneurship Journal*, 17(4), 802–829. <https://doi.org/10.1002/sej.1474>
- Gayer, B. D., Saurin, T. A., & Anzanello, M. (2022). The nature and role of informal resilience practices in the performance of lean production systems. *Journal of Manufacturing Technology Management*, 33(6), 1080–1101. <https://doi.org/10.1108/JMTM-12-2021-0489>
- Grego, M., Magnani, G., & Denicolai, S. (2024). Transform to adapt or resilient by design? How organizations can foster resilience through business model transformation. *Journal of Business Research*, 171. <https://doi.org/10.1016/j.jbusres.2023.114359>
- Hair, J., Anderson, R., & Babin, B. (2009). *Multivariate Data Analysis* (7th ed.). Prentice Hall.
- Herrera, I., Branlat, M., Grøtan, O., Save, L., Ruscio, D., Woltjer, R., Hermelin, J., Trnka, J., Feuerle, T., Förster, P., Cohen, O., Cafiero, L., Cedrini, V., Mancini, M., Ferrara, G., Mandarino, G., Rosi, L., Johnson, C. O., Morin, E., ... Costello, M. (2019). *Resilience Management Guidelines for Critical Infrastructures, Practical Solutions Addressing Expected and Unexpected Events*.
- Hillmann, J., & Guenther, E. (2021). Organizational Resilience: A Valuable Construct for Management Research? *International Journal of Management Reviews*, 23(1), 7–44. <https://doi.org/10.1111/ijmr.12239>
- Holling, C. S. (1973). Resilience and Stability of Ecological Systems. *Annual Review of Ecology and Systematics*, 4, 1–23. <https://www.jstor.org/stable/2096802?seq=1&cid=pdf->
- Hollnagel, E. (2017). *Safety-II in Practice: Developing the Resilience Potentials*. Routledge.
- Hollnagel, E., Pariès, J., Woods, D. D., & Wreathall, J. (2012). *Resilience engineering in practice: a guidebook*. Ashgate.
- Hollnagel, E., Woods, D. D., & Leveson, N. (2006). *Resilience engineering: concepts and precepts*. Ashgate.
- IBGE. (2019). *Margem de comercialização de empresas comerciais. Rio Grande do Sul*. Brazilian Institute of Geography and Statistics. <https://ibge.gov.br/estatisticas/economicas/comercio/9075-pesquisa-anual-de-comercio.html?=&t=destaques>
- Ibrahin, E. (2021). O encalhe do Ever Given. *Revista Do Clube Naval*, 1(397), 58–61.

- Kantur, D., & Iseri-Say, A. (2015). Measuring Organizational Resilience: A Scale Development. *Journal of Business Economics and Finance*, 4(3), 456–472. <https://doi.org/10.17261/Pressacademia.2015313066>
- Lavarda, R. A. B., & Leite, F. K. (2022). Open strategizing and organizational resilience considering the environmental uncertainty. *Revista Ibero-Americana de Estratégia*, 21(Special issue), 1–25. <https://doi.org/10.5585/riae.v21i2.21447>
- Lengnick-Hall, C. A., Beck, T. E., & Lengnick-Hall, M. L. (2011). Developing a capacity for organizational resilience through strategic human resource management. *Human Resource Management Review*, 21(3), 243–255. <https://doi.org/10.1016/j.hrmr.2010.07.001>
- Leta, S. D., & Chan, I. C. C. (2021). Learn from the past and prepare for the future: A critical assessment of crisis management research in hospitality. *International Journal of Hospitality Management*, 95, 102915. <https://doi.org/https://doi.org/10.1016/j.ijhm.2021.102915>
- Lin, J., & Fan, Y. (2024). Seeking sustainable performance through organizational resilience: Examining the role of supply chain integration and digital technology usage. *Technological Forecasting and Social Change*, 198. <https://doi.org/10.1016/j.techfore.2023.123026>
- Linnenluecke, M., & Griffiths, A. (2010). Beyond adaptation: Resilience for business in light of climate change and weather extremes. *Business and Society*, 49(3), 477–511. <https://doi.org/10.1177/0007650310368814>
- Linnenluecke, M. K. (2017). Resilience in Business and Management Research: A Review of Influential Publications and a Research Agenda. *International Journal of Management Reviews*, 19(1), 4–30. <https://doi.org/10.1111/ijmr.12076>
- Llop, R., Grasas, A., Paassen, J. van, Rosés, L., & Araújo, M. S. (2017). O papel dos gestores atuais para sobreviver num ambiente VUCA. *Revista de Ciências Empresariais e Jurídicas*, 29, 7–33.
- Mao, Y., Li, P., & Li, Y. (2023). The relationship between slack resources and organizational resilience: The moderating role of dual learning. *Heliyon*, 9(3). <https://doi.org/10.1016/j.heliyon.2023.e14044>
- Marcazzan, E., Campagnolo, D., & Gianecchini, M. (2022). Reaction or anticipation? Resilience in small- and medium-sized enterprises. *Journal of Small Business and Enterprise Development*, 29(5), 764–788. <https://doi.org/10.1108/JSBED-07-2021-0271>
- Margolis, J. D., & Stoltz, P. G. (2010). How to Bounce Back from Adversity. *Harvard Business Review*, January-February. [www.hbr.org](http://www.hbr.org)
- Matias-Pereira, J. (2016). *Manual de Metodologia da Pesquisa Científica* (4th ed.). Atlas.

- Morales, S. N., Martínez, L. R., Gómez, J. A. H., López, R. R., & Torres-Argüelles, V. (2019). Predictors of organizational resilience by factorial analysis. *International Journal of Engineering Business Management*, 11. <https://doi.org/10.1177/1847979019837046>
- Mubarik, M. S., Naghavi, N., Mubarik, M., Kusi-Sarpong, S., Khan, S. A., Zaman, S. I., & Kazmi, S. H. A. (2021). Resilience and cleaner production in industry 4.0: Role of supply chain mapping and visibility. *Journal of Cleaner Production*, 292. <https://doi.org/10.1016/j.jclepro.2021.126058>
- Naikar, N., & Elix, B. (2021). Designing for self-organisation in sociotechnical systems: resilience engineering, cognitive work analysis, and the diagram of work organisation possibilities. *Cognition, Technology and Work*, 23(1), 23–37. <https://doi.org/10.1007/s10111-019-00595-y>
- Napier, E., Liu, S. Y. H., & Liu, J. (2024). Adaptive strength: Unveiling a multilevel dynamic process model for organizational resilience. *Journal of Business Research*, 171. <https://doi.org/10.1016/j.jbusres.2023.114334>
- Nkomo, L., & Kalisz, D. (2023). Establishing organisational resilience through developing a strategic framework for digital transformation. *Digital Transformation and Society*, 2(4), 403–426. <https://doi.org/10.1108/dts-11-2022-0059>
- Novak, D. C., Wu, Z., & Dooley, K. J. (2021). Whose resilience matters? Addressing issues of scale in supply chain resilience. *Journal of Business Logistics*, 42(3), 323–335. <https://doi.org/10.1111/jbl.12270>
- Peñaloza, G. A., Saurin, T. A., Formoso, C. T., & Herrera, I. A. (2020). A resilience engineering perspective of safety performance measurement systems: A systematic literature review. *Safety Science*, 130. <https://doi.org/10.1016/j.ssci.2020.104864>
- Provan, D. J., Woods, D. D., Dekker, S. W. A., & Rae, A. J. (2020). Safety II professionals: How resilience engineering can transform safety practice. *Reliability Engineering and System Safety*, 195. <https://doi.org/10.1016/j.ress.2019.106740>
- Rahi, K. (2019). Indicators to assess organizational resilience – a review of empirical literature. *International Journal of Disaster Resilience in the Built Environment*, 10(2/3), 85–98. <https://doi.org/10.1108/IJDRBE-11-2018-0046>
- Roberts, K. H., Madsen, P., & Desai, V. (2007). Organizational Sensemaking During Crisis. In C. M. Pearson, C. Roux-Dufort, & J. A. Clair (Eds.), *International Handbook of Organizational Crisis Management*. SAGE Publications.
- Salehi, V., Salehi, R., Mirzayi, M., & Akhavizadegan, F. (2020). Performance optimization of pharmaceutical supply chain by a unique resilience engineering and fuzzy mathematical framework. *Human Factors and Ergonomics in Manufacturing & Service Industries*, 30(5), 336–348. <https://doi.org/10.1002/hfm.20845>
- Sampieri, R. H., Collado, C. F., & Lucio, M. del P. B. (2013). *Metodologia de pesquisa* (5th ed.). Penso.



- Santos, A. Y. P., & Spers, R. G. (2023). Como mensurar a resiliência organizacional? Validando um modelo simplificado. *RAM. Revista de Administração Mackenzie*, 24(6), 1–33. <https://doi.org/10.1590/1678-6971/eramd230007.pt>
- Sheffi, Y., & Rice, J. B. (2005). A supply chain view of the resilient enterprise. *MIT Sloan Management Review*, 47(1).
- Soliman, M., & Saurin, T. A. (2022). Lean-as-imagined differs from lean-as-done: the influence of complexity. *Production Planning & Control*, 33(11), 1097–1114. <https://doi.org/10.1080/09537287.2020.1843729>
- Souiden, N., Ladhari, R., & Chiadmi, N. E. (2019). New trends in retailing and services. *Journal of Retailing and Consumer Services*, 50, 286–288. <https://doi.org/10.1016/j.jretconser.2018.07.023>
- Spieske, A., & Birkel, H. (2021). Improving supply chain resilience through industry 4.0: A systematic literature review under the impressions of the COVID-19 pandemic. *Computers and Industrial Engineering*, 158. <https://doi.org/10.1016/j.cie.2021.107452>
- Tasic, J., Amir, S., Tan, J., & Khader, M. (2020). A multilevel framework to enhance organizational resilience. *Journal of Risk Research*, 23(6), 713–738. <https://doi.org/10.1080/13669877.2019.1617340>
- Weber, A. N. (2021). Responding to supply chain disruptions caused by the covid-19 pandemic: A black swan event for omnichannel retailers. *Journal of Transport and Supply Chain Management*, 15, 1–16. <https://doi.org/10.4102/jtscm.v15i0.628>
- Werner, M. J. E., Yamada, A. P. L., Domingos, E. G. N., Leite, L. R., & Pereira, C. R. (2021). Exploring Organizational Resilience Through Key Performance Indicators. *Journal of Industrial and Production Engineering*, 38(1), 51–65. <https://doi.org/10.1080/21681015.2020.1839582>
- Woods, D. D. (2015). Four concepts for resilience and the implications for the future of resilience engineering. *Reliability Engineering & System Safety*, 141, 5–9. <https://doi.org/10.1016/j.ress.2015.03.018>
- Yu, D. J., Schoon, M. L., Hawes, J. K., Lee, S., Park, J., Rao, P. S. C., Siebeneck, L. K., & Ukkusuri, S. V. (2020). Toward General Principles for Resilience Engineering. *Risk Analysis*, 40(8), 1509–1537. <https://doi.org/10.1111/risa.13494>
- Zhang, X., Mahadevan, S., Sankararaman, S., & Goebel, K. (2018). Resilience-based network design under uncertainty. *Reliability Engineering & System Safety*, 169, 364–379. <https://doi.org/10.1016/j.ress.2017.09.009>

## Authors

### 1 – Matheus Pedroso Valau Soares

Institution: Federal University of Santa Maria (UFSM), Industrial Engineering course  
 Santa Maria, Rio Grande do Sul. Brazil  
 Industrial Engineering undergraduate student in the Federal University of Santa Maria (UFSM)  
 Orcid: <https://orcid.org/0009-0003-9241-8163>  
 E-mail: mpvsoares1999@gmail.com

### 2 – Marlon Soliman

Institution: Federal University of Santa Maria (UFSM), Industrial Engineering and Systems Department  
 Santa Maria, Rio Grande do Sul. Brazil  
 PhD in Production Engineering from the Federal University of Rio Grande do Sul (2018), Master in Production Engineering from the Federal University of Santa Maria (2014), and Chemical Engineer from the Federal University of Santa Maria (2013). E-mail: marlon.soliman@ufsm.br  
 Orcid: <https://orcid.org/0000-0001-8084-6716>  
 E-mail: marlon.soliman@ufsm.br

## Contribution of authors

Contribution	[Author 1]	[Author 2]
1. Definition of research problem		✓
2. Development of hypotheses or research questions (empirical studies)		✓
3. Development of theoretical propositions (theoretical work)		✓
4. Theoretical foundation / Literature review	✓	✓
5. Definition of methodological procedures	✓	✓
6. Data collection	✓	
7. Statistical analysis	✓	
8. Analysis and interpretation of data	✓	✓
9. Critical revision of the manuscript	✓	✓
10. Manuscript writing	✓	✓
11. Other (please specify)		

### **Conflict of Interest**

*The authors have stated that there is no conflict of interest.*

### **Copyrights**

*ReA/UFSM owns the copyright to this content.*

### **Plagiarism Check**

*The ReA/UFSM maintains the practice of submitting all documents approved for publication to the plagiarism check, using specific tools, e.g.: Turnitin.*

### **Edited by**

*Jordana Marques Kneipp*