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BARREIRAS PARA INOVAÇÃO E SUSTENTABILIDADE NAS PEQUENAS E MÉDIAS INDÚSTRIAS DE TRANSFORMAÇÃO DO OESTE DO PARANÁ

BARRIERS TO INNOVATION AND SUSTAINABILITY IN SMALL AND MEDIUM-SIZED MANUFACTURING INDUSTRIES IN WESTERN PARANÁ

[TRADUÇÃO INGLESA]

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Dissertation presented in partial fulfilment of the requirements for the degree of Master of Science in Administration in the Department of Administration, Western Paraná State University.
Advisor: Elizandra da Silva, Dr.

Dissertação apresentada ao programa de pós-graduação em administração (PPGAdm) – mestrado profissional da universidade estadual do oeste do paraná, como requisito parcial para obtenção do grau de Mestre em administração**.**
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GUILHERME LUSTOSA DOS SANTOS

Barreiras para inovação e sustentabilidade nas pequenas e médias indústrias de transformação do Oeste do Paraná

Dissertação apresentada ao Programa de Pós-Graduação em Administração em cumprimento parcial aos requisitos para obtenção do título de Mestre em Administração, área de concentração Competitividade e Sustentabilidade, linha de pesquisa Sustentabilidade, APROVADO(A) pela seguinte banca examinadora:

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RESUMO

Santos, G. L. dos (2024). ***Barreiras para inovação e sustentabilidade nas pequenas e médias indústrias de transformação do Oeste do Paraná***. Dissertação de mestrado, Universidade Estadual do Oeste do Paraná, Cascavel, PR, Brasil.

A pesquisa teve como objetivo a análise das principais barreiras para inovação e sustentabilidade que as pequenas e médias indústrias de transformação enfrentam na região Oeste do Paraná. Os dados foram obtidos através da aplicação de um questionário baseado na escala de concordância (Likert) com um total de 25 respondentes de 7 diferentes setores de indústrias de transformação em 6 diferentes cidades da região. Foram realizadas estatística descritiva e matriz de correlação para analisar os dados. Os resultados mostraram que as principais barreiras para inovação foram as incertezas políticas e/ou econômicas, o alto custo inicial e a falta de recurso financeiro, as quais são interligadas e prevalentes no contexto de países em desenvolvimento. Para sustentabilidade, os obstáculos identificados foram a dificuldade de mensurar o retorno financeiro, as dificuldades com leis e regulamentações e o alto custo inicial, todas comumente observadas em pequenas e médias empresas de outras localidades. Foram observadas diferentes barreiras para diferentes setores e tamanhos das empresas. Para inovação os setores de alimentos e moveleiro apresentaram as incertezas políticas e/ou econômicas como principal barreira, diferindo dos setores metalúrgico e químico. Para sustentabilidade, a dificuldade em mensurar o retorno financeiro foi a principal barreira dos setores metalúrgico e alimentício, divergindo quando comparados aos demais. Quanto ao porte, para inovação a principal barreira das micro empresas são as incertezas políticas e/ou econômicas, sendo o alto custo inicial e a falta de recursos financeiros os obstáculos identificados pelas pequenas e médias empresas respectivamente. Já para sustentabilidade, as micro empresas apresentaram o alto custo inicial como principal impeditivo, ao passo que a dificuldade em mensurar o retorno financeiro e as dificuldades com leis e regulamentações foram identificadas como principais impeditivos para pequenas e médias respectivamente. As análises também sugerem que pode haver correlação entre algumas barreiras para inovação e sustentabilidade, como o alto custo inicial e a falta de recurso financeiro. Essa pesquisa pode contribuir no avanço do conhecimento sobre o tema na região, além de oferecer uma abordagem prática com ações concretas para mitigação ou eliminação das barreiras através de políticas públicas ou iniciativas privadas direcionadas, beneficiando as empresas inseridas nesse contexto.

Palavras-chave: barreiras para inovação; barreiras para sustentabilidade; pequenas e médias empresas (PMEs); indústrias de transformação;

ABSTRACT

Santos, G. L. dos (2024). ***Barriers to innovation and sustainability in small and medium-sized manufacturing industries in Western Paraná***. Master's dissertation, State University of Western Paraná, Cascavel, PR, Brazil.

The objective of this research was to analyze the main barriers to innovation and sustainability faced by small and medium-sized manufacturing industries in the Western region of Paraná, Brazil. Data were collected through a questionnaire based on a Likert scale, with a total of 25 respondents from seven different manufacturing sectors across six cities in the region. Descriptive statistics and a correlation matrix were employed to analyze the data. The results indicated that the primary barriers to innovation were political and/or economic uncertainties, high initial costs, and lack of financial resources—factors that are interconnected and prevalent in the context of developing countries. Regarding sustainability, the identified obstacles included the difficulty in measuring financial return, challenges related to laws and regulations, and high initial costs, all of which are commonly observed in small and medium-sized enterprises (SMEs) in other regions as well. Distinct barriers were observed across different sectors and company sizes. In terms of innovation, the food and furniture sectors identified political and/or economic uncertainties as the main barrier, differing from the metallurgy and chemical sectors. As for sustainability, the difficulty in measuring financial return was the main barrier for the metallurgy and food sectors, diverging from the others. When analyzing company size, political and/or economic uncertainties were the main innovation barrier for micro enterprises, while high initial costs and lack of financial resources were the primary obstacles identified by small and medium-sized enterprises, respectively. Regarding sustainability, micro enterprises reported high initial costs as the main impediment, whereas the difficulty in measuring financial return and challenges with laws and regulations were identified as key barriers for small and medium-sized enterprises, respectively. The analysis also suggests potential correlations between certain barriers to innovation and sustainability, such as high initial costs and lack of financial resources. This research contributes to advancing knowledge on the subject within the region and offers a practical approach with concrete actions for mitigating or eliminating these barriers through targeted public policies or private initiatives, thereby benefiting companies operating within this context.

Keywords: innovation barriers; sustainability barriers; small and medium-sized enterprises (SMEs); transformation industry;

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LIST OF ABBREVIATIONS AND ACRONYMS

ACI – High Initial Cost

CNI – National Confederation of Industries

DLR – Difficulties with laws and regulations

DMR – Difficulty measuring the return

EPP – Small Business

ESG – Environmental, Social and Corporate Governance

FCT – Lack of technical knowledge

FECOMÉRCIO – Federation of Commerce

FRF – Lack of financial resources

FT – Lack of time

FIEP – Federation of Industries of Paraná

IBGE – Brazilian Institute of Geography and Statistics

IPE – Political and/or economic uncertainties

IPARDES – Paraná Institute of Economic and Social Development

OECD – Organization for Economic Cooperation and Development

SDG – Sustainable Development Goals

UN – United Nations

GDP – Gross Domestic Product

SMEs – Small and medium-sized enterprises

PMI – Small and Medium Industries

MDICS – Ministry of Development, Industry, Commerce and Services

ME – Micro Enterprises

RM – Resistance to change

SEBRAE – Brazilian Micro and Small Business Support Service

SENAC – National Service for Trade Learning

SESC – Commercial Social Service

SESI – Social Service of Industry

SME – *Small and Medium Enterprises*

SUMMARY

1 INTRODUCTION

According to the conjuncture involved in sustainable development, the main challenge for countries, governments, civil society, entrepreneurs, and even researchers and academia is to end poverty. The 2030 Agenda seeks to relate this entire context of efforts and reflections necessary to, in addition to poverty, enhance the protection of the environment and the climate, and ensure that people can enjoy prosperity and peace (United Nations [UN], 2015).

Therefore, the 2030 Agenda, similar to large companies that develop in their strategic planning or master plan, built 17 sustainable development goals, the so-called SDGs. Its main objective is to maximize efforts in a coordinated manner and clearly determine detailed actions to achieve the established goals. These SDGs range from health and well-being, quality education, industry, innovation and infrastructure, to partnerships and means of implementation (UN, 2015).

In this sense, SDG 9 deals with industry, innovation and infrastructure, with the objective of "building resilient infrastructure, promoting inclusive and sustainable industrialization and fostering innovation". To this end, item 9.4 mentions that by 2023, it is necessary to: "modernize infrastructure and rehabilitate industries to make them sustainable, with increased efficiency in the use of resources and greater adoption of clean and environmentally correct technologies and industrial processes". Moving on to item 9.5, this SDG recalls the importance of research development and academia in contributing to the theme: "strengthen scientific research, improve technological capabilities of industrial sectors in all countries, encouraging innovation and increasing the number of research and development workers" (UN, 2015).

In Brazil, the industrial sector is responsible for approximately 24% of the gross domestic product generated (GDP), so that, according to the National Confederation of Industry (CNI, 2023), almost 13% of the national GDP comes from the manufacturing industries, which are responsible for transforming the raw material into a final or intermediate product. With important relevance in the country's financial results, just over 90% of this sector is characterized by small and medium-sized companies (Wu, 2017).

Small and medium-sized enterprises (SMEs) are the economic engines in the European Union, where 9 out of 10 companies are classified as small and medium-sized, generating approximately 90 million jobs (The European Commission, 2020). In Brazil, similarly, data

from SEBRAE indicate that they are responsible for generating 60% of the workforce in the entire country, in addition to contributing to about 20% of the national gross domestic product (GDP) (Pacheco, 2020). In the state of Paraná, about 23% of GDP is generated by the industrial sector (Paraná Institute of Economic and Social Development [IPARDES], 2020). In the Western region of Paraná, the industrial GDP is around R$ 22.5 billion (IPARDES, 2021) and represents approximately 15% of the entire state, generating almost 12% of all industrial jobs (Federation of Industries of the State of Paraná [FIEP], 2016).

Several studies relate the resilience and growth of SMEs with actions aimed at innovation and sustainability (Brunhera et al., 2015; Fernandes et al., 2023; Franklin et al., 2021; Menezes et al., 2011; Paraginski, 2014). However, more than identifying and diagnosing practices and actions aimed at innovation and sustainability, it is necessary to determine the barriers that companies understand and have in their businesses that prevent success towards these topics (Beyer, 2022).

Barriers are understood as the problems, needs or conditions that prevent or influence companies not to implement actions or not direct efforts in a certain sector, segment or strategic planning. Identifying and understanding the barriers to innovation and sustainability becomes a fundamental task for process management, maintenance, and business health (Beyer, 2022; Torugsa & Arundel, 2016).

In the specificity of SMEs, there are several difficulties encountered in developing strategies aimed at innovation and sustainability. The main barriers found for innovation are: lack of resources (capital, knowledge, and skills), the difficulty of innovating radically, and the focus of short-term management (Pacheco, 2020). When it comes to sustainability, the main obstacles encountered for these initiatives, and similar to the previous one, are: lack of resources, the high initial cost for implementation, and the lack of knowledge on the subject (Jaramillo et al., 2019).

Therefore, considering the financial and economic impact that SMEs have on the global industrial situation, it becomes relevant to advance in studies as a way to understand the current national scenario: to identify the main barriers found in these businesses and to provide private and governmental associations with this information, aiming at channeling efforts to support and continuous growth.

1.1 RESEARCH PROBLEM

When it comes to industries and businesses in general, 95% of them are classified as small and medium-sized companies, which correspond to approximately 40% of the global gross domestic product (Wu, 2017). However, these companies need to advance and establish themselves in a more significant way in the areas of sustainability and innovation. Efforts towards these practices must be pioneering for business sustenance (Kuzma et al., 2020). Therefore, the lack of knowledge of the factors that prevent actions aimed at innovation and sustainability in SMEs becomes a significant problem with an impact on global economic development.

It is a fact that the federal government, mainly guided by the Brazilian Institute of Geography and Statistics (IBGE), has evaluations and several indicators (including sustainability and innovation) of the industrial environment in all regions of Brazil. However, it is necessary to look at sustainability with greater attention and breadth for the advancement in research in the state's industrial SMEs as a way to increase the depth of knowledge of the characteristics in the regional sector, as well as the advancement in studies to determine the difficulties encountered in topics such as innovation and sustainability in this environment (FIEP, 2023).

Academic studies have sought to determine the factors that influence SMEs to have commitments and actions towards themes such as the environment, sustainability, and innovation (Ayuso & Navarrete-Báez, 2018; Jansson et al., 2017). However, the difficulties faced by these entrepreneurs developing their companies towards these themes are rarely discussed. More precisely, the real barriers encountered to improve their operational results through innovation and sustainable development still need to be explored (Ghergina et al., 2020; Siqueira & Kodama, 2023).

In the environmental sphere, there is a consensus in the literature on the impact of SMEs on global pollution, resource consumption, and waste generation (Jabbour et al., 2020; Madrid-Guijarro & Duréndez, 2023). Data from the internal institutes of the Organization for Economic Cooperation and Development (OECD, 2018) indicate that the environmental impact of SMEs varies between 60 and 70%. In Asia, approximately 50% of industrial pollution generation is attributed to SMEs (De et al., 2020). The present authors recognize the need to develop a greater number of studies around sustainability in this sector.

In innovation, several studies discuss its importance and its positive effect on indicators such as productivity, sales, profits, among others. However, there is a need for a greater number

of studies in the sense of what could discourage and prevent investments or actions aimed at this topic (Martinez-Azúa & Sama-Berrocal, 2022). Even more categorically, considering the points of some authors, it is recommended as future studies to understand the main barriers to innovation and sustainability faced by companies in Brazil and whether there are relationships between SMEs and these barriers (Jaramillo et al., 2019; Siqueira & Kodama, 2023).

1.1.1 Research Question

Considering all the importance of the exposed context, and as a way of directing the study, the following research question is presented: what are the barriers to innovation and sustainability in small and medium-sized manufacturing industries in the Western Region of Paraná?

1.2 OBJECTIVES

1.2.1 General objective

To analyze the barriers to innovation and the barriers to sustainability in small and medium-sized manufacturing industries in Western Paraná.

1.2.2 Specific objectives

a) to identify the theoretical-empirical constructs on barriers to innovation and sustainability from a survey in the literature;
b) verify, together with small and medium-sized manufacturing industries in Western Paraná, the existing barriers to innovation and sustainability;
c) to comparatively analyze the barriers identified in the literature with those found empirically in the industries, highlighting similarities, differences and practical implications.

1.3 JUSTIFICATION AND CONTRIBUTION

There are several motivations that justify the development of this work. The first of these is the importance of understanding that SMEs have in every economic scenario in several countries, especially in the impact of their businesses on job creation and the construction of local GDPs (Menne et al., 2022; Pacheco, 2020; THE, 2020; Thi, 2022; Wu, 2017). In addition to the impact at the global level, at the regional level, to which this study is limited, the small and medium-sized enterprise manufacturing industries have an important contribution to the results of gross domestic product, job creation and income for the region, as well as the need for greater knowledge and understanding of how the areas of innovation and sustainability of these businesses work (FIEP, 2023; IPARDES, 2021).

The barriers to innovation and sustainability have a direct impact on the results, resilience, and growth potential of SMEs, so advancing studies that can identify them can help meet not only the SDGs, but also the entire economic cycle that involves these businesses (Beyer, 2022; Franklin et al., 2021; Brunhera et al., 2015; Fernandes et al., 2023; Menezes et al., 2011; Paraginski, 2014).

Also in the environmental context, several studies point out how small and medium-sized companies in the manufacturing industry sector tend to generate significant volumes of waste, pollution and consumption of raw materials. These studies also consider the importance of sustainability-related research in this area, to advance knowledge and understanding of the sector in other global locations (De et al., 2020; Jabbour et al., 2020; Madrid-Guijarro, & Duréndez, 2023)

Mainly related to Brazil, recent studies point to the development of this type of research in the national scenario as a suggestion for future work, as a form of a gap to be filled (Auer, & Jarmai, 2017; Ghergina et al., 2020; Jaramillo et al., 2019; Martinez-Azúa & Sama-Berrocal, 2022; Pacheco, 2020; Ullah et al., 2021).

After practical and theoretical justifications, it is understood that the main contribution of the development of this research is characterized by the possibility of providing a study in the regional scenario on the obstacles that prevent SME manufacturing industries from investing in innovation and sustainability actions, and the possible relationship between these barriers. Thus, as a way of presenting it to trade associations, public, private and governmental structures, to assist in the construction of initiatives that can minimize these difficulties and enable greater investments in these fundamental areas for the health of business, the

environment and the regional economy.

1.4 STRUCTURE OF THE DISSERTATION

The structural content of this dissertation is developed and divided into a few chapters. In the initial chapter, number 01, it is possible to check the introductory part on the theme of the work, on the global context of this theme and the preview of how innovation, sustainability and their barriers are addressed in scientific research and studies. Also in this chapter, there is the question, the justification and the contribution that this research can provide.

Chapter 02 is composed of the theoretical-empirical construct of the work. It is possible to deepen concepts, understand the current context of small and medium-sized manufacturing industries in the national and regional scenario, and, through a systematic review of the literature, verify some similar research developed in Brazil and in several other countries.

Chapter 03 presents the methodology and techniques involved in the research. The entire design of the development of the research, the characterization and framing of the work, the way in which the sampling will be determined, the collection of data through questionnaires and, finally, the analyses that will be carried out and the way in which the data will be treated are verified.

In the fourth chapter, all the analyses involved in the research were developed. Graphs, tables and matrices were prepared as a way to deepen the study and obtain the best conclusions.

Chapter 05 presents the discussions of the results found and, finally, chapter 06 presents the final considerations of the study, presenting the main conclusions from the results obtained and suggestions for future research.

2 THEORETICAL-EMPIRICAL REVIEW

This chapter presents the theoretical assumptions assumed for the development of research and study, as well as recent studies and systematic review of literature. Therefore, it will be possible to verify the concepts of innovation and sustainability, the concepts, types and classifications of barriers to innovation and sustainability, as well as a relationship and critical analysis of similar works developed on this topic.

2.1 SYSTEMATIC LITERATURE REVIEW

Previously, to begin the understanding of the theme and build the theoretical framework of this work, a systematic review was carried out practically in two phases, one part of which was the search in national journals and articles, and the other part permeated international research and journals. The result of this review can be observed in this theoretical framework and in the references of the work, and approximately 57 scientific articles were used for this construction.

The search for national studies began using the Sucupira Platform, generating an archive with the main journals with Classification Event in the quadrennium from 2017 to 2020 and an evaluation area in "Public and Business Administration, Accounting Sciences and Tourism". At this first moment, more than 5 thousand records of searches were observed.

Classifying in Portuguese or national language and fitting into the Qualis classification A1, A2, A3, B1, B2 and B3, and searching for journals with the title "innovation", a total of 21 registrations were reached. There were still tourism, hospital and health areas that were removed, resulting in 16 records. Using the title "sustainability", a total of 15 journals were reached, although 2 of them had already permeated the previous search. Therefore, when it comes to innovation and sustainability, we have a total of 29 classified journals.

In these classified journals, the search for titles such as "barrier", "barriers", "barrier* and "innovation" and "barrier* and sustainability" was used as a way to reach scientific articles that could assist in this work between the years 2017 and 2023. In the context of innovation, only two journals had articles related to barriers to innovation, although they had no similarity with the theme studied. On sustainability, barrier studies appeared in 5 journals with a total of 7 scientific articles, however, none were related to SMEs. Some articles addressed civil construction, another the installation of biodigesters and others the installation of electricity

generation systems. Therefore, there are no similar studies in the national scenario in these databases.

On the international scene, works belonging to the "Scopus" and "*Web of Science*" databases were searched. In this case, considering the knowledge that a previous search using terms only with "*innovation and sustainability*" would point to an extremely significant number of articles, words such as "*barriers and innov* and sustain* and sme** were used as search terms, SME refers to the term *Small and Medium Enterprises*, i.e. SME translation. As in the Scopus database no symbols such as * can be used in the search, the term "*barriers and innovation and sustainability and sme*" was used. Due to the high number of results, unlike what was observed in the national scenario, filters were used to assist in the search. First, filter for articles and followed by recent years between 2017 to 2023. Table 1 below shows a summary of the results found in this last search.

Table 1
Summary of research in international databases

Base	Searched term	Total	Articles	Year (2017 to 2023)	Title	Summary
Scopus	*barriers and innovation and sustainability and sme*	6410	506	390	91	22
Web of Science	*barriers and innov* and sustain* and sme*	374	297	284	62	35

Source: prepared by the author (2024).

Therefore, after elaborating the research and applying the filters in articles, year, reading of titles and, subsequently, abstract, a total of 57 scientific articles were selected for study, advancement in knowledge on the subject and construction of the theoretical framework developed.

In general, in different research methodologies, study locations, sampling and data processing, the articles identified the main barriers to innovation and sustainability in various types of businesses. In the researched databases, there is an absence of similar research in Brazil and South America, on the other hand, there is a large concentration of studies developed in the European territory.

2.2 BRAZILIAN CONTEXT OF MANUFACTURING INDUSTRIES

By SEBRAE's definition, SMEs are composed of micro-enterprises (ME), small-sized enterprises (EPP) and medium-sized enterprises. In figure 1, below, it is possible to verify the differences in relation to the sizes and size of each of them, both for the trade and services sector and for the industrial sector.

Table 2
Definition of the size of the companies

Size	Commerce/Services	Industry
Microenterprise (ME)	Up to 09 employees	Up to 19 employees
Small Business (EPP)	From 10 to 49 employees	From 20 to 99 employees
Midsize Enterprise	From 50 to 99 employees	From 100 to 499 employees
Large companies	100 or more employees	Over 500 employees

Source: adapted from SEBRAE, 2013.

Also, according to SEBRAE data, when it comes to the importance of these companies for the national scenario, it is estimated that SMEs correspond to a total of 99% of active companies in Brazil. They are also responsible for approximately 27% of the gross domestic product and 62% of formal jobs in the country, that is, just over half of the national workers with a formal contract are currently working in some SME spread across the Brazilian regions.

Regarding the sectors in which they operate, companies are divided into: services, commerce, manufacturing industry, civil construction, agriculture, mineral extraction, among others. According to the Bulletin of the 3rd quarter of 2023, from the Ministry of Development, Industry, Commerce and Services [MDICS]), just as a matter of knowledge of the participation of each sector in the national volume of companies, approximately half of the SMEs correspond to the service sector, with 49.6%. Other sectors can be seen in figure 1.

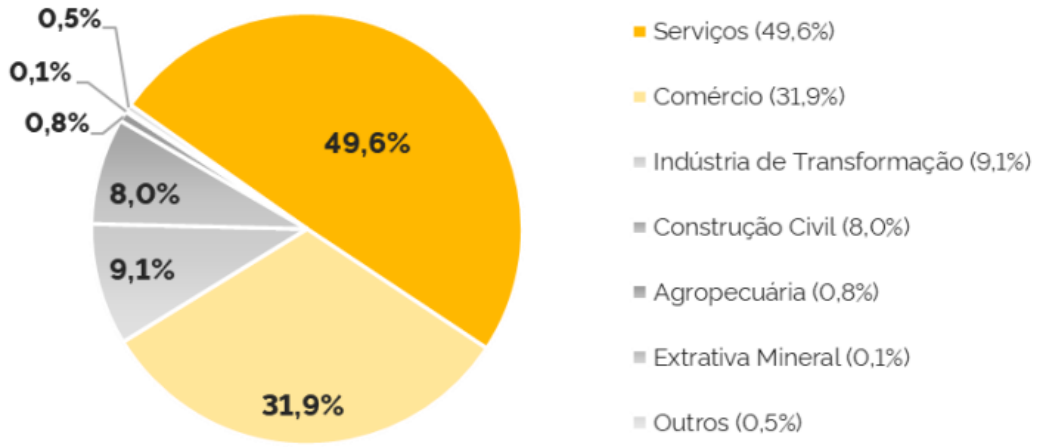

Figure 1. Distribution of sectors among SMEs

Source: Adapted from Ministry of Development, Industry, Commerce and Services, 2023.

The second largest slice of the pie chart corresponds to the trade sector with 31.9% of the total number of SMEs opened in Brazil, followed by the manufacturing industries with 9.1%, civil construction with 8% and agriculture with 0.8%. Therefore, considering the total amount, for every 10 SMEs currently opened, about 8 are in the services and commerce sectors. An important scenario to be considered when defining the size of samples when any type of research is initiated for this segment.

Advancing in the national analysis of SMEs, and as what interests us for this research are the active companies, the entire percentage written above was stratified into total numbers. Thus, Table 3 presents the total number of active SMEs in Brazil and the main regions in which they are inserted.

Table 3

Active SMEs by Brazilian region

Regions	Active SMEs
Southeast	4.434.373
South	1.922.502
Northeast	1.492.237
Midwest	860.411
North	455.462

Source: Adapted from Ministry of Development, Industry, Commerce and Services, 2023.

It should be noted that the Southeast region emerges as the one with the largest global number of active SMEs, practically 48% of the total detailed in October 2023 according to a report by the federal government itself. In second place, we have the south region with about 1.9 million companies, followed by the northeast regions with approximately 1.5 million and, later, the midwest and north. The total number of active SMEs in Brazil, according to data

updated to date, is 9.1 million. Recording that this data can change over the months, as new companies are opened and some close.

After understanding the arrangement of SMEs by regions, the breakdown by states was also specified. This exposition is important, considering the need, during the work, to define the size of the sample that will be researched. Thus, table 4 below presents the first five states that have the largest number of active SMEs in Brazil.

Table 3
Five states with the highest number of active SMEs

States	Active SMEs
São Paulo	2.754.992
Minas Gerais	906.845
Paraná	740.794
Rio Grande do Sul	647.781
Rio de Janeiro	598.706
Other	3.516.489

Source: Adapted from Ministry of Development, Industry, Commerce and Services, 2023.

As listed in the table of regions, in which the southeast region accounted for almost half of the active SMEs in Brazil, it was expected that the states belonging to this location would appear in the first positions in this detail. Therefore, the state of São Paulo is home to the largest number of active SMEs with almost 2.8 million, about 30% of the total volume in Brazil. Next we have another state in this region, Minas Gerais appears with approximately 900 thousand active SMEs, followed by the first state to appear outside that region, Paraná with about 740 thousand companies. We close the list with Rio Grande do Sul, very close to Paraná, and Rio de Janeiro.

As this work studies the manufacturing industries and, knowing that they correspond to approximately 9% of the total volume of active SMEs in Brazil, in the following table it is possible to verify the number of projected manufacturing industries in Brazil, in the southern region and in the state of Paraná, locations that will be defined later for data collection.

Table 4
Number of active manufacturing industries

Local	Active manufacturing industries
Brazil	824.905
South	173.025
Paraná	66.671
Western Region of Paraná	8.001

Source: Adapted from Ministry of Development, Industry, Commerce and Services, 2023.

In this detail, it can be seen that, in estimated numbers, Brazil has a total of approximately 825 thousand manufacturing industries - considered SMEs - active until October 2023. In the South region, this number corresponds to about 173 thousand, while the state of Paraná has a total of 66,671 active SMEs in the manufacturing industry sector. Bringing this analysis to percentage values of the Brazilian total, the state of Paraná is home to about 8% of this active sector and approximately 38% of the total in the southern region of the country, when compared to the states of Rio Grande do Sul and Santa Catarina. Finally, in the place where the study is delimited, the Western region of Paraná has a total of approximately 8 thousand active manufacturing industries, classified as SMEs.

2.3 NATIONAL CONTEXT IN RELATION TO INNOVATION

In June 2020, the National Confederation of Industry (CNI), through the FSB Research Institute, hired and disseminated a survey on innovation in the industry through business leaders, with the objective of mapping the perception of medium and large companies about innovation and its importance in the country's scenario. The interviews took place by telephone with a total of 402 business units throughout the national territory.

First, it is interesting to show the perception of the actors in relation to the companies' revenues, as shown in figure 2.

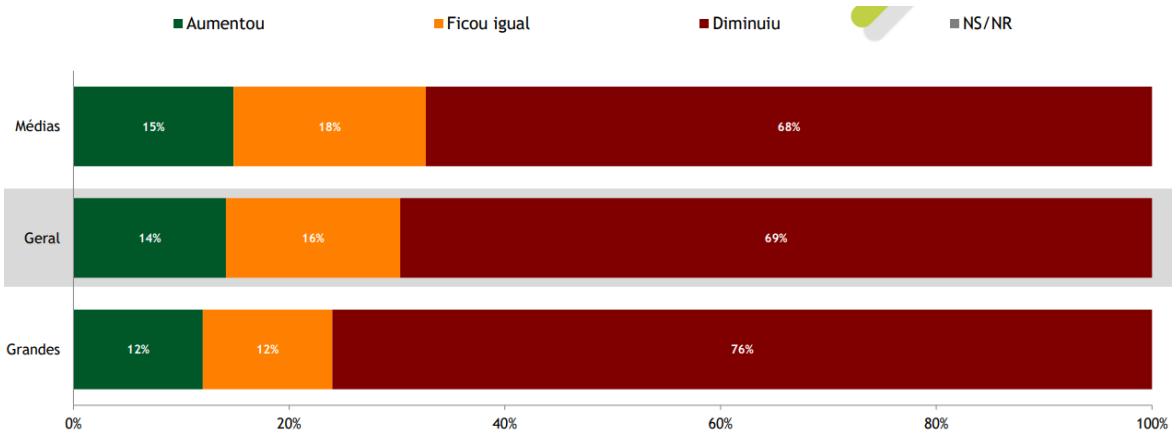

Figure 2. Post-pandemic company revenues

Source: Adapted from FSB Research Institute, CNI, 2020.

Regarding revenue, approximately 70% of all companies understood that there was a decrease in the post-pandemic period, while 68% of medium-sized companies had this perception. Another interesting point to be noted is that, when it comes to averages, only 15%

were able to see an increase in revenue. This graph is interesting, while this reduction directly impacts the health of the main businesses that drive the Brazilian economy, which means that the general economy itself (jobs, income and the entire chain) is affected. A similar graph divided by region can be seen in figure 3.

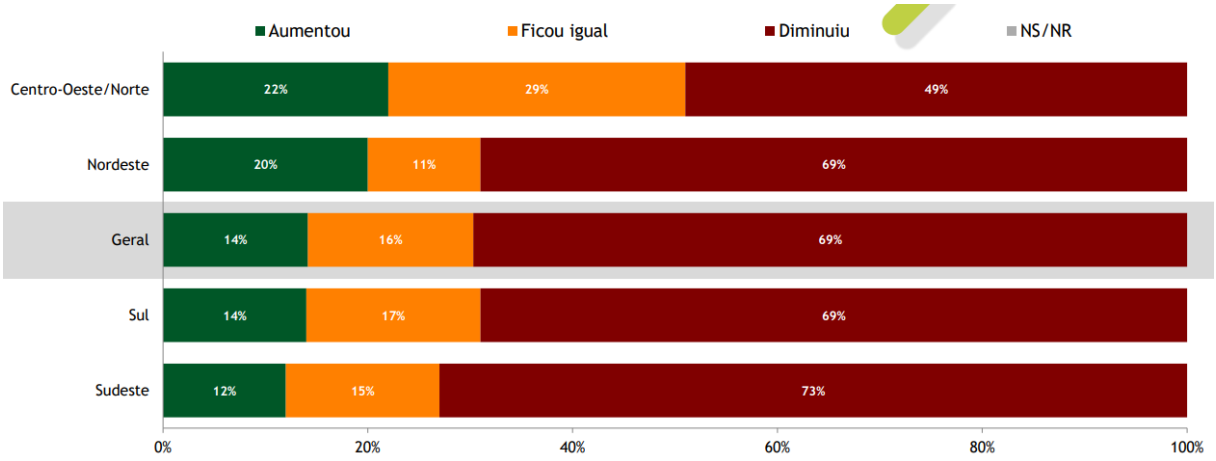

Figure 3. Companies' revenues by region after the pandemic

Source: Adapted from FSB Research Institute, CNI, 2020.

The division of companies regionally continues to point to greater fragility of revenue in the post-pandemic period, and the southern region – where this research work is developed – presents a perception of a reduction of approximately 70% in revenue in this period. As there is a reduction in revenue, the surviving companies tend to direct their efforts directly to maintaining their business, maintaining lean capacity and failing to direct their efforts to investments. Considering that some of the main barriers to innovation happen due to financial conditions and knowledge factors, there is a possibility that these types will be found in data collection and at the end of the work.

This argument, which with the condition of reducing revenues tends to generate structural changes in organizations, can be confirmed in figure 4.

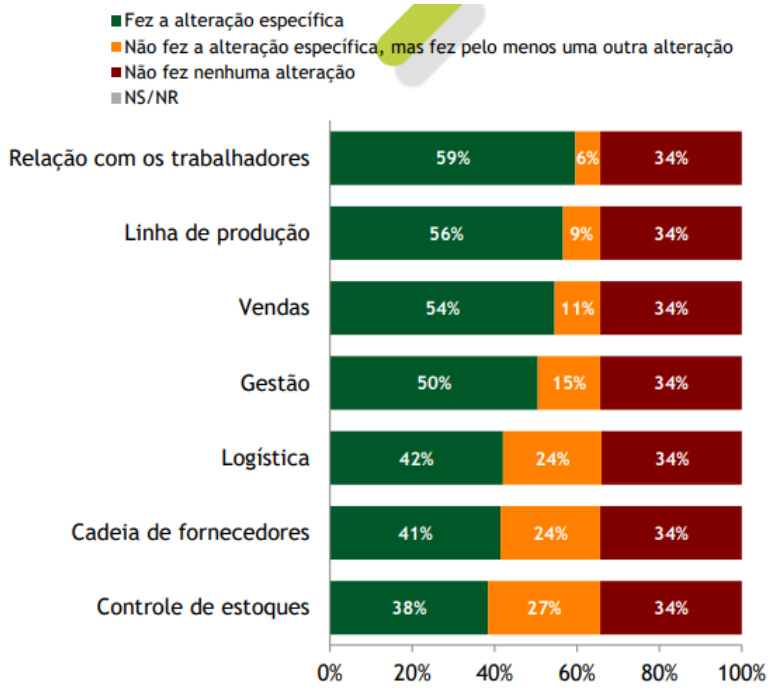

Figure 4. Structural changes in medium-sized enterprises

Source: Adapted from FSB Research Institute, CNI, 2020.

It is noted that, specifically in medium-sized, companies made several structural changes because of the drop in revenue, and the main changes occurred in relation to workers with 59%, a change in the production line with 56%, a change in the sales area with 54% and practically half of them with changes in the management of the organization.

Bringing innovation into context, in figure 5, it is possible to verify the involvement of innovation in the 272 companies that said they had made some changes in the production line.

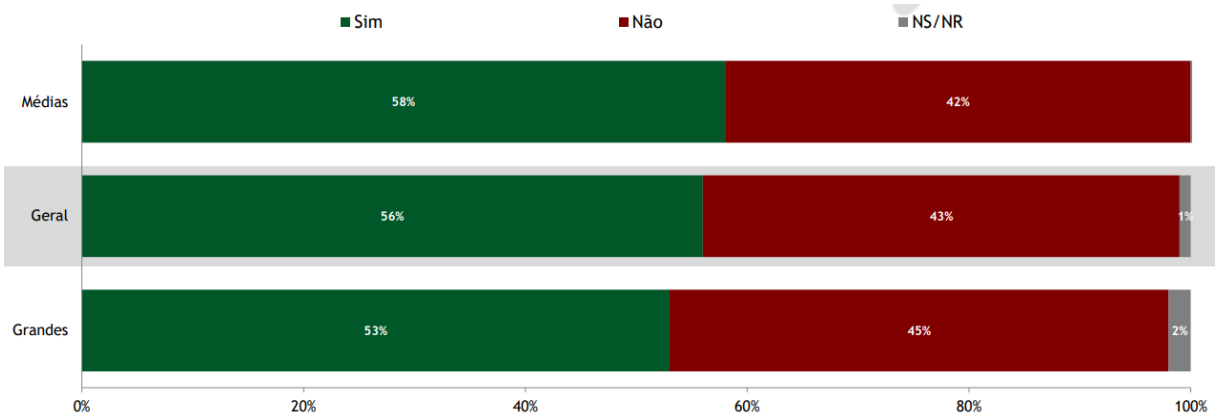

Figure 5. Change with innovation

Source: Adapted from FSB Research Institute, CNI, 2020.

In this case, it is noted that 58% of medium-sized companies pointed out innovative changes in their organizations in the post-pandemic period. Thus, analyzing a global context, it is understood that, among all the companies surveyed, approximately 60% of them did not make any type of change related to innovation. Therefore, as previously concluded, it is possible to determine that – after data collection and analysis of the results – more than half of the companies should present barriers to innovation in their business.

Narrowing a little more towards innovation, the survey also detailed the importance that medium and large companies – separated by regions – understand in relation to the theme, as can be seen in figure 6.

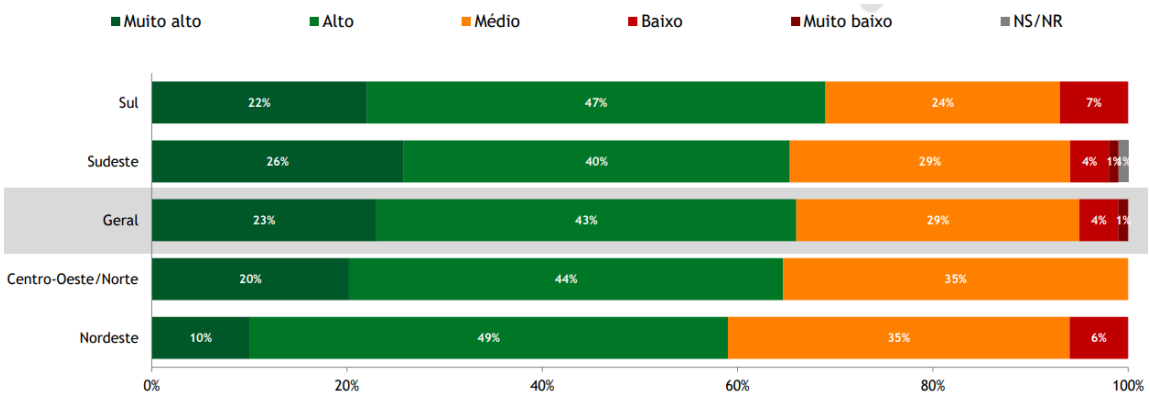

Figure 6. Degree of importance given to innovation

Source: Adapted from FSB Research Institute, CNI, 2020.

Considering the southern region, approximately 70% of the companies surveyed understand that innovation has important relevance in their business, having a high or very high degree. On the other hand, about 30% have medium, low or very low grade. These reasons can be interpreted as barriers, and in figure 7 it is possible to verify them.

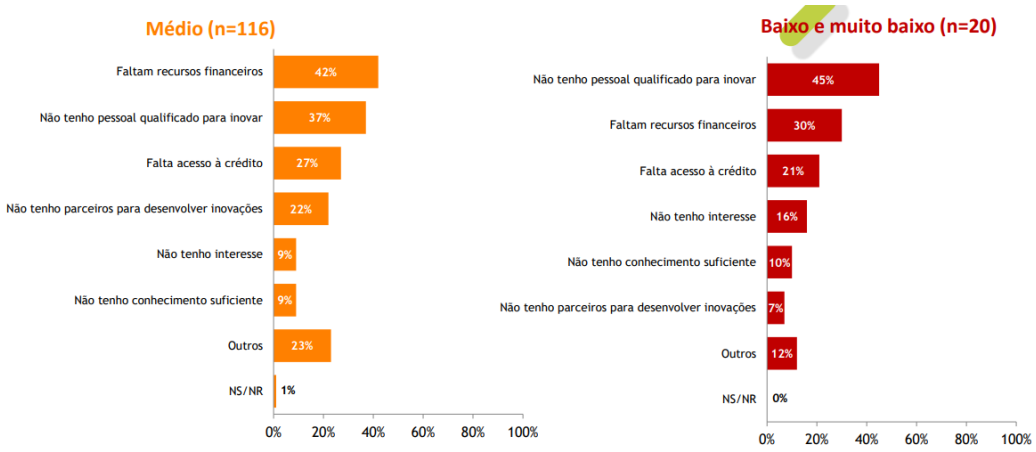

Figure 7. Reasons given for medium, low or very low grades

Source: Adapted from FSB Research Institute, CNI, 2020.

There is considerable similarity between the reasons that companies classified as medium, low or very low for the importance of innovation, with the types of barriers determined by the OECD in the Oslo Manual previously. And, also as said, considering the conditions of reduced revenue, as observed, companies understand that the main reasons for this low importance are defined as lack of financial resources, lack of qualified personnel to innovate and lack of credit for this type of investment.

Still dealing with the degree of innovation, figure 8 presents a graph focused on medium-sized companies related to having an area focused on innovation.

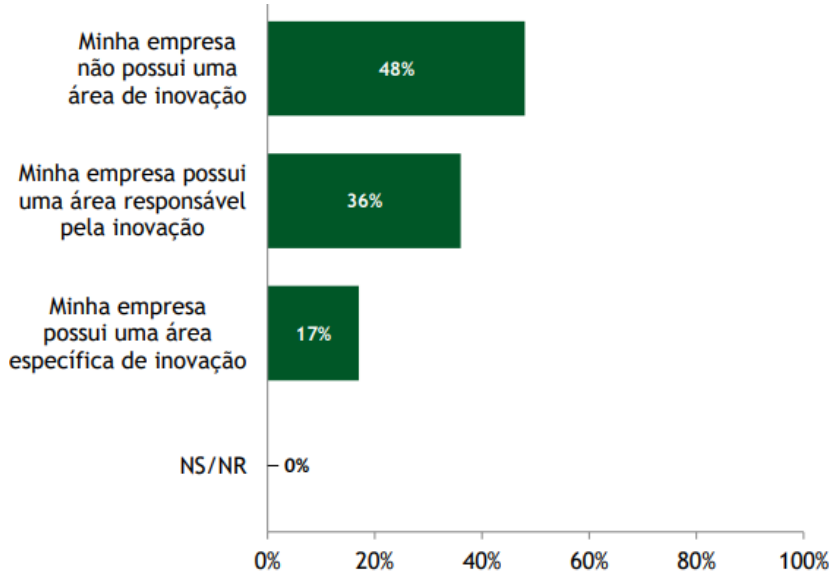

Figure 8. Characteristics of medium-sized companies related to innovation

Source: Adapted from FSB Research Institute, CNI, 2020.

It is noted that practically half of the companies that have innovation in their production process do not have a specific area for this purpose. In this way, it is interpreted that there is importance and innovation happens, however there is no specific sector in which this subject or these investments are a priority. On the other hand, just over half of the companies have a responsible or specific area to direct efforts in innovation.

All this research on innovation goes hand in hand with its barriers, while one is determined by the other. Therefore, advancing further on this topic, a survey by the Gartner Inc. Group in Silicon Valley, conducted in 2019 with the main managers of companies in this place, pointed out that the main barriers found to innovation are: employees focused on the short term (30%), employees resistant to change (28%), compliance restrictions (27%), resistance from top management (25%) and 24% characterized it as lack of resources. An interesting movement

when compared to the CNI survey which, despite being in different places and companies, shows a change in the motivations that prevent innovation directed to lack of resources.

2.4 BARRIERS TO INNOVATION

Dealing with one of the themes of the research in question, the barriers to innovation can be caused by various situations or reasons (Cordeiro & Vieira, 2012) and can be any factor that negatively influences the innovation process (Hadjimanolis, 2003). The OECD, on the other hand, also includes economic factors such as lack of demand, high costs, specific conditions of companies and sectors (such as the difficulty of finding qualified labor) and legislative or legal factors, such as laws and tax burdens (OECD, 2005). Table 6 shows the main barriers listed and how they are classified.

Table 5.
Classification and types of barriers to innovation

Factors related to knowledge	**Cost factors**
Insufficient innovative potential	Risks perceived as excessive
Shortage of qualified personnel:	High cost
- within the company	Lack of internal funding
- in the labor market	Lack of funding from other external sources
Lack of information about technology	**Market Factors**
Lack of market information	Uncertain demand for innovative goods/services
Deficiency in the provision of services	Potential market established by established companies
Difficulty in finding partners for cooperation in:	**Institutional factors**
- Product or process development	
- Marketing partnerships	Lack of infrastructure
	Fragility of property rights
Inflexibility within the company:	Legislation, regulations, taxation
- Staff attitude to change	**Other reasons not to innovate**
- Management's attitude towards change	No need to innovate due to old innovations
- Company management structure	No need due to lack of demand for innovation
Inability to direct employees to innovative activities	

Source: Adapted from OECD, 2005.

Other authors, such as Bessant, Tidd, & Pavitt (2008), understand that barriers to innovation occur in the planning process, where it receives great resistance due to cultural change, also cited as a factor related to knowledge by the OECD. For Bes and Kotler (2011), there are 7 main barriers to innovation:

a) understanding of what innovation really means;
b) lack of clarity in the assignment of responsibilities;
c) confusing innovation with creativity;

d) lack of framework;
e) lack of control;
f) lack of management;
g) lack of focus on non-customers.

Several other authors also point out and observe types of barriers to innovation (Alshwayat et al., 2022; Cordeiro & Vieira, 2012; Hadjimanolis, 2003; Holzl & Janger, 2014; Maia & Cabral, 2015; Martínez-Azúa & Sama-Berrocal, 2022; Piatier, 1984; Rawindaran et al., 2023; Roldan et al., 2013; Siqueira & Kodama, 2023), however, in general they tend to be similar or similar to those identified by the previous researchers described and by figure 10 provided by the OECD.

There are several typologies in use, so it is possible to classify the barriers to innovation in different ways. A useful classification is one that, based on the firm, differentiates the barriers between internal and external (Hadjimanolis, 2003). In this case, he understands that internal barriers have direct actions by companies, while external ones cannot be influenced or impacted by the organization (Brandão & Bruno-Faria, 2017). Table 7 shows the factors and differences.

Table 6
Classification of barriers to innovation

External	Internal
Market-related: market risk, inadequate size of research and development (R&D), difficulty in capturing income and profits from innovations, focus on the short term, availability of financing.	**Structure-related:** inadequate incentive systems, inadequate communication flow, obstructions by other departments, centralization of power, lack of time, failure to search for information from external sources, cultural inertia, and internal political games.
Government-related: laws, policies, regulations, and standards.	**Strategy-related:** risk aversion, lack of knowledge about strategic planning and objectives, lack of budgetary resources.
Others: intellectual property, technology, patents, corporate relations, relations with suppliers and consumers	**Related to people:** lack of motivation, lack of commitment, lack of initiative, perceptions, lack of skills, existence of interests and personal goals different from the organization, fear of the unknown.

Fonte: Adapted from Hadjimanolis, 2005.

In summary, external barriers related to the market refer to the focus on the short term, the low level of ability of companies to account for the possible profits generated by innovations, and the difficulties in obtaining financing. Those related to the government, on the other hand, are characterized by all the bureaucracy, laws and regulations that confuse and hinder the performance of organizations. Finally, the other sources are determined by the lack of cooperation between suppliers, technology obsolescence, corporate and insufficient capital scale.

On the other hand, internal barriers are related in human management to lack of motivation, lack of skills, personal goals different from those sought by the organization, fear of change, among others. Barriers related to structure are characterized by the way management is conducted, especially in relation to the centralization of power, resistance to change, inadequate communication and failure to seek external knowledge. In the end, those related to strategy refer to lack of budget, absence of focus on the long term and lack of master plan or strategic planning.

2.4.1 Studies on barriers to innovation

After checking some important research from institutes, there is an analysis of academic works focused on barriers to innovation in companies. To facilitate visualization and reading, Table 8 was constructed, in which it is possible to summarize the authors, the year of the studies, the location and size of the sample, as well as the main barriers encountered and considerations of the work. This evaluation is important, because it will be based on it that the results of this study will be compared.

Table 7
Summary scheme of similar research – barriers to innovation

Authors	Location/Sample size	Main barriers	Considerations
(Cordeiro & Vieira, 2012)	SMEs in Portugal; Sample of 45 companies;	Current condition of the economy; Lack of financial resources; Resistance to change; Lack of incentives for innovation; High cost;	Trabalho did not mention which sectors were evaluated and included two large companies in the sample;
(Souza & Bruno-Faria, 2013)	3 Brazilian companies; 2 large and one medium;	Disbelief in relation to the theme of innovation; Difficulties in integration among employees; Limitation of human resources; Fear of consequences and resistance to innovation;	Small sample; He did not make it clear which sectors were surveyed; A total of 18 interviews were conducted with professionals from different areas between the companies, making comparative analysis difficult;
(Roldan et al., 2013)	SMEs in Ceará; Service sector;	Lack of innovation sector; Lack of qualified personnel/knowledge; Resistance to change; Lack of approach to the subject;	Work was limited to only one company in the service sector; It is recommended by the authors themselves to use a larger sample;
(Cabral, 2015)	304 SMEs in Ceará;	High cost for innovation; Lack of qualified personnel; Lack of government support; Unfavorable economic environment;	A structured questionnaire was used with 12 stimulated barriers; The Likert scale was used; A descriptive analysis of the results was performed with the average of the scales per barrier; It would be interesting to be

			able to check the barriers by type of business;
(Antonioli et al., 2017)	3825 companies of different sizes and sectors in France	High cost for innovation; Lack of qualified personnel;	Well-designed research, with a large number of samples and statistical analysis tools; Main objective of comparing barriers with cooperation between companies; In a closed questionnaire, it evaluated only a few barriers;
(Auer & Jarmai, 2018)	8 SMEs from Austria; Industries and services in the health sector;	Lack of financial resources; Difficulties with laws and regulations; Risk aversion; Lack of knowledge; Lack of specialized personnel; Difficulty in measuring results;	The work was carried out with semi-structured interviews with the CEOs of the companies; Researcher divided the results and classified the barriers; Sample considered small;
(Alshwayat et al., 2022)	Financial Institution (Bank) in Jordan	Lack of communication; Lack of time; Resistance to change;	A survey with a semi-structured interview was conducted with only one senior manager of a financial institution;
(Beyer, 2022)	9 SMEs and 3 large ones; Manufacturing and service sectors;	Lack of knowledge; Difficulties with laws and regulations; Very competitive market; Lack of financial resources; Lack of qualified personnel; High cost for innovation;	Well-structured research, open interviews and following the Oslo manual. The author also classified the barriers into internal and external; Small sample and considered large, medium and small companies;
(Martínez-Azúa & Sama-Berrocal, 2022)	194 companies in Spain; Agribusiness sector; 88% of the SME sample;	Lack of innovation culture; Lack of internal organization; Lack of support from the public sector; Difficulties with rules and regulations;	This paper makes a quantitative analysis and sought to relate the types of barriers with objectives and classifications between innovative and non-innovative companies; There was a limitation due to the explored area;
(Khani et al., 2023)	Sample of 41 carpet and leather industries in Iran;	Lack of organizational culture on the subject; Lack of government support; Difficulties with laws, regulations;	The study used the BWM and ANOVA methods for an interesting analysis of the results; It did not indicate the size of the companies evaluated; It was restricted to only the two sectors;
(Siqueira & Kodama, 2023)	96 companies of various sizes in Brazil	Misalignment of company values with individual values; Unstable environment and leadership; Inefficient communication;	The study considered a reasonable sample, using a Likert scale and a closed questionnaire with 22 questions; The sample was obtained from 17 sectors, however only 4 sectors accounted for 50% of the results;

Source: Prepared by the author, 2024

Throughout the analyzed period from 2012 to 2023, there are several studies with different sample sizes, research methods, and analysis methods. Therefore, it is verified that the barriers that prevent innovation tend to have a certain similarity between countries, periods and types of business.

Cordeiro and Vieira (2012) conducted a survey with 45 SMEs in Portugal, comparing the results with other European countries and identified that the main barriers found were: current economic condition, financial limitation, risk-taking culture, resistance to change, lack of incentives and high cost. This study did not present a specific result of the interest of manufacturing industries.

Close to 2012, and entering the national context, Souza and Bruno-Faria (2013) identified that disbelief in innovation, difficulty in integrating employees, limitation of human resources, fear of consequences and resistance to innovation were the main barriers in the three companies surveyed. However, the research was carried out with several professionals from each of the companies in a non-distributed way, not detailing the sectors, thus making it impossible to draw further conclusions for manufacturing industries.

In the same year, also in the national territory, Roldán et al. (2013), concluded that the lack of an innovation sector, lack of qualified personnel, resistance to change and lack of approach to the subject were the main barriers to innovation in a medium-sized company in the service sector in Ceará. The authors indicate that the research was carried out in only one company as a limitation of the work.

Cabral (2015), in a survey also in Brazil, identified that the high cost of innovation, lack of qualified personnel, lack of government support and unfavorable economic environment were the main barriers encountered by 304 SMEs in Ceará. This study presented a good sample size with a closed questionnaire and stimulated answers. In total, 60% of the sample corresponded to the food industry, clothing manufacturing and civil construction.

Antonioli et al. (2017) concluded that the main barriers for companies of various sectors and sizes in France were: the high cost of innovation and lack of qualified personnel. The study had several statistical analyses and a large sample size when compared to the others. The limitation described by the authors was that only a few barriers were available in the structured questionnaire.

In the following year, Auer and Jarmai (2018) found that financial limitation, difficulties with laws and regulations, risk aversion, lack of knowledge and personnel, were the main barriers encountered by 8 SMEs in the Austrian healthcare sector. Semi-structured interviews were conducted with the CEOs of the companies and classification of the barriers found, however, a low sample number.

In 2022, in Poland, Beyer (2022) conducted open interviews, followed the Oslo manual, and classified the barriers between internal and external. In general, despite the low sample, the 12 companies reported that lack of knowledge, difficulties with laws and

regulations, very competitive market, financial limitation, lack of qualified personnel, high cost for innovation and difficulties in accessing financing are factors that inhibit innovation in the manufacturing and services sectors.

That same year, Martínez-Azúa and Sama-Berrocal (2022), surveyed 194 companies in the agribusiness sector in Spain. With 88% of the sample in SMEs, barriers such as lack of culture for innovation, lack of internal organization, lack of support from the public sector and difficulties with laws and regulations were identified. Each of the identified barriers was also classified, with the study area as a limitation.

Moving on to the following year, Khani et al. (2023), found that lack of organizational culture on the topic, lack of government support, and difficulties with laws and regulations were the main barriers to innovation in 41 carpet and leather industries in Iran. An interesting analysis of the sample was carried out using the BWM and ANOVA methods, however, the sizes of the businesses were not presented and there was a restriction in only two sectors.

Finally, Siqueira and Kodama (2023) concluded that misalignment of company values in relation to employees, unstable environment and leadership, and inefficient communication were the main barriers found in 96 Brazilian companies from various sectors. With a good sample size, a structured questionnaire with 22 questions was elaborated and a Likert scale was used to evaluate the answers. About 50% of the results corresponded to the sectors of service provision, manufacturing industry, agribusiness and trade. However, there was no comparison between the main sectors or size of the companies studied.

It is observed that similar studies were carried out in different countries, with different approaches and methodologies applied. It should be noted that in most of the studies, SMEs in general were considered, covering all sectors (services, manufacturing industry, commerce, civil construction, among others). Therefore, increasing the importance of specific work for SMEs in the manufacturing industry sector.

2.5 NATIONAL CONTEXT IN RELATION TO SUSTAINABILITY

As with innovation, the esteemed author sought to obtain information related to the theme in research contracted by specialized bodies in companies and organizations, national confederations and other bodies such as SEBRAE, SENAC, SESI, FIEP System, SESC, FECOMÉRCIO, among others. Curiously, among these institutions, the last open research

presented on the subject was published in December 2013 in the SEBRAE Final Report of that year, developed by Opinião Consultoria.

Although approximately 10 years since the publication of the document, this author understands that it is relevant to present a part of the results focused on barriers to sustainability, due to the context of the research having been carried out in 2,326 small companies in a questionnaire structured in a weighted manner between regions. Another reason is also the possibility of comparison and reflection between the results of the work and whether there were significant differences over time. Figure 9 shows the barriers that hinder sustainability actions in the day-to-day life of companies.

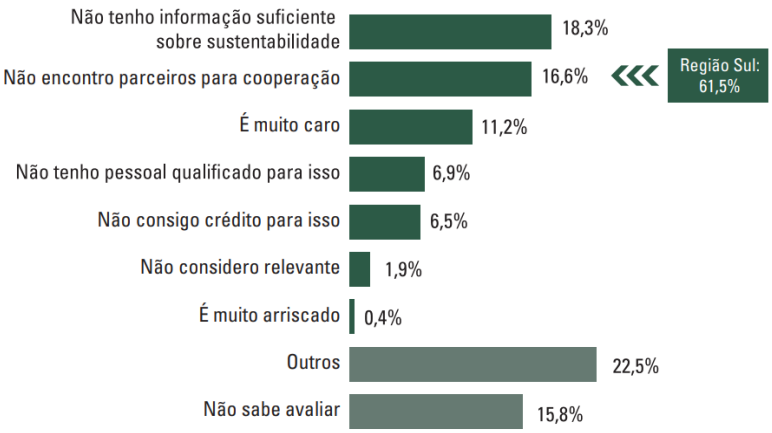

Figure 9. Barriers to sustainability actions

Source: Adapted from SEBRAE, 2013.

At that time, the main barrier to adopting sustainable actions by entrepreneurs was the lack of sufficient information on the subject in 18.3% of the sample. In a way, we can reflect that this is something expected, considering that the topic began to be more widespread among Brazilian companies precisely at that time. The fact that 11.2% answered "being too expensive" is also expected to be present among the main barriers found in that period, even justified by the economic crisis in 2012.

However, the lack of finding partners for cooperation also proved to be a relevant barrier in this research with 16.6% response in the sample and, even more, when it is highlighted that this value was 61.5% in the South region, that is, part of the place where this dissertation thesis is developed. Important information that can also be found in the development of this work. Specifying the sectors surveyed, Figure 10 presents this same distribution, although bringing the sectoral analysis.

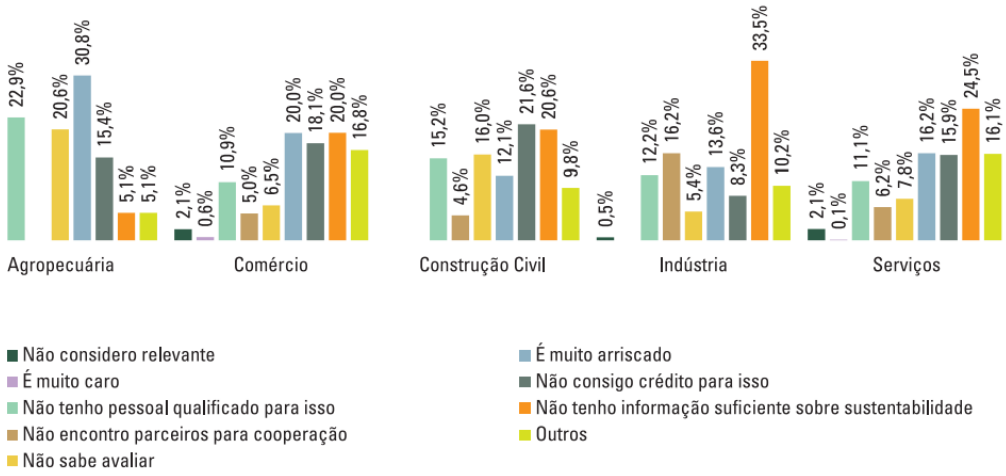

Figure 10. Barriers to sustainability by sector

Source: Adapted from SEBRAE, 2013.

Focusing on the industrial sector, it is noted that the biggest barrier to sustainability found was the lack of sufficient information on the subject, with 33.5% of the responses. Then there is the lack of partners for cooperation with 16.2% and the perception that it is too risky with 13.6%. Soon after, the lack of qualified personnel on the subject also appears with 12.2%. In macro analysis, it is also possible to notice that the barriers are different and vary according to the sector surveyed.

Recent and specific research on sustainability contracted by these institutions was no longer carried out – in the author's understanding – due to the change in perspective regarding this topic and inclusion in the ESG tripod, that is, sustainability continues to be a topic of research by confederations and company services, however included within the governance package, social and environmental aspects.

2.6 BARRIERS TO SUSTAINABILITY

Similar to what was previously exposed about barriers to innovation, barriers to sustainability also have a classification for each of their types. Therefore, initially there is the classification suggested by Bolman and Terrence (2008) in their book entitled *Reframing organizations: art, choice and leadership*. In this work, the authors classify barriers into four dimensions, very similar to the OECD (2005). These four dimensions are: structural, political, human, and cultural.

The structural dimensions are characterized by the way the organization is architected, that is, the way in which the units and branches are designed and managed, as well as their functions, rules, objectives and operating policy. The human dimensions are focused on understanding people, therefore their strengths and weaknesses, their thoughts and emotions, and their fears and anxieties (Bolman & Terrence, 2008).

In the remaining two, the political dimensions, and perhaps the most sensitive of them, are related in the way scarce resources are directed, in the competition between internal interests and in the search for advantages and powers. Finally, we have the cultural dimension, which is characterized by beliefs and the ambiguous and chaotic sense with which human beings conduct their lives (Bolman, & Terrence, 2008).

The dimensions of Bolman and Terrence (2008) are similar to what was conceived by the OECD, but they advance more deeply in the context of people and cultures. Table 9 shows a summary of each of the dimensions prepared by them, as well as the framing of the types of barriers to sustainability in each of them.

Table 8
Classification of barriers to sustainability into dimensions

Structural Dimensions	**Political dimensions**
Lack of strategy, difficulty in prioritizing objectives; Difficulty in achieving goals; Difficulty in defining the most relevant sustainable parameters; Lack of integration and cooperation; Lack of clear distribution of responsibilities; Difficulties related to decision-making; Lack of adaptation in relation to the indicators; Impossibilities related to financial capital;	Difficulty in preparing a case study and managing conflicts; Lack of time or short-term vision; Lack of alignment with other projects; Lack of relevance compared to other projects; Lack of financial resources; Lack of human resources; Lack of a specific sector to conduct the demands; Lack of R&D or innovative capacity;
Human dimensions	**Cultural dimensions**
Lack of knowledge; Lack of interest; Lack of involvement; Lack of skills and training; Difficulties connected with the learning process; Fear of losing creativity or flexibility; Fear of increasing the volume of work; Discomfort on the subject; Difficulty in finding trained professionals to teach on the subject;	Skepticism related to potential benefits; Lack of entrepreneurial spirit; It is not the company's responsibility; Sustainability is a distraction; Language-related barriers; Sustainability was not invented here; Sustainability does not work;

Source: Adapted from Bolman and Terrance, (2008).

Another classification on the subject, and very similar to the one elaborated by Hadjimanolis (2003) on innovation, was developed by Souza (2013) through the combination of several authors from various topics and, first, focused on the barriers of green supply chain management. However, with some adaptations, it is understood that this classification also fits perfectly to the conditions of barriers to sustainability, even due to the relationship and interaction between the themes. The classification is basically distributed into internal factors and external factors.

Internal factors correspond to costs, human resources, internal continuous improvement process, availability of resources and the values of the organization. On the other hand, external factors are related to technology, government regulations and laws, competition, society, and corporate image. Table 10 shows a summary of this classification, its subtopics, and the types of barriers involved in each of them.

Table 9
Classification of barriers to sustainability into internal and external

External factors:	Internal factors:
Technology: lack of strategy to invest in new processes, difficulty in understanding the need for change, lack of a bank of ideas for employee suggestions	Organization values: low focus on environmental needs, lack of training, lack of awareness campaigns and need to increase the number of employees
Government regulations and laws: need to comply with regulatory requirements, lack of knowledge of the laws	Human resources: lack of employee interest, lack of training, lack of bonuses, and need for layoffs
Competition: lack of strengthening of internal policies, lack of knowledge of new market strategies	Costs: lack of understanding of cost needs, lack of clarity in strategy and cost-benefit of investments
Society: lack of market positioning, lack of compliance with laws	Continuous improvement: lack of certifications on the subject, lack of requirement in qualitative guidelines, lack of audits
	Availability of resources: lack of a specialized sector on the subject, lack of understanding of the need for investment in this area, difficulty in justifying investments in this direction

Source: Adapted from Souza, 2013.

2.6.1 Studies involving barriers to sustainability

Entering the academic area of research studies involving barriers to sustainability in Brazil and other countries, table 11 shows a summary similar to the one built on barriers to innovation, as a way to synthesize the main studies found and, subsequently, compare the results with those of this research.

Table 10
Summary scheme of similar studies – barriers to sustainability

Authors	Location/Sample size	Main barriers	Considerations
(Jaramillo et al., 2018)	Literature review involving 46 works between 2013 and	Lack of resources; High initial cost for implementation; Lack of	Literary revision that involved several sectors; Work for contribution to the theoretical framework;

	2017; Study carried out in SMEs;	knowledge on the subject;	
(Bakos et al., 2019)	Literature review involving 122 studies between 2013 and 2019 in several countries; Study carried out in SMEs;	Lack of resources; High expected turnaround time; Lack of government support or regulations;	Only 22% of the sector surveyed corresponds to the industrial sector; Most of the studies found were developed in Europe and one in Brazil;
(Oliveira et al., 2021)	Work was developed in 24 SMEs in the Brazilian metallurgical sector;	Lack of knowledge on the subject; Lack of resources; Employees with resistance to change;	Work was developed in the metallurgy sector; Descriptive analysis and Fuzzy TOPSIS were used; Research in a specific sector and different from what will be done in this work, however the approach is interesting
(Caldera et al., 2019)	Research conducted in 20 SMEs in Queensland, Australia; Various industrial sectors;	Lack of resources; Lack of time; Lack of knowledge on the subject; Risk associated with implementation; Regulations and laws;	The study included several excerpts from the interviews, used a semi-structured questionnaire and classified the answers in different scales; It also included quality tools in the research; Low sampling;
(Madrid-Guijarro & Duréndez 2023)	Study carried out in 351 SMEs in Spain; Miscellaneous sectors;	Lack of time; Lack of resources; Fear of losing competitiveness; Lack of training; Difficulty in combining sustainability with the company's business plan;	Quantitative study using PLS to test hypotheses; 30% of the sample was carried out in the industrial sector; 56% in the service sector; Questionnaire sent by email using a Likert scale;
(Alayón et al., 2022)	Literature review between 1999 and 2018 with 32 works in SMEs industrial sector;	Lack of access to technical knowledge; Lack of skill of employees; Lack of knowledge; It talks about resources;	Study identified barriers and facilitators; It did not specify sectors or the main countries of the studies found;
(Steur et al., 2019)	Study carried out in 64 SMEs in the winemaking sector in Italy	Need for additional effort; Abuse of the concept of sustainability; Bureaucracy (regulations); Lack of time; Lack of resources;	Interview structured in an exploratory manner; The Likert scale was used; Study presented new barriers; Conducted in only one sector;
(Cantele & Zardini 2019)	Survey of 348 SMEs from various sectors in Italy;	Lack of resources; Lack of time; Fear of losing competitiveness;	Sent a structured questionnaire to more than 3500 Italian SMEs; They related the pressures, barriers and benefits for sustainability; The sectors surveyed were not specified;
(Neri et al., 2021)	Survey of 26 SMEs in the chemical and metallurgy sectors in Germany and Italy;	Bureaucracy; Lack of tempo; Lack of resources;	Conducted semi-structured interviews with the main managers; They classified them into internal and external barriers; Labor divided and compared the barriers between countries; Low sampling;
(Costache et al., 2021)	Study with 71 SMEs in Romania;	Lack of resources; Lack of human resources; Government responsibility;	They performed a structured questionnaire and descriptive analysis of the results; Study related barriers with facilitators; It did not identify the sectors surveyed;
(Mahmood et al., 2019)	200 SMEs from Pakistan;	Lack of resources; Lack of training; Lack of knowledge;	The research carried out a structured questionnaire and 8 semi-structured interviews with managers; Did not perform

	descriptive analysisDid not inform the sectors analyzed;

Source: Prepared by the author.

Jaramillo et al. (2018), verified, through a systematic review between the years 2013 and 2017, that the main barriers to sustainability in SMEs were: lack of resources, the high initial cost of implementing actions and lack of knowledge on the subject. The work involved 46 articles from different countries and a total of 175 barriers were found. Interestingly, only one study was found on the subject in Brazil and only two in South America. The work also classified the barriers into internal and external and suggested relating them to barriers to innovation in future studies.

Bakos et al. (2019), also in their systematic review work, identified that the main barriers to sustainability in SMEs between the years 2013 and 2019 were: lack of resources, high expected time for return on investment, and lack of government support or legislation. This research had a total of 122 studies, with the vast majority being carried out in European territory and 22% in SMEs in the industrial sector. Only one study has been developed in Brazil and, again, the lack of resources is repeated as the main barrier to sustainability found so far.

Oliveira et al. (2021), developed their research on barriers to sustainability in 24 SMEs in the Brazilian metallurgy sector. They conducted exploratory research with a structured questionnaire, descriptive analysis, and Fuzzy TOPSIS methodology to evaluate the results. The main barriers identified in this sector were: lack of knowledge on the subject, lack of resources and employees with resistance to change. Although the research was carried out in a specific sector, different from what will be developed in this work, the way the researchers analyzed and approached the research methodology was interesting.

Caldeira et al. (2019), conducted a study in 20 SMEs in the industrial sector in the state of Queensland in Australia. They used a semi-structured questionnaire and interviews with the directors of the companies, including some excerpts from the interviews in the body of the article. The main barriers to sustainability found were: lack of resources, lack of time, lack of knowledge on the subject, risk associated with implementation, regulations and laws. The authors took advantage of the research and included some topics related to continuous improvement and certifications at work.

Madrid-Guijarro and Duréndez (2023), sent a structured questionnaire, with a Likert scale, to 2,000 SMEs from various sectors in Spain. With a total of 351 respondents, they used the PLS model to test the hypotheses. With a sample of 30% of the industrial sector, the main

barriers found were: lack of time, lack of resources, fear of losing competitiveness, lack of training and difficulty in uniting sustainability with the company's business plan. Of the total, 56% of the results correspond to companies in the service sector.

Alayón et al. (2022), also in a study involving a literature review, identified in 32 studies in various manufacturing companies, between 1999 and 2018, that the main barriers were: lack of access to technical knowledge, lack of employee skills, lack of knowledge, and lack of resources. However, the study did not mention the main sectors of the study, as well as the main countries in which the work was developed.

Steur et al. (2019), developed a study in 64 SMEs in the winemaking sector in Italy. In personal interviews with the heads of the companies, with structured questionnaires and using the Likert scale, they identified that the main barriers to sustainability were: the need for additional effort on the subject, abuse of the concept of sustainability, bureaucracy related to laws and regulations, lack of time and lack of resources. Emphasis on the different barriers when compared to previous studies.

Cantele and Zardini (2019), in a structured questionnaire, identified that the main barriers to sustainability in 348 SMEs in Italy are: lack of resources, lack of time, and fear of losing competitiveness. The study also related the pressures and benefits to sustainability, however, the sectors that had the greatest representation in the sample were not mentioned.

Neri et al. (2021), found that the main barriers to sustainability in the 26 SMEs studied in Germany and Italy were: bureaucracy, lack of time, and lack of resources. Semi-structured interviews were conducted with the managers of companies in the metallurgy and chemical sector. Authors classified the barriers and compared them between countries. However, the limitation was due to the low sampling.

Costache et al. (2021), conducted the survey in 71 SMEs with the main managers in a structured questionnaire. The barriers to sustainability that had the highest percentage of points were: lack of resources, lack of human resources and government responsibility. The latter is new, so that 35% of Romanian managers understand that sustainability should be driven and managed by the government, not by companies. The study did not identify the sectors studied.

Mahmood et al. (2019) sent 200 structured questionnaires and conducted 8 semi-structured interviews with managers of SMEs in Pakistan. The main barriers found were: lack of resources, lack of training and lack of knowledge. No descriptive analysis of the results was performed. The sample sectors were also not presented. It was not possible to understand in the survey whether the results were based only on the interviews, only on the questionnaires, or on the combination of the two.

Although several studies were evaluated in different countries and sectors, the barriers to sustainability that appeared most frequently in this literature review were: lack of resources (11), lack of knowledge/training (6) and lack of time (5). Other barriers such as bureaucracy, laws and regulations, lack of human resources, among others, were also identified in these studies, although less frequently.

2.7 CONCEPTUALIZING THE MAIN BARRIERS

Considering the conditions of business size and cash flow volume of SMEs, the **lack of financial resources** is widely found as the main barrier to innovation (Auer & Jarmai, 2018; Beyer, 2022) and sustainability (Costache et al., 2021; Mahmood et al., 2019). in all literature. The available resources of organizations end up conflicting with other areas. With the lack of financial resources, it practically makes it impossible to invest in these practices, in addition to forcing other barriers such as lack of human resources, lack of specific area for these activities, among others, to also accompany it (Hadjimanolis, 2003).

The lack of technical knowledge or qualification of the workforce is another barrier commonly identified in organizations (Alayón et al., 2022; Auer & Jarmai 2018; Jaramillo et al., 2018; Roldan et al., 2013). In a study carried out in India, Pachouri and Sharma (2016) concluded that 85% of Indian SMEs understand that their teams are not prepared with adequate knowledge to innovate. They also found that most organizations have less than 10 employees with a technical level on some topic and more than 50% reported not having any scientist or engineer in their business. Considering that it is an emerging country, it is possible that these same conditions are found in its peers (Raghuvanshi & Agrawal 2020).

Considering the size of the business, the reduced number of human resources, and the volume of work that each employee ends up covering in their activities, **lack of time** becomes a significant barrier for SMEs. Several studies present this barrier as one of its main ones, regardless of the country, the sector or the type of business involved (Baz et al., 2016; Cantele & Zardini, 2019; Neri et al., 2021).

The **bureaucracy** It is a barrier commonly found in emerging countries that are still in full development. These are government laws and regulations that, due to high bureaucracy in place, end up making it difficult for SMEs to invest their resources in innovation and sustainability (Beyer, 2022). In addition, laws have several variations between countries, and, in addition, they can alternate within the same nation between states, such as the different

environmental regulations that occur in Brazil, which present differences between state governments.

Another barrier found is the **high cost for sustainability and innovation,** which is the difficulty related to the financial amount to be spent for the development of actions or investments for innovation. It is the perception that the owner or partners have and that can be an impediment to including the topic in internal discussions or in the strategic planning of companies (Beyer, 2022).

Uncertainties **about the future and economy** are also barriers commonly found in companies. Uncertainties that permeate from the institution's own financial health in relation to the future, as well as changes in the political situation, agreements and disagreements of the world economic blocs, wars, among others (Cabral, 2015; Cordeiro & Vieira, 2012).

In another research, which aimed to identify the variables that affect investor sentiment, Marschner & Ceretta (2021) point out that there is a consensus on the importance of investor sentiment in the financial, accounting, and economic literature, with several theoretical and empirical works documented and discussed. In this research, it was concluded that political and/or economic uncertainties can generate unfavorable impacts on companies, causing demotivation of production and investments, but also on families, causing a reduction in consumption.

Another study, which aimed to investigate how political and economic uncertainty affects investments in innovation in American companies, Chen and Xu (2023) concluded that these uncertainties have a significant negative impact on investments in innovation, resulting in companies tending to reduce spending on research and development and tend to postpone decisions about innovation when faced with periods of economic and political uncertainty, especially smaller companies, which have greater difficulties in absorbing risks.

Ghani and Parsa (2022), in a similar study that aimed to examine the relationship between political instability and investments in innovation from the perspective of the institutions of each country, also concluded that this uncertainty has a negative impact on investments in innovation, however good governance and institutions with greater robustness can be protective factors for these risks.

Resistance **to change** is also an impediment to investments in innovation and sustainability. This resistance may come not only from company employees, but also from managers and owners, who may not believe that investments in these areas are important, or that they can improve institutional processes, and hinder progress on these issues (Alshwayat et al., 2022; Roldan et al., 2013).

Another barrier identified in this theoretical framework is characterized by **the difficulty of measuring the return on** investments in innovation and sustainability. Some studies have pointed out that managers stop investing in these topics because they understand that the financial return has a low guarantee or inability to be quantified (Auer & Jarmai, 2018; Bakos et al. 2019).

The difficulty of measuring return on investments is widely discussed in the scientific community. Friede et al (2023), in their systematic literature review, which aimed to understand how companies that invest in sustainable environmental practices are able to measure financial return, concluded that although there is a positive correlation between investments in sustainability and financial performance, the measurement of these effects is difficult due to the lack of comparable data and the variability of environmental impacts over time. They also concluded that there is a need for new methodological approaches and standardization of environmental criteria in traditional financial models.

Another article that addresses this topic was developed by Porter and Kramer (2021). The work aimed to investigate how investments in green innovations and sustainable environmental practices could impact the financial performance of companies. Based on a case study, they concluded that although these investments can result in significant financial results in the long term, there is difficulty in quantifying the benefits in the short term. They also found that companies that make investments in environmental sustainability often face difficulties in separating direct financial returns from intangible benefits. They concluded that the lack of robust methods for measuring long-term financial impacts limits investments in this area.

Some other barriers commonly found in studies, although less frequently than the previous ones, are: **lack of institutional support, lack of profitability, perception of high risk involved, lack of credit availability, highly competitive pressure, lack of information about technologies, lack of research and development, lack of innovative ideas, and lack of demand** (Neri et al., 2021; Raghuvanshi & Agrawal, 2019).

2.8 CONSIDERATIONS ON THE CHAPTER

It was observed the existence of several studies related to barriers to innovation and barriers to sustainability in small and medium-sized manufacturing industries in various locations and countries. By verifying them, it is possible to notice the different forms of sampling, different methodologies of data collection and analysis. In general, despite the

different sectors and types of companies, some similar results were found in relation to the barriers identified in these studies, the most frequent being listed in Table 12.

Table 11
Summary scheme of barriers and authors

Barrier	Authors	Description
Lack of financial resources	Alayón et al., 2022; Auer & Jarmai, 2018; Bakos et al., 2019; Beyer, 2022; Caldera et al., 2019; Cantele & Zardini 2019; Costache et al., 2021; Cordeiro & Vieira, 2012; Jaramillo et al., 2018; Madrid-Guijarro & Duréndez 2023; Mahmood et al., 2019; Neri et al., 2021; Oliveira et al., 2021; Steur et al., 2019	Low volume in cash flow generates conflict of available resources between areas and prevents investment in innovation and sustainability
Lack of technical knowledge or qualification of the workforce	Alayón et al., 2022; Antonioli et al., 2017; Auer & Jarmai, 2018; Beyer, 2022; Cabral, 2015; Caldera et al., 2019; Jaramillo et al., 2018; Mahmood et al., 2019; Oliveira et al., 2021; Roldan et al., 2013	Employees are not prepared to conduct or participate in innovative and sustainable projects
Lack of time	Alshwayat et al., 2022; Caldera et al., 2019; Cantele & Zardini 2019; Madrid-Guijarro & Duréndez 2023; Neri et al., 2021; Steur et al., 2019	Small and medium-sized businesses have a reduced number of employees, who develop activities in several areas with a high volume of work, making it impossible to advance in other topics
Bureaucracy or difficulty with laws and regulations	Auer & Jarmai, 2018; Beyer, 2022; Caldera et al., 2019; Neri et al., 2021; Steur et al., 2019	The difficulty in understanding laws and regulations makes it difficult to invest in the areas of innovation and sustainability
High cost	Antonioli et al., 2017; Beyer, 2022; Cabral, 2015; Cordeiro & Vieira, 2012; Jaramillo et al., 2018;	Company owners understand that investments in innovation and sustainability demand high financial value, so they do not discuss these issues
Uncertainty about the future and economy	Cabral, 2015; Cordeiro & Vieira, 2012;	Political changes, global economic volatility and unpredictability about the future prevent investments in innovation and sustainability

Resistance to change	Alshwayat et al., 2022; Cordeiro & Vieira, 2012; Oliveira et al., 2021; Souza & Bruno-Faria, 2013; Roldan et al., 2013	Pragmatic employees, managers and/or owners hinder changes in companies and sectors
Difficulty in measuring the return	Auer & Jarmai, 2018; Bakos et al., 2019	The lack of guarantee of return or inability to quantify it are barriers that prevent investment in innovation and sustainability

Source: Prepared by the author (2024).

All the studies and articles found in the literature review presented us with an extensive range of barriers to innovation and sustainability, even having a certain similarity despite the differences between the characteristics of these types of investments. The table in the previous figure presents us with a summarized scheme of the barriers that were most frequently identified in the results of these articles, as well as the authors and the description of each of them.

The criterion used for the elaboration of this abstract was the identification of barriers with frequencies in at least two studies found. For example, the "difficulty in measuring return" was a barrier found in the studies by Auer and Jarmai (2018) and Bakos et al. (2019), unlike "lack of profitability" in which it was identified by only one author among the several verified and, therefore, was not used.

This criterion was established due to the need to synthesize the barriers to the construction of the questionnaire, which would be too extensive if this artifice were not performed. The description presented in Figure 18 was also used to formulate the questions present in the questionnaire that was later sent for data collection.

3 RESEARCH METHOD AND TECHNIQUES

In this chapter, the entire planning of the research is detailed, ranging from the concepts and framing of the study, to the way the data were collected, the size of the sample explored, as well as the main analyses involved for the subsequent construction of the results.

3.1 RESEARCH DESIGN

Regarding the approach, it is quantitative research. Quantitative research is characterized by presenting relationships that may not be so clear to the researcher. This type of research also prevents the researcher from being led to have false impressions by other qualitative data statements (Eisenhardt, 1989). Quantitative research is justified in this work because it is a descriptive statistical analysis of data and a correlation matrix to verify the behavior between variables.

As for nature, considering that the study seeks to identify and solve concrete problems, it is applied research. In other words, it seeks to assist government and private entities in identifying problems that may put the health of business, the economy and the environment at risk (Zanella, 2009).

The objectives are considered descriptive. This type of investigation is characterized by non-interference in the observed facts, only the recording and description. It aims to establish relationships between variables, describing the characteristics of a given phenomenon or a given population (Prodanov & Freitas, 2013). It tends to use standardized techniques, such as questionnaires for data collection (Cooper & Schindler, 2003).

Regarding the means, it is classified as a survey study. This type of medium is characterized by the direct involvement of people, as a way of obtaining direct information through some type of questionnaire. The main advantages for this type of survey are in the economy, speed, direct contact with reality and quantification (Prodanov & Freitas, 2013).

3.2 DATA COLLECTION PROCEDURES

3.2.1 Sampling

The Western region of Paraná has approximately 8 thousand active manufacturing industries (FIEP, 2023). According to the Paraná State Finance Department, this number is responsible for generating around R$ 26 billion of the regional GDP, which corresponds to approximately 14% of the state's industrial gross domestic product (IPARDES, 2023).

In this study, it was decided to carry out accessibility or convenience sampling. Sampling of this type is characterized by the selection of elements to which the researcher has access, assuming that these elements may be representative of the universe (Gideon, 2012). The

convenience criterion used, due to direct framing with the target audience to be reached in this research, was that of industries served by SEBRAE in the Western region of Paraná, which enabled contact with manufacturing industries in the region and different sectors of activity, minimizing the possibility of the sampling being biased and promoting randomness and representativeness before the universe.

Neri et al. (2021) used a sample of 26 industries from the chemical and metallurgy sectors to represent SMEs in Italy and Germany in their study to identify barriers to sustainability. Caldeira et al. (2019) also researched the barriers to sustainability with 20 SMEs representing the Queensland region of Australia. Therefore, considering all the above, a sample value similar to that explored by other researchers may be representative in the regional context studied. Table 13 shows the 25 companies participating in the survey, as well as the city in which it is established, the respondents' position and the sector in which it operates.

Table 12
Summary table of sampling

ID	City	Respondent Job Title	Industry
1	Cafelândia	Supervisor	Foods
2	Marshal Cândido Rondon	Supervisor	Foods
3	Marshal Cândido Rondon	Supervisor	Drugs
4	Marshal Cândido Rondon	Owner	Metallurgy
5	Rattlesnake	Owner	Mobile
6	Rattlesnake	Owner	Mobile
7	Blue sky	Supervisor	Foods
8	Blue sky	Supervisor	Foods
9	Rattlesnake	Owner	Chemists
10	Toledo	Manager	Foods
11	Toledo	Owner	Foods
12	Toledo	Manager	Metallurgy
13	Foz do Iguaçu	Owner	Hygiene and cleanliness
14	Rattlesnake	Owner	Metallurgy
15	Rattlesnake	Owner	Metallurgy
16	Marshal Cândido Rondon	Owner	Mobile
17	Rattlesnake	Owner	Metallurgy
18	Rattlesnake	Owner	Mobile
19	Rattlesnake	Owner	Chemists
20	Toledo	Manager	Metallurgy
21	Rattlesnake	Manager	Chemists
22	Rattlesnake	Supervisor	Chemists
23	Rattlesnake	Owner	Hygiene and cleanliness
24	Toledo	Manager	Metallurgy
25	Rattlesnake	Owner	Textile

Source: Survey data.

3.2.2 Questionnaire

The research technique used was characterized by extensive direct observation through the application of a questionnaire. This technique consists of an ordered series of questions without the presence of the researcher. The questionnaire is sent directly to the informant who, agreeing with the terms provided, responds to the investigator (Marconi & Lakatos, 2010). In order to clearly highlight the objectives of the research, the importance of the results and the need for clear and reliable answers, according to this reference, the header of the form was constructed so that they can really present results consistent with the subject investigated, which can be verified in the appendix.

There are several advantages and disadvantages to this type of research technique. The main advantages, which are in line with the sample of this study, are the coverage of a wider geographical area, savings in time and travel, obtaining faster and more accurate answers, greater freedom of answers due to anonymity, greater security due to the fact of not having identification, greater flexibility in response time and greater uniformity in the evaluation. The main disadvantages are the low percentage of questionnaires answered, the impossibility of helping the informant, and one question can influence the answer of the other (Marconi & Lakatos, 2010).

Based on Marconi and Lakatos (2010), the questionnaire was elaborated seeking to achieve the objective with clarity and effectiveness, having been considered from the order of the questions to their proper formulation, which was developed based on the articles verified in the theoretical framework and arranged in figure 18 above.

Table 14 shows the data collection instrument used and the appropriate references. The barriers to innovation were grouped according to the classification of Hadjimanolis (2003), while the barriers to sustainability were grouped according to the classification of Bolman and Terrance (2008), both previously detailed.

Table 13
Aspects covered and references

Introductory questions		
Sectorization	City, position and sector of activity	
Company size	Number of employees and management	
Barriers to innovation (Hadjimanolis, 2003)		
Strategy-related	Lack of financial resources High initial cost	Antonioli et al, 2017; Auer & Jarmai, 2018; Beyer, 2022; Cordeiro, & Vieira, 2012;

Structure-related	Lack of time	Alshwayat et al, 2022; Antonioli et al, 2017; Auer & Jarmai, 2018; Beyer, 2022; Cabral, 2015; Roldan et al, 2013;
Related to people	Lack of technical knowledge or qualification	Alshwayat et al, 2022; Antonioli et al, 2017; Auer & Jarmai, 2018; Beyer, 2022; Cabral, 2015; Roldan et al, 2013;
	Resistance to change	
Government-related	Laws and regulations	Auer & Jarmai, 2018; Beyer, 2022; Martínez-Azúa, & Sama-Berrocal, 2022; Khani et al, 2023
Market-Related	Difficulty in measuring the return	Auer & Jarmai, 2018;
	Uncertainties about the future and/or economy	Cabral, 2015; Cordeiro & Vieira, 2012;
	Barriers to sustainability (Bolman and Terrance, 2008)	
Political dimensions	Lack of financial resources	Alayón et al, 2022; Bakos et al, 2019; Caldera et al, 2019; Cantele & Zardini, 2019; Costache et al, 2021; De Steur et al, 2019; Jaramillo et al, 2018; Madrid-Guijarro & Duréndez, 2023; Mahmood et al, 2019; Neri et al, 2021; Oliveira et al, 2021;
	High initial cost	Jaramillo et al, 2018;
Human dimensions	Lack of time	Caldera et al, 2019; Cantele & Zardini, 2019; De Steur et al, 2019; Madrid-Guijarro & Duréndez, 2023; Neri et al, 2021;
	Lack of technical knowledge or qualification	Alayón et al, 2022; Caldera et al, 2019; Jaramillo et al, 2018; Mahmood et al, 2019; Neri et al, 2021; Oliveira et al, 2021;
	Laws and regulations	Bakos et al, 2019; Caldera et al, 2019; De Steur et al, 2019; Neri et al, 2021;
Cultural dimensions	Resistance to change	Oliveira et al, 2021;
Structural difficulties	Difficulty in measuring the return	Bakos et al, 2019;
	Uncertainties about the future and/or economy	Cabral, 2015; Cordeiro & Vieira, 2012;

Source: Prepared by the author (2024).

All questions related to the main objective of the work, which is to identify the main barriers to innovation and sustainability, as well as the relationship between them, were elaborated with answers using the Likert agreement scale. This proposition suggests a unified scale, making it possible to identify meaning and intensity in each item (Lucian & Dornelas, 2015). Therefore, the answers ranged from "strongly disagree" to "strongly agree", with a ranking between 1 and 5.

As a way to improve and verify the effectiveness of the questionnaire elaborated, a "pre-test" was carried out in the first companies interviewed. The performance of a previous test aims to identify potential problems that may occur during the data collection period, as well as to optimize the questionnaire and achieve greater efficiency in the responses, observing the reactions and the good progress of the information collected (Prodanov & Freitas, 2013). The preliminary test was intentionally carried out in two companies with professionals who already had a master's degree and with the other in the final phase to complete this level of education, therefore, people capable of determining the validity and efficiency of the questionnaire. After

this application, the professionals presented positive feedback regarding the clarity of the text of the questions, the construction of the questionnaire and the speed of conclusion, due to the vast majority of the questions being closed to mark. They suggested detailing the objective of the work in the introduction of the questionnaire, which was accepted and done. These answers were also used in the data analysis. The full questionnaire, with a total of 20 questions, can be found in the appendix.

3.2.3 Collection procedures

In view of the entire sample context and with the appropriate companies that meet the criteria of sector and size, using the tool *Google Forms*, the questionnaire was sent via email to collect the information that took place between October 29, 2024 and November 13, 2024. SEBRAE reported difficulties in adhering to data collection in recent surveys carried out by the agency, so to ensure greater effectiveness in the number of responses, a messaging application was used to assist in the dissemination of the survey.

Therefore, the research and data collection technique performed is defined as extensive direct observation, which occurs through a questionnaire or form. Thus, the data collected are characterized as primary, as they are obtained through the work of the researcher himself and extracted from reality (Prodanov & Freitas, 2013).

Of the total number of forms sent, a total of 25 responses were presented with the industries available in the region, which were established in the cities of Cascavel, Toledo, Marechal Cândido Rondon, Cafelândia, Céu Azul and Foz do Iguaçu. As the targeted public already met the requirements for the analysis of the work and as all questionnaires were answered correctly in their entirety, there was no need for exclusion.

Considering the sample representativeness calculations presented in the previous topic, it is noted that a sample of 25 industries is lower than the ideal estimate of 96 samples, which would point to a sampling error of 10% with a confidence interval of 95%. For calculation purposes, with a sample of 25, there is a margin of error of 19.5% with the same confidence interval, i.e., slightly higher than the ideal reasonable estimate. This margin of error may be one of the limitations of the work, however, considering a convenience sampling, in which the companies indicated were randomly presented, that the sample is well distributed in terms of location, size of the companies and sectors of operation and that the objective of the

work is to understand patterns, a sample of 25 industries can be representative for the universe studied.

3.3 PROCEDURES AND DATA ANALYSIS

At first, classifying data through selection is the best way to interpret them (Marconi & Lakatos, 2010). Thus, a critical analysis of all the information annotated was carried out in order to detect flaws, errors, or distorted and incomplete information that may interfere with the result of the research (Birochi, 2015).

As a way of comparing with the research carried out and presented in the theoretical framework, descriptive statistics were used for data analysis. In this case, Barbetta (2010) was the main reference in the development of calculations of proportions, percentages, standard deviation, media, mode and other methods of exploratory data analysis. Various graphs were also developed to assist in the visualization of information.

As the questionnaire made it possible to answer with grading using the Likert scale, the answers were enumerated as follows: I totally disagree with value 1, I disagree with value 2, I am indifferent with value 3, I agree with value 4 and I totally agree with value 5. Thus, for each item that suggests a certain barrier, the average of the response values was performed as a way to identify the intensity of each one of them. After the average of the answers for each item, the barriers were ordered through the grading scale, with values close to 5 indicating a greater tendency towards a given barrier, values close to 1 indicating less relevance. After identifying the means for each item, the barriers were ordered from highest to lowest, as a form of subsequent comparison and verification of correlation between them.

To verify whether there is a relationship between the barriers to innovation and the barriers to sustainability, a correlation analysis was performed between the variables using a correlation matrix. A correlation matrix is a statistical tool used to analyze and measure the relationship between two or more variables in a data set. It presents the degree and direction of the correlation, which can be positive, negative, or non-existent (Field, 2013).

The main measure used to quantify this relationship is Pearson's correlation coefficient (r), which ranges from -1 to 1. An r-value close to 1 indicates a strong positive correlation, close to -1 a strong negative correlation, and close to 0 means that there is no significant linear correlation between the variables. The associated p-value (p-value) tests the statistical significance of the correlation. A p-value below 0.05 is considered indicative of a statistically

significant correlation. These indicators are fundamental to understand whether the variables are associated in a relevant way (Field, 2013).

3.4 LIMITATIONS OF RESEARCH METHODS AND TECHNIQUES

Small and medium-sized companies are represented by several sectors of activity, with different regional characteristics. This research was limited to studying only manufacturing industries present in the western region of Paraná, considering some sectors and micro, small and medium-sized companies. Also considering the large number of existing barriers identified in the theoretical review, there was a need to prioritize the research using 8 of them.

4 ANALYSIS AND INTERPRETATION OF RESULTS

In this topic, the results obtained after data collection from the responding companies will be presented, as well as all the details carried out to analyze this information and discussions around the results obtained.

4.1 PROFILE OF THE RESPONDING INDUSTRIES

Before starting the analysis of the barriers to innovation and sustainability, we chose to elaborate this topic to understand the profile of the sample collected, such as the cities in which the industries operate, the positions of the respondents, the sector of operation of each company, as well as the size of each one of them. In figure 11 it is possible to verify the cities in which the responding industries operate.

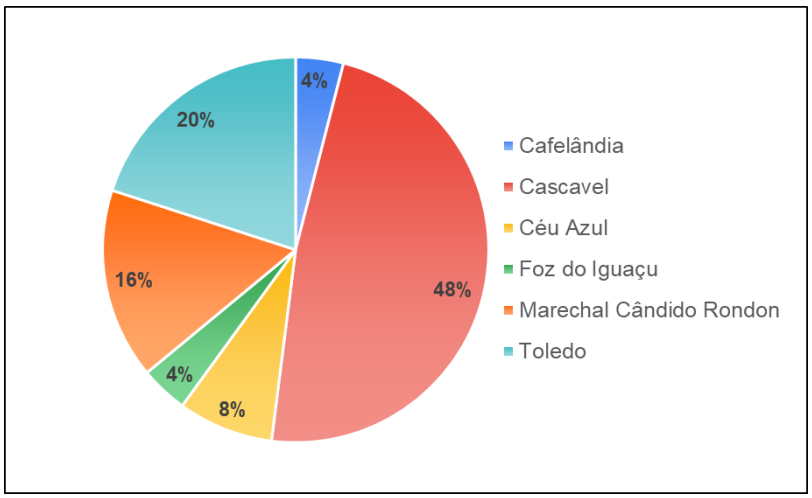

Figure 11. Location of the responding industries

Source: Survey data.

Considering that Cascavel, Toledo, Marechal Cândido Rondon and Foz do Iguaçu are present among the five main cities in the western region of Paraná in terms of criteria such as population, GDP and number of industries, it can be seen that the data collected by the respondents also follow this proportion and coherence as to the degree of regional importance of the municipalities, with Cascavel as the main city in the region and the largest slice of the graph with 48% of the total manufacturing industries present in the database.

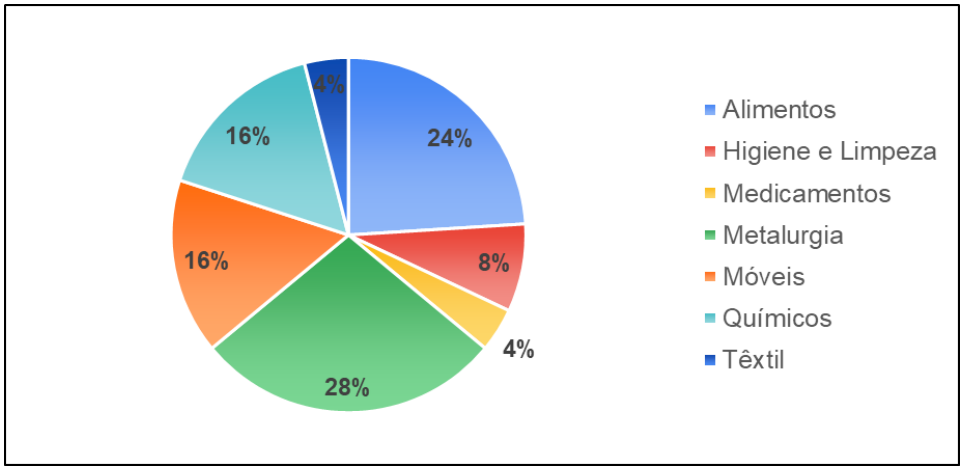

Figure 12. Sectors of activity

Source: Survey data.

Similarly to the cities, the profile of the sectors of the respondent manufacturing industries follows a certain proportion in terms of the companies in this area present in the region. As the industries in the food, metalworking (metallurgical), furniture, and chemical sectors are among the five most important (FIEP, 2023), it can be seen in the figure that this same coherence is obtained among the respondents, with these industries representing more than 80% of the data collected with the metallurgy and food sectors having the largest slices in the graph.

Table 14

Distribution of the size of the companies surveyed

Size	Quantity	Percentage
Medium	6	24%
Micro enterprise	13	52%
Small	6	24%

Source: Survey data.

Considering that most of the existing companies, not only in the western region of the state, but as a characteristic throughout the country, are classified as micro and small companies, this same profile condition was obtained after data collection from the respondents, with 76% of the total belonging to this same classification niche in terms of size. Results that also demonstrate coherence regarding the regional universe researched.

Table 15

Respondents' profile

Responder	Quantity	Percentage
Manager	5	20%
Owner	14	56%
Supervisor	6	24%

Source: Survey data.

The presentation of the respondents' profile is important for understanding the characteristics and trends in the responses. It is noted that just over half of the data collected came from business owners, who tend to focus more on financial viability and short-term survival (Beck & Dozzi, 2015). With 44% of the total answered, managers and supervisors begin to emphasize conditions such as resistance to change, lack of financial and human resources in their work routine (Kara & Boles, 2014). Therefore, the distribution of the profile among respondents can be more inferred for these conditions.

4.2 RESULTS OF BARRIERS TO INNOVATION

In view of the knowledge of the general aspects of the sample, we move on to understanding the results obtained through the answers collected by the questionnaire. Thus, in table 17 it is possible to verify the ordered results of the main barriers to innovation obtained, as well as descriptive statistics for each of them.

Table 16
Results of barriers to innovation

Barriers to Innovation	Average	Standard deviation	Variance
Lack of financial resources (FRF)	3,64	1,11	1,22
Lack of technical knowledge (FCT)	3,24	1,08	1,2
Lack of time (FT)	2,64	1,1	1,13
Laws and regulations (DLR)	3,32	1,27	1,43
High Initial Cost (ACI)	3,88	0,86	0,72
Political and/or economic uncertainties (IPE)	3,96	0,93	0,84
Resistance to change (RM)	2,92	1,3	1,71
Difficulty measuring return (DMR)	3,36	1,17	1,4

Source: Survey data.

As can be seen in the table, arranged ordinally according to the questionnaire, the barrier that presented the highest average on the scale, according to the industries collected, is related to Political and/or economic uncertainties with 3.96. Among other words, the main impediment that promotes greater influence on the entrepreneur's decision when it comes to investments in innovation occurs due to the difficulty of understanding and clarity of the conduct of the rulers and the economic future of the country and the planet. It is also noted, compared to the other barriers, that the standard deviation and variance obtained for this one present one of the lowest values, that is, it is understood that there was greater homogeneity in the answers due to less dispersion of the data. Therefore, with a value close to 4 on the scale, the respondents point out

that the main barrier to investments in innovation is characterized by political and/or economic uncertainties.

The result found differs from the survey conducted by CNI in 2020, as can be seen in figure 8 of this work, in which political and economic uncertainties did not appear among the main barriers identified among the 402 companies in the national territory, mainly comprising internal financial conditions. However, political and/or economic uncertainty is also present in small and medium-sized enterprises in Portugal (Cordeiro & Vieira, 2012) and in the state of Ceará in the Brazilian scenario (Cabral, 2015).

As an aid in the visualization of the results and seeking to deepen the analysis, Table 18 presents the results in an ordinal manner and the frequency of response for each of the barriers surveyed.

Table 17
Frequency of response for each barrier

Barriers to innovation	Average	Strongly disagree (1)	Disagree (2)	Indifferent (3)	Agree (4)	Totally Agree (5)
Political and/or economic uncertainties	3,96	4%	8%	12%	40%	36%
High initial cost	3,88	0%	12%	12%	52%	24%
Lack of financial resources	3,64	4%	16%	12%	48%	20%
Difficulty measuring return	3,36	8%	20%	8%	56%	8%
Difficulties with laws and regulations	3,32	8%	24%	12%	40%	16%
Lack of technical knowledge	3,24	4%	32%	4%	56%	4%
Resistance to change	2,92	12%	36%	12%	28%	12%
Lack of time	2,64	8%	52%	12%	24%	4%

Source: Survey data.

By exposing the frequency of responses obtained by each barrier, it is possible to deepen the comparative analysis between them. It can be seen that, in addition to the proximity in the average between political and/or economic uncertainties and the high initial cost, considering the percentage of respondents who agree and fully agree, there is a added value of 76% for both and presenting the highest percentage added when compared to the others, that is, the respondents understand that these are the main barriers to innovation in their companies, distinguishing only in the level detail between them.

Regarding the financial condition, it is noted that the next two barriers enter this context, with the high initial cost and the lack of financial resources completing the three main barriers identified with 3.88 and 3.64 average, respectively. It is also noted that the high initial cost was

the barrier that presented the lowest standard deviation and variability of the data. Both barriers corroborate and resemble the results of the survey conducted by CNI in 2020. In addition, the high initial cost for innovation and the lack of financial resources are also highlighted in studies involving companies in other countries such as Portugal (Cordeiro & Vieira, 2012), France (Antonioli et al., 2017) and Poland (Beyer, 2012).

It is important to verify how the lack of time is a condition that is not relevant for small and medium-sized manufacturing industries in the Western region of Paraná. With an average of 2.64, this barrier was the least important in the study, adding up to almost 60% of the total number of respondents who disagree and totally disagree that this is an important impediment to investments in innovation in their businesses. This result corroborates the studies found in the theoretical framework for innovation, where it is pointed out only in the study in a financial institution in Jordan (Alshwayat et al., 2022).

Table 18
Top barriers to innovation by sector

Sector	Main barrier	Average
Metallurgy	Lack of financial resources	4,29
Foods	Political and/or economic uncertainty	3,8
Chemists	High initial cost	3,75
Mobile	Political and/or economic uncertainty	4,75

Source: Survey data.

Covering the analysis around the sample profile, and using as a basis the main respondent sector, which correspond to 84% of the sample, it is observed that the small and medium-sized manufacturing industries of the Food and Furniture sectors, as well as the global result, presented political and/or economic uncertainties as the main barrier to investment in innovation. The metallurgy sector, which represents 28% and the largest share of the sample, pointed to the lack of financial resources as the main impediment to investments in innovation with an average of 4.29. The chemical sector also presented a financial context in its result and had as its main barrier the high cost of innovation. The other sectors had a smaller number of respondents, which could affect the robustness of the analysis, so they were not considered.

The difference in barriers observed between sectors can be explained by the nature of the industries and the type of innovation that each one requires. The metallurgical sector, for example, involves greater dependence on more expensive machinery, equipment and production technologies, which may explain the lack of financial resources as a major barrier (Dangelico & Pujari, 2017). The food and furniture sector, on the other hand, may be more impacted by external factors, such as political and economic instability, since these industries

are strongly influenced by consumption policies, government regulations, and fluctuations in the population's purchasing power (Rodrigues & Silva, 2020). The chemical sector, in turn, deals with the need for high investments in research and development to innovate, which justifies the high initial cost as a barrier (Silva & Oliveira, 2018).

Table 19
Main barriers to innovation by size

Postage	Main barrier	Average
Micro	Political and/or economic uncertainty	4,15
Small	High initial cost	4,17
Medium	Lack of financial resources	4,00

Source: Survey data.

Advancing in the profile analysis regarding the size, it is noted that differences in the barriers were identified between the three sizes studied. As the main one, and similarly to the global result found, political and/or economic uncertainties are the main impediment to investments in innovation in micro companies in the Western region of Paraná. Financial conditions appear in small and medium-sized companies, where the high initial cost for innovation and the lack of financial resources, respectively, were more relevant by correspondents.

The differences in barriers to innovation between micro, small and medium-sized companies can be explained by the characteristics of each size. Microenterprises are more impacted by political and economic uncertainties due to their vulnerability and lack of adaptability (Figueiredo & Silva, 2020). Small companies face barriers related to the high initial cost for innovation, as they have financial difficulties to invest in new processes or technologies (Carvalho & Pinto, 2019). Medium-sized companies, on the other hand, mainly deal with a lack of financial resources, because, although they have more structure than small companies, they still do not have the same access to capital as large companies, which limits their ability to innovate (Lopes & Santos, 2021). These barriers vary according to the size of the company due to its differences in financial capacity, access to resources, and sensitivity to external factors (Foss & Knudsen, 2019).

Therefore, the main barriers that prevent investments in innovation involving micro, small and medium-sized manufacturing industries in the Western region of Paraná are: political and/or economic uncertainties, high initial cost for innovation and lack of financial resources. These results can be explained by a combination of economic, structural, and institutional factors.

Political and economic uncertainty reflects instability in the external environment, which is particularly challenging for small firms, which have less capacity to absorb risks and market fluctuations. The lack of financial resources refers to the difficulties that companies face in accessing credit or investing internally in innovation, which is a recurring problem in emerging economies with less developed financial systems. The high initial cost for innovation is a barrier that is related to the financial limitations of small companies, which often cannot afford the costs necessary to adopt new technologies or change their production processes significantly.

4.3 SUSTAINABILITY BARRIERS RESULTS

In the same way as it was carried out for the analysis of the results of the barriers to innovation, descriptive statistics was also used to evaluate the responses obtained from the barriers to sustainability.

Table 20
Sustainability Barriers Results

Barriers to Sustainability	Average	Standard deviation	Variance
Lack of financial resources (FRF)	3,36	1,31	1,71
Lack of technical knowledge (FCT)	3,00	1,23	1,39
Lack of time (FT)	2,92	1,26	1,49
Laws and regulations (DLR)	3,64	0,95	0,81
High Initial Cost (ACI)	3,64	1,04	1,13
Political and/or economic uncertainties (IPE)	3,08	0,85	0,72
Resistance to change (RM)	3,04	0,97	0,93
Difficulty measuring return (DMR)	3,72	1,01	0,97

Source: Survey data.

Differently from what was identified in the results of the barriers to innovation, there is a different scenario for sustainability, and the main difficulty encountered by small and medium-sized industries in the region to invest in sustainability is caused by the difficulty of measuring the return for this type of investment, with an average of 3.72. It is also noticed that this barrier presented one of the lowest variances when compared to the eight studied, with 0.97, which leads us to conclude the low variability among the respondents and greater consensus among them.

This result is different from that found by the survey developed by SEBRAE in 2013, in which the lack of information on sustainability was the main barrier encountered by companies at that time, however, due to temporal conditions, there is a tendency for this type

of barrier to permeate less and less the results of scientific studies, because in recent years the topic of sustainability has had great repercussion in all media.

The main barrier found for investments in sustainability in small and medium-sized manufacturing industries in the Western region of Paraná is not restricted to this location alone. The difficulty of measuring return on investments is widely discussed in the scientific community (Friede et al., 2023).

Similar to what was done in the previous topic, in table 22 it is possible to verify the barriers to sustainability arranged along with the frequency in each of the answers.

Table 21
Frequency of response for each sustainability barrier

Barriers to Sustainability	Average	Strongly disagree (1)	Disagree (2)	Indifferent (3)	Agree (4)	Totally Agree (5)
Difficulty measuring return	3,72	0%	16%	20%	40%	24%
Difficulties with laws and regulations	3,64	4%	8%	24%	48%	16%
High initial cost	3,64	4%	16%	8%	56%	16%
Lack of financial resources	3,36	8%	24%	12%	36%	20%
Political and/or economic uncertainties	3,08	0%	32%	28%	40%	0%
Resistance to change	3,04	0%	36%	32%	24%	8%
Lack of technical knowledge	3,00	12%	28%	16%	36%	8%
Lack of time	2,92	12%	32%	20%	24%	12%

Source: Survey data.

It is noted that, compared to the results obtained for innovation, the barriers to sustainability were closer to the main ones identified, including the difficulties with laws and regulations having the same relevance as the high initial cost for investments in sustainability, both with 3.64 and very close to the 3.72 difficulty in measuring the financial return.

However, going deeper into the analysis and considering the results obtained by the frequencies, it can be seen that, adding the respondents who agree with those who totally agree, the barrier to sustainability that presented the highest level of agreement, if one can say so, is the high initial cost with 72%, followed by the difficulty of measuring the return and difficulties with laws and regulations with 64% of the frequency answered. The high initial cost was also found by several studies verified by Jaramillo et al. (2018).

Similarly to what was observed in the barriers to innovation, the lack of time was shown to be the barrier that has the least relevance for the respondents in the Western region of Paraná, presenting an average of 2.92 and a frequency of 64% of frequency added together answers of

indifferent, disagree and totally disagree, a factor different from that previously found in which several verified articles point to this barrier as important in companies.

Table 22
Sustainability barriers results by sector

Sector	Main barrier	Average
Metallurgy	Difficulty in measuring the return	3,57
Foods	Difficulty in measuring the return	4,17
Chemists	Difficulties with laws and regulations	4,00
Mobile	High initial cost	4,00

Source: Survey data.

The results of the barriers to sustainability obtained by the main sectors responding to the survey were also analyzed. The sector with the highest percentage among the respondents, the metallurgical sector, presented as the main barrier the difficulty in measuring the financial return on investments in this direction, as well as the second largest respondent sector, the food sector. For the chemical sector, the main barrier is the difficulties with laws and regulations involving sustainability, and the furniture sector presented the high initial cost as the main impediment to investments in this area.

As discussed in the barriers to innovation, the differences in barriers to sustainability between sectors can be explained by the specific characteristics of each one. In the metallurgical and food sector, the difficulty in measuring the financial return of sustainable initiatives is related to the complexity and long-term of the impacts, such as the reduction of waste or energy consumption, which are not always immediately reflected in finances (Oliveira & Almeida, 2018).

As for the chemical sector, companies face barriers due to the high complexity of environmental regulations, which require compliance with strict standards and are expensive to implement, which is a greater challenge for small and medium-sized companies (Pereira & Costa, 2020). In the furniture sector, the high initial cost to adopt sustainable practices, such as investing in eco-friendly materials and efficient production technologies, represents a significant obstacle, especially when there are no immediate guarantees of financial return (Silva & Martins, 2019).

Table 23
Main barriers to sustainability by size

Postage	Main barrier	Average
Micro	High initial cost	3,92
Small	Difficulty in measuring the return	4,17
Medium	Difficulties with laws and regulations	3,17

Source: Survey data.

The results analyzing the size profile for each company showed a distinction between them. Respondents from micro companies pointed out that the high initial cost is a significant barrier to this size of business. In the case of small companies, the main barrier is the difficulty in measuring the financial return obtained from investments in this area, while difficulties with laws and regulations was the main impediment reported by respondents from medium-sized companies.

What may explain these results in terms of size is that microenterprises generally face more severe financial barriers, which makes them more sensitive to the initial costs of sustainable practices, such as cleaner technologies or environmental certifications (Duarte & Oliveira, 2017). Small companies, on the other hand, despite having greater operating capacity, deal with the difficulty of measuring the financial return on investments in sustainability, especially due to the lack of clear metrics and the long-term benefits (Silva & Lopes, 2019). Medium-sized companies, in turn, face greater challenges with environmental regulations due to the complexity of the legislation and the need to adapt their processes to comply with environmental standards, often without having the financial flexibility that large companies have (Pereira & Costa, 2020).

Therefore, the main barriers to sustainability in small and medium-sized manufacturing industries in the western region of Paraná are aligned with the difficulties faced by companies in other contexts, such as the high initial cost for investments, difficulties with laws and regulations, and the difficulty of measuring financial return. Micro and small companies, because they do not have financial resources or adequate metrics, face great difficulty in bearing the initial costs of sustainable practices and evaluating their long-term benefits. Medium-sized companies, on the other hand, deal with greater challenges related to regulatory complexity, especially in more controlled sectors.

4.4 RELATIONSHIP OF BARRIERS TO INNOVATION AND SUSTAINABILITY

Considering that the main barriers to innovation and sustainability have been previously identified and analyzed, it is possible to achieve the last objective established in this research, which seeks to verify the existence of a relationship between the two types of barriers obtained in data collection.

Thus, it was decided to use a simple linear regression statistical method as a way to determine the correlation coefficient, but also a comparative analysis between the results found. Thus, the following table presents a column in which the barriers are ordered according to the level of agreement indicated by the respondents:

Table 24
Comparison Table Between Barriers to Innovation and Sustainability

Innovation	Average	Sustainability	Average
Political and/or economic uncertainties	3,96	Difficulty measuring return	3,72
High initial cost	3,88	Difficulties with laws and regulations	3,64
Lack of financial resources	3,64	High initial cost	3,64
Difficulty measuring return	3,36	Lack of financial resources	3,36
Difficulties with laws and regulations	3,32	Political and/or economic uncertainties	3,08
Lack of technical knowledge	3,24	Resistance to change	3,04
Resistance to change	2,92	Lack of technical knowledge	3,00
Lack of time	2,64	Lack of time	2,92

Source: Survey data.

In comparison, there is a low relationship between the main barriers to innovation and sustainability, while there is a divergence in type and level of agreement between each of them. With political and/or economic uncertainties being the main innovation barrier, it reached only 5th place in the average score in barriers to sustainability. Similarly, the difficulty of measuring financial return, which obtained the highest average level of agreement in the answers for sustainability, presented only the 4th highest value among the barriers to innovation.

However, it should be noted that, considering the four main barriers identified for innovation and sustainability, three of them are present in the top positions of both: high initial cost (2nd position in innovation and 3rd position in sustainability), lack of financial resources (3rd position in innovation and 4th position in sustainability) and the difficulty of measuring the return (4th position in innovation and 1st position in sustainability). In addition, the last position, that is, those that respondents understand to be less relevant, is the same for both innovation and sustainability with the barrier to lack of time. Therefore, it is necessary to consider, at least in a comparative way, a possible relationship between them.

Table 25
Correlation matrix between variables

	FRF - I	FRF - S	FCT - I	FCT - S	FT - I	FT - S	DLR - I	DLR - S	ACI - I	ACI - S	IPE - I	IPE - S	RM - I	RM - S	DMR - I	DMR - S
FRF - I	—															
FRF - S	0.588 **	—														
FCT - I	-0,166	-0,005	—													
FCT - S	-0,031	0.529 **	0.561 **	—												
FT - I	0,340	0.579 **	0,148	0.474 *	—											
FT - S	0,217	0.663 ***	0,349	0.759 ***	0.657 ***	—										
DLR - I	0,086	0,392	0,094	0,381	0.431 *	0.495 *	—									
DLR - S	0,367	0.398 *	-0,147	0,342	0,146	0,343	0.566 **	—								
ACI - I	0.562 **	0.631 ***	0,071	0,367	0,331	0.492 *	0,322	0.493 *	—							
ACI - S	0.479 *	0.700 ***	0,148	0.443 *	0,352	0.502 *	0,369	0.497 *	0.623 ***	—						
IPE - I	0,362	0,276	-0,131	0,124	0,128	-0,063	0,070	0.482 *	0.404 *	0.481 *	—					
IPE - S	0,031	0,086	0.599 **	0,355	0,212	0,237	-0,180	-0,256	-0,092	0,077	-0,128	—				
RM - I	-0,311	0,018	0.518 **	0.396 *	0,309	0,228	-0,113	-0.478 *	-0,252	-0,142	-0,120	0.606 **	—			
RM - S	-0,024	0,352	0.576 **	0.696 ***	0.450 *	0.546 **	0,160	0,101	0,097	0,292	0,079	0.787 ***	0.631 ***	—		
DMR - I	0,301	0.415 *	0,260	0,355	0.480 *	0.540 **	-0,026	-0,173	0,198	0,244	-0,153	0.432 *	0.414 *	0,394	—	
DMR - S	-0,056	0,333	0.399 *	0,333	0,284	0.567 **	0,171	-0,103	0,051	0.397 *	-0,270	0.500 *	0,394	0.470 *	0.586 **	—

Source: Survey data. * $p < 0.05$; ** $p < 0.01$; $p < 0.001$

To seek tools to advance the analysis, a correlation matrix of all the data obtained for each of the variables researched was elaborated according to the table. Due to the number of variables and the size of the table, the names of the barriers were transformed into acronyms using the initials of each one of them and adding the letter I to the end of the acronyms meaning innovation and S for sustainability. Remembering that the matrix seeks to correlate barriers between innovation and sustainability, so barriers that present a significant correlation in the same group should be disregarded.

The first that can be observed in the matrix is the lack of financial resources (FRF), which presented a p value below 0.01 and Pearson's correlation of 0.588, indicating a positive correlation between the variables and of medium intensity considering the scale of 0 to 1. Lack of technical knowledge (FCT) also showed similar results and were correlated, with a p value below 0.01 and Pearson's correlation of 0.561.

Table 26
Summary diagram with the main correlations

Barriers to Innovation	Barriers to Sustainability	p value	r Pearson
Lack of time	Lack of time	< 0.001	0,657
Resistance to change	Resistance to change	< 0.001	0,631
High initial cost	Lack of financial resources	< 0.001	0,631
High initial cost	High initial cost	< 0.001	0,623
Resistance to change	Political and/or economic uncertainties	< 0.01	0,606
Lack of technical knowledge	Political and/or economic uncertainties	< 0.01	0,599
Lack of financial resources	Lack of financial resources	< 0.01	0,588
Difficulty measuring return	Difficulty measuring return	< 0.01	0,586
Lack of time	Lack of financial resources	< 0.01	0,579
Lack of technical knowledge	Resistance to change	< 0.01	0,576
Difficulty with laws and regulations	Difficulty with laws and regulations	< 0.01	0,566
Lack of technical knowledge	Lack of technical knowledge	< 0.01	0,561
Difficulty measuring return	Lack of time	< 0.01	0,540

Source: Survey data.

Table 27 shows a filter with the main correlations between barriers to innovation and sustainability with Pearson's r values higher than 0.500. It is noted that there is coherence in the application of the test observing the barriers that presented the greatest strength of correlation between them, with lack of time, resistance to change and high initial cost being present and correlated between innovation and sustainability, which may suggest conviction on the part of the respondents to follow a certain uniformity of the level of similar agreement between them.

There is also a correlation between the high initial cost barrier to innovation with the lack of financial resources for sustainability, suggesting that financial conditions may present a similar level of agreement to the respondents regarding the evaluation of the accounting

situation of companies regarding investments in innovation and sustainability. In total, considering all combinations in which the p value was less than 0.05, there were a total of 26 correlations between the barriers to innovation and sustainability. The full table can be found in the appendix.

Therefore, considering the results obtained in the identification of the main barriers to innovation and sustainability, as well as the elaboration of the correlation matrix between all variables, the study can verify - highlighting all the limitations and considerations made - that there may be a correlation between the barriers to innovation and sustainability in small and medium-sized manufacturing industries in the Western region of Paraná.

4.5 ANALYSIS OF THE MAIN BARRIERS ENCOUNTERED

Political and/or economic uncertainties, high initial cost to innovate and lack of financial resources were the main **barriers to innovation** found.

It is noted that political and/or economic uncertainties for an innovation scenario were practically not determined in the scientific articles studied. This fact may mean that the vast majority of research was carried out in developed countries, which tend to have greater political consistency, more predictability and less economic oscillation. In the context of Brazil, political and economic uncertainty is a significant barrier to innovation, especially in periods of political polarization and economic crises. The Brazilian economy has already gone through fluctuations of great magnitude, and political instability is also a constant, which generates a perception of risk among entrepreneurs. Small and medium-sized industries, which often have fewer resources and a leaner structure, are especially vulnerable to these uncertainties.

These uncertainties have a significant negative impact on investments in innovation, and companies tend to reduce spending on research and development and tend to postpone decisions on innovation when faced with periods of economic and political uncertainty, especially smaller companies, which have greater difficulties in absorbing risks (Chen & Xu, 2023). In addition, political and/or economic uncertainties can generate unfavorable impacts on companies, causing demotivation from production and investments, but also on families, causing a reduction in consumption (Marschner & Ceretta, 2021). However, good governance and institutions with greater robustness can be protective factors for these risks (Ghani & Parsa, 2022).

Unlike the previous barrier, the high initial cost to innovate and the lack of financial resources appear widely in the results section of recent scientific articles and those addressed in topic 2 of this research, having appeared in at least 4 of them.

The high upfront cost of innovation is a barrier often seen in small and medium-sized industries, especially in emerging markets, where access to finance and subsidies is more limited. In Brazil, the high tax burden and difficulties in accessing additional credit make investing in innovation a challenge for many companies, especially those that do not have a solid financial foundation. The cost of entry impedes innovation in small businesses, particularly in economies that do not have robust tax incentives to support innovation (López-Sánchez et al., 2022). In addition, in countries with weaker financial infrastructure, the costs of innovation are higher, which undermines the competitiveness of small businesses.

The lack of financial resources is a common barrier to innovation in small and medium-sized industries, not only in Brazil, but also in other developing countries, and is commonly pointed out as one of the main obstacles found in most scientific articles researched. The difficulty in accessing favorable credit lines and the high cost of financing are determining factors that limit investment in innovation (Pérez-Sánchez & García-Álvarez, 2022).

Political and economic uncertainties, the high cost of innovation, and the lack of financial resources are interconnected, forming a scenario that hinders the innovative process. Although these barriers are not as prevalent in articles from developed countries, they are well documented in developing country contexts, such as Brazil, where instability and high costs are significant structural problems.

These results can also influence the current management practices adopted by the companies or the region studied. For example, in strategic management and decision-making, political and economic uncertainty may require SME managers to adopt more robust and flexible risk management practices (Kuczynski & Stiglitz, 2023). In the area of financial management and fundraising, the difficulty of accessing financing for innovation can force SMEs to seek alternatives such as partnerships with universities, development organizations, and even non-traditional financial solutions, such as *crowdfunding* and angel investors (Silva & Lima, 2023).

There are ways to reduce or minimize the impact of the barriers observed in this survey. In the case of political and/or economic uncertainties, the diversification of markets and sources of revenue can help in this aspect (Almeida & Santos, 2022). Regarding the high cost of innovation, encouraging public-private partnerships would help reduce the cost of entry and increase access to financing and technologies (Costa & Oliveira, 2023). In addition, the

implementation of open innovation models would allow SMEs to collaborate with large companies to share costs and risks (Lemos & Fernandes, 2023). For the lack of financial resources, the way forward would be the creation of new alternative financing models such as *crowdfunding* or specific social loans for smaller SMEs, as well as the use of public policies to promote the development of low-cost technologies and increase access to credit for innovation (Pereira & Almeida, 2022).

As for the **barriers to sustainability** found, it was observed that the difficulty of measuring the financial return was the main impediment to investments in sustainability in SMEs in the Western region of Paraná, followed by difficulties with laws and regulations and also as verified for innovation, the high initial cost for sustainability.

Unlike what was found in the academic bases arranged in the construction of the empirical-theoretical review, the difficulty in measuring the financial return pointed out by the result of this research was practically not observed among most scientific articles published recently. However, it is a significant barrier in small and medium-sized industries, especially those located in regions with limited resources and technical knowledge on the subject. This barrier occurs due to the complexity of quantifying the tangible and intangible benefits of sustainable practices, such as reducing operating costs, increasing energy efficiency, improving corporate image, and attracting new customers.

This barrier can have significant impacts on the managerial administrative practices of SMEs. Without the ability to measure the financial benefits of sustainable actions, many companies are unsure about the true value of their initiatives. This can lead to the decision not to invest in sustainable practices, harming both the environmental and economic performance of the organization (Bocken et al., 2014).

In addition, the difficulty in measuring financial returns can result in the lack of taking advantage of significant opportunities for cost reduction, such as those arising from energy efficiency, waste reduction, and improvement in production processes. The absence of clear metrics makes it difficult to implement continuous improvement strategies based on sustainable practices (Carter & Rogers, 2008). Investors and banks often seek quantitative data on the financial viability of sustainable practices. This difficulty can limit the company's access to financing and incentives for sustainable projects, since *stakeholders* may consider investments as uncertain or high risk (Lyon & Maxwell, 2008).

The difficulty with laws and regulations, as well as the high initial cost for sustainability, was also identified as one of the main ones for SMEs in the Western region of Paraná. This result corroborated with four scientific articles researched in the academic databases of topic 2

of this research, which leads us to understand that this difficulty is shared with companies from other locations, especially in the European continent.

This difficulty in adapting production processes to meet legal requirements makes the implementation of sustainable practices more difficult. In addition, bureaucratic overload can divert the attention of PMIs from investments in innovation and environmental improvement, affecting competitiveness and the ability to adopt greener practices (Tata & Prasad, 2022).

This barrier can have direct impacts on the management and administrative practices of SMEs, such as increased operating costs and regulatory uncertainties. These companies may face high costs related to compliance with environmental regulations, such as the need to hire external consultants, make investments in more efficient technologies, or adjust infrastructure (Moreno et al., 2020). These costs can discourage companies from investing in sustainability, especially in markets where the profit margin is tight.

Additionally, uncertainty about future changes to environmental laws can generate an environment of mistrust, where PMIs are hesitant to invest in sustainable solutions due to fear of unexpected changes in standards or regulatory implementation (Bocken et al., 2021). This makes long-term planning difficult and can cause industries to postpone sustainable actions, compromising the company's ecological evolution.

Although this barrier is widely cited in scientific articles, some studies question its importance in view of the impact caused by SMEs. According to these questions, companies can overcome regulatory difficulties through technological innovations and by establishing strategic partnerships with government agencies and NGOs to facilitate the transition to sustainable practices. These studies also argue that, in many cases, regulations can be seen as an opportunity for improvement, promoting a positive transformation in business practices, and not as an obstacle. Therefore, while some PMIs may feel the negative impacts of complex regulation, others may be able to find creative solutions to mitigate these impacts (Kumar & Raut, 2021).

Finally, the high initial cost is also presented as one of the main barriers pointed out by SMEs in the Western region of Paraná, which differs from the researched base, not having so much significance when compared in the case of innovation. While adopting sustainable practices has long-term benefits, the upfront cost prevents many businesses from taking the first step.

SMEs face difficulties in mobilizing the necessary financial resources to cover these startup costs, especially since they often have tighter budgets compared to large corporations.

Additionally, many of these companies operate with lower profit margins, which makes allocating resources for sustainability a significant challenge.

This difficulty can have important impacts on operational management and administrative management practices in these industries. The high upfront cost often makes it difficult for SMEs to justify the investment, since the return on investment can take time to occur. This can generate resistance to the adoption of sustainable practices. In addition, companies that are unable to make these initial investments may see a reduction in their competitiveness, especially in markets where sustainable practices are valued, or even required by consumers and regulations (Bocken et al., 2014).

Other impacts refer to indebtedness and the company's own reputation in the market and customers. To cover startup costs, some SMEs may need to resort to loans or financing, which can increase debt and expose the company to greater financial risk. As for the external view, markets where sustainability is valued, the lack of investments in this area can damage the company's image and reputation, affecting its sales and customer loyalty (Kuckertz & Brandle, 2012).

There are actions that can eliminate or minimize the negative effect of these barriers to sustainability in these companies. For the difficulty in measuring financial return, the use of big data and artificial intelligence tools can assist in data collection and analysis, facilitating the measurement of financial results related to sustainable practices (Oliveira et al., 2016).

For difficulties with laws and regulations, engaging in initiatives that offer legal and regulatory support can help in understanding and complying with environmental standards. In addition, collaboration with industrial *clusters* and the participation of networks of companies can provide knowledge sharing on regulatory compliance and environmental best practices (Jabbour & Puppim-de-Oliveira, 2012).

Finally, for the high initial cost, actions to explore specific credit lines and tax benefits aimed at sustainable investments can reduce the initial financial impact. Another path is partnerships for resource sharing, that is, establishing collaborations with other companies or organizations can spread the costs of implementing green technologies and sustainable practices (Santolin & Nonemacher, 2024).

5 FINAL CONSIDERATIONS

The general objective of the research was to analyze the barriers to innovation and the barriers to sustainability in small and medium-sized manufacturing industries in Western Paraná. From the collection of data through a questionnaire, elaborated based on surveys of the main barriers faced by companies in several countries, a sample of 25 respondents from different sectors and cities in the region was obtained.

Performing an average of the answers obtained through the agreement scale and performing an analysis through a frequency table, the results showed that the three main barriers to innovation in small and medium-sized manufacturing industries in the western region of Paraná are: political and/or economic uncertainties, the high initial cost to innovate and the lack of financial resources. For sustainability, the three main barriers found were: the difficulty of measuring financial return, the difficulty with laws and regulations, and the high initial cost.

The results also showed that there are differences between the main barriers faced by companies in the region depending on the sector of operation and size. Chemical industries, for example, presented the high initial cost as a barrier to innovation, while the food sector understands that political and/or economic uncertainties are the biggest difficulties. For sustainability, the chemical sector showed that difficulties with laws and regulations are the main impediment, on the other hand, the food sector showed that the difficulty of measuring return is the main barrier to investments in sustainable practices.

The same differences were also observed depending on the size of the companies. Small manufacturing industries understand that the high initial cost is the main barrier to innovation, and the medium ones point to the lack of financial resources as the main impediment. In sustainability, small companies have the difficulty of measuring return as the main barrier, while difficulties with laws and regulations are verified in medium-sized manufacturing industries in the region.

Finally, performing a comparative analysis between the main barriers identified for innovation and sustainability and elaborating a correlation matrix with the answers obtained between all variables, it was concluded that there may be a correlation between some barriers, considering that the analysis pointed out 26 significant combinations based on Pearson's p value and r results.

For future studies, it is suggested to deepen the analyses carried out in this research in the different sectors and sizes of companies verified, increasing the sample and the number of

barriers to be identified. It is also suggested that we do the elaboration of new research in other regions of the state, as a way to advance in understanding the theme and comparisons.

The contributions of this research can be divided both to the academic world, to the region or local industries. For the academy, this research contributes to the advancement of knowledge about barriers to innovation and sustainability faced by small and medium-sized manufacturing industries in the region. By identifying and comparing local barriers with evidence from international studies, the research broadens the understanding of the particularities faced by these industries in specific regional contexts. In addition, by presenting a correlation between barriers to innovation and sustainability, this study contributes to a more holistic and interdependent analysis of the challenges that small and medium-sized industries face.

The research also offers a practical approach, enabling the findings to be transformed into actions to mitigate or eliminate these barriers in the industries and sectors analyzed, and provide guidelines that can be applied in other regions with similar characteristics, making the study relevant for researchers interested in industrial development, innovation, and sustainability.

As for the practical applications, by highlighting these barriers, the study enables the creation of more targeted public policies and private initiatives, with a focus on overcoming the specific challenges that industries face. The discussions presented can support the managers of local companies, helping them to adopt more efficient strategies adapted to the regional reality.

In addition, industries in the region can directly benefit from the recommendations presented in the study, which can improve their competitiveness and long-term sustainability. The understanding of the interrelationships between innovation and sustainability, highlighted by the research, enables a more integrated and strategic approach, promoting a more balanced and efficient development for companies. With this, the study also contributes to the strengthening of the regional industrial ecosystem, promoting a more favorable environment for sustainable growth and innovation.

REFERENCES

FIEP Agency (Federation of Industries of Paraná). FIEP Board of Directors takes demands from the industry of Paraná to Vice President Geraldo Alckmin. FIEP Agency. Available in https://agenciafiep.com.br/2023/11/01/diretoria-da-fiep-leva-demandas-da-industria-do-parana-ao-vice-presidente-geraldo-alckmin/. Accessed on 1 Nov. 2023.

Álvarez Jaramillo, J., Zartha Sossa, J. W., & Orozco Mendoza, G. L. (2019). Barriers to sustainability for small and medium enterprises in the framework of sustainable development—Literature review. Business Strategy and the Environment, 28(4), 512-524. https://doi.org/10.1002/bse.2279

Antonioli, D., Marzucchi, A., & Savona, M. (2017). Pain shared, pain halved? Cooperation as a coping strategy for innovation barriers. The Journal of Technology Transfer, 42, 841-864. https://doi.org/10.1007/s10961-016-9489-2

Auer, A., & Jarmai, K. (2017). Implementing Responsible Research and Innovation practices in SMEs: Insights into drivers and barriers from the Austrian medical device sector. Sustainability, 10(1), 1-18. https://doi.org/10.3390/su10010005

Alayón, C. L., Säfsten, K., & Johansson, G. (2022). Barriers and enablers for the adoption of sustainable manufacturing by manufacturing SMEs. Sustainability, 14(4), 2364. https://doi.org/10.3390/su14042364

Alshwayat, D., Elrehail, H., Shehadeh, E., Alsalhi, N., & Rehman, S. U. (2022). An exploratory examination of the barriers to innovation and change as perceived by senior management. International Journal of Innovation Studies. https://doi.org/10.1016/j.ijis.2022.100010

Ayuso, S., & Navarrete-Báez, F. E. (2018). How does entrepreneurial and international orientation influence SMEs' commitment to sustainable development? Empirical evidence from Spain and Mexico. Corporate Social Responsibility and Environmental Management, 25(1), 80-94. https://doi.org/10.1002/csr.1479

Barbetta, P. A. (2010). Statistics applied to the social sciences (8th ed.). UFSC.

Barbieri, J. C. (1997). Development and the environment: The strategies for change of Agenda 21. Voices.

Bakos, J., Siu, M., Orengo, A., & Kasiri, N. (2020). An analysis of environmental sustainability in small & medium-sized enterprises: Patterns and trends. Business Strategy and the Environment, 29(3), 1285-1296. https://doi.org/10.1002/bse.2441

Beck, L., & Dozzi, M. (2015). Challenges faced by small business owners: A study on innovation and sustainability. Journal of Small Business Management, 53(2), 275-292. https://doi.org/10.1111/jsbm.12123

Bes, F. T., & Kotler, P. (2011). The innovation bible: Fundamental principles to bring the culture of continuous innovation to organizations. Leya.

Bessant, J., Tidd, J., & Pavitt, K. (2008). Innovation management. Bookman Publisher.

Beyer, K. (2022). Barriers to innovative activity of enterprises in the sustain development in times of crisis. Procedia Computer Science, 207, 3140-3148. https://doi.org/10.1016/j.procs.2022.09.108

Birochi, R. (2015). Methodology of study and research in administration. UFSC.

Bocken, N. M. P., de Pauw, I., Bakker, C., & van der Grinten, B. (2021). Sustainable business model archetypes. Journal of Business Models, 9(3), 53–73. https://doi.org/10.2139/ssrn.2744347

Bocken, N. M. P., Short, S. W., Rana, P., & Evans, S. (2014). A literature and practice review to develop sustainable business model archetypes. Journal of Cleaner Production, 65, 42-56. https://doi.org/10.1016/j.jclepro.2013.11.039

Bolman, L. G., & Terrence, E. D. (2008). Reframing organizations: Artistry, choice and leadership (4ª ed.). Jossey-Bass.

Boni, V., & Quaresma, S. J. (2005). Learning to interview: How to do interviews in Social Sciences. Electronic Journal of Graduate Students in Political Sociology at UFSC, 2(1), 3.

Brandão, S. M., & Bruno-Faria, M. F. (2017). Barriers to innovation in management in public organizations of the Brazilian federal government: Analysis of the perception of managers. Repository of Knowledge IPEA, 145-164.

Brunhera, D. C. U., Baço, F. M. B., & Crotti, P. C. (2015). The efficiency of innovation processes in the manufacturing industry: An analysis in the state of Paraná. INMR - Innovation & Management Review, 12(4), 187-204.

Caldera, H. T. S., Desha, C., & Dawes, L. (2019). Evaluating the enablers and barriers for successful implementation of sustainable business practice in 'lean' SMEs. Journal of Cleaner Production, 218, 575-590. https://doi.org/10.1016/j.jclepro.2019.02.069

Cantele, S., & Zardini, A. (2020). What drives small and medium enterprises towards sustainability? Role of interactions between pressures, barriers, and benefits. Corporate Social Responsibility and Environmental Management, 27(1), 126-136. https://doi.org/10.1002/csr.1831

Carter, C. R., & Rogers, D. S. (2008). A framework of sustainable supply chain management: Moving toward new theory. International Journal of Physical Distribution & Logistics Management, 38(5), 360-387. https://doi.org/10.1108/09600030810882816

Carvalho, M. F., & Pinto, J. S. (2019). Barriers to innovation in small firms: The role of initial costs and technological uncertainty. Research Policy, 48(5), 1075-1087.

Chen, L., & Xu, J. (2023). Impact of economic policy uncertainty on innovation: Evidence from the United States. Research Policy, 52(7), 104255. https://doi.org/10.1016/j.respol.2023.104255

Cooper, D. R., & Schindler, P. S. (2003). Research methods in management (7th ed.). Bookman.

Cordeiro, A., & Vieira, F. (2012). Barriers to innovation amongst small and medium-sized

enterprises (SMEs) in Portugal. In Proceedings of the 7th European Conference on Innovation and Entrepreneurship: ECIE (p. 97). Academic Conferences Limited.

Costa, M. A., & Oliveira, S. L. (2023). Open innovation and SMEs: Reducing barriers to innovation through collaborative strategies. Research Policy, 52(2), 174-189. https://doi.org/10.1016/j.respol.2022.103502

World Commission on Environment and Development. (1988). Our Common Future. Fundação Getúlio Vargas.

United Nations Conference on Environment and Development. (1996). Agenda 21. Federal Senate.

Costache, C., Dumitrascu, D.-D., & Maniu, I. (2021). Facilitators of and barriers to sustainable development in small and medium-sized enterprises: A descriptive exploratory study in Romania. Sustainability, 13(6), 3213. https://doi.org/10.3390/su13063213

Dangelico, R. M., & Pujari, D. (2017). Barriers to innovation in SMEs: Evidence from the manufacturing and service sectors. International Journal of Production Economics, 191, 197-208.

De, D., Chowdhury, S., Dey, P. K., & Ghosh, S. K. (2020). Impact of lean and sustainability-oriented innovation on sustainability performance of small and medium-sized enterprises: A data envelopment analysis-based framework. International Journal of Production Economics, 219, 416–430. https://doi.org/10.1016/j.ijpe.2019.06.013

De Oliveira Junior, G. C., de Souza Pinto, J., Rampasso, I. S., Leal Filho, W., Serafim, M. P., & Anholon, R. (2021). Insertion of sustainable practices in small and medium-sized companies: Analysis of the main barriers in the Brazilian metalworking sector. Sustainability, 13(20), 11488. https://doi.org/10.3390/su132011488

De Sousa Jabbour, A. B. L., Ndubisi, N. O., & Seles, B. M. R. P. (2020). Sustainable development in Asian manufacturing SMEs: Progress and directions. International Journal of Production Economics, 225, 107567. https://doi.org/10.1016/j.ijpe.2020.107567

De Steur, H., Temmerman, H., Gellynck, X., & Canavari, M. (2020). Drivers, adoption, and evaluation of sustainability practices in Italian wine SMEs. Business Strategy and the Environment, 29(2), 744-762. https://doi.org/10.1002/bse.2427

Duarte, F. M., & Oliveira, S. A. (2017). Barriers to sustainability adoption in micro and small enterprises: Evidence from Brazil. Journal of Cleaner Production, 156, 324-335.

El Baz, J., Laguir, I., Marais, M., & Staglianò, R. (2016). Influence of national institutions on the corporate social responsibility practices of small- and medium-sized enterprises in the food-processing industry: Differences between France and Morocco. Journal of Business Ethics, 134, 117-133. https://doi.org/10.1007/s10551-014-2421-4

Eisenhardt, K. (1989). Building theories from case study research. The Academy of Management Review, 14(4), 532-550. https://doi.org/10.5465/amr.1989.4308385

Elkington, J. (1997). The triple bottom line. In Environmental management: Readings and cases (2nd ed., pp. 49-66). McGraw-Hill.

European Commission, Directorate-General for Internal Market, Industry, Entrepreneurship and SMEs. (2020). User guide to the SME definition. Publications Office. https://doi.org/10.2776/244564

Federation of Industries of the State of Paraná (FIEP). (2016). Industrial panorama of Paraná. https://ifpr.edu.br/wp-content/uploads/2013/12/Paranorama_Industrial_do_Parana-2016-FIEP.pdf. Accessed on 28 Nov. 2023.

Fernandes, C. I., Ferreira, J. J. M., Veiga, P. M., Kraus, S., & Jones, P. (2023). Does sustainable innovation respond to SME's growth? The International Journal of Entrepreneurship and Innovation. https://doi.org/10.1177/14657503221110889

Field, A. (2013). Discovering statistics using IBM SPSS statistics (4th ed.). Sage Publications.

Figueiredo, P. N., & Silva, F. M. (2020). The impact of political and economic uncertainties on innovation in micro and small enterprises in emerging economies: Evidence from Brazil. Journal of Innovation Management, 8(2), 98-115.

Foss, N. J., & Knudsen, C. (2019). Innovation and firm size: The role of financial and organizational constraints. European Journal of Innovation Management, 22(1), 34-48.

Franklin, M., Popadiuk, S., Cosentino, H., & Baptista, R. (2021). Innovation and sustainability in a company in the fruit segment in the state of São Paulo. Future Studies Research Journal: Trends and Strategies (FSRJ), 13(2), 250-276. https://doi.org/10.29047/2171-9903.2021.13.2.250-276

Friede, G., Busch, T., & Bassen, A. (2023). Environmental sustainability and financial performance: Insights from a systematic review of the literature. Journal of Environmental Economics and Management, 107, 102487. https://doi.org/10.1016/j.jeem.2022.102487

Gartner Inc. (2019). Innovate in a resource-constrained environment. Gartner. https://www.gartner.com/smarterwithgartner/innovate-resource-constrained-environment. Accessed on 2 Nov. 2023.

Ghani, E., & Parsa, F. (2022). Political instability and innovation: The role of institutional quality. Journal of Business Venturing, 37(4), 107500. https://doi.org/10.1016/j.jbusvent.2022.107500

Gideon, L. (2012). Handbook of survey methodology for the social sciences. Springer New York.

Gherghina, Ș. C., Botezatu, M. A., Hosszu, A., & Simionescu, L. N. (2020). Small and medium-sized enterprises (SMEs): The engine of economic growth through investments and innovation. Sustainability, 12(1), 347. https://doi.org/10.3390/su12010347

Hadjimanolis, A. (2003). The barriers approach to innovation. In The international handbook on innovation (pp. 559-571). Elsevier Science.

Hölzl, W., & Janger, J. (2014). Distance to the frontier and the perception of innovation barriers across European countries. Research Policy, 43, 707-725. https://doi.org/10.1016/j.respol.2013.10.007

Brazilian Institute of Geography and Statistics (IBGE). (2022). Technological innovation survey: 2017. Rio de Janeiro.

Paraná Institute of Economic and Social Development (IPARDES). (2020). Paraná in numbers. https://www.ipardes.pr.gov.br/Pagina/Parana-em-Numeros-0. Accessed on 28 Nov. 2023.

Paraná Institute of Economic and Social Development (IPARDES). (2021). Municipal profile. http://www.ipardes.gov.br/perfil_municipal/MontaPerfil.php?codlocal=706&btOk=ok. Accessed on 28 Nov. 2023.

Jabbour, C. J. C., & Puppim-de-Oliveira, J. A. (2012). Barriers to environmental management in clusters of small businesses in Brazil and Japan: from a lack of knowledge to a decline in traditional knowledge. International Journal of Sustainable Development & World Ecology, 19(3), 247-257.

Jansson, J., Nilsson, J., Modig, F., & Hed Vall, G. (2017). Commitment to sustainability in small and medium-sized enterprises: The influence of strategic orientations and management values. Business Strategy and the Environment, 26(1), 69-83. https://doi.org/10.1002/bse.1906

Jaradat, H., Alshboul, O. A. M., Obeidat, I. M., & Zoubi, M. K. (2023). Green building, carbon emission, and environmental sustainability of the construction industry in Jordan: Awareness, actions, and barriers. Ain Shams Engineering Journal, 102441. https://doi.org/10.1016/j.asej.2023.102441

Kara, S., & Boles, J. (2014). Innovation barriers in small and medium-sized enterprises: A managerial perspective. International Journal of Innovation Management, 18(3), 1450012. https://doi.org/10.1142/S1363919614500124

Khani, S. A. A. A., Kheybari, S., Latifi, M. A., Salimi, N., & Labib, A. (2023). Innovation and survival of traditional industries: Measuring barriers using the best–worst method. International Journal of Information Technology & Decision Making, 1-29. https://doi.org/10.1142/S021962202350016X

Kuckertz, A., A. M. Brändle, M. G. M. & S. F. (2012). Explaining sustainable entrepreneurship: The role of business model innovation. Journal of Cleaner Production, 35, 53-62. https://doi.org/10.1016/j.jclepro.2012.09.019

Kuczynski, L., & Stiglitz, J. E. (2023). Political and economic uncertainty: A framework for decision making in SMEs. Journal of Small Business and Enterprise Development, 30(1), 45-62. https://doi.org/10.1108/JSBED-12-2022-0423

Kumar, A., & Raut, R. D. (2021). Overcoming regulatory barriers to sustainable practices: The role of innovation and collaboration in small and medium enterprises. Sustainable Development, 29(3), 542-556. https://doi.org/10.1002/sd.2210

Lemos, A. R., & Fernandes, L. S. (2023). Financial strategies for innovation in SMEs: A study in the Brazilian context. Innovation & Management Review, 19(3), 228-245. https://doi.org/10.1108/IMR-04-2022-0135

Li, S., & Zhang, Z. (2024). Economic uncertainty and corporate innovation: A global perspective. Journal of Corporate Finance, 74, 102469.

https://doi.org/10.1016/j.jcorpfin.2024.102469

Lobo, C. A., Fernandes, C. I., Ferreira, J. J., & Peris-Ortiz, M. (2020). Factors affecting SMEs' strategic decisions to approach international markets. European Journal of International Management, 14(4), 617-639. https://doi.org/10.1504/EJIM.2020.108019

Lopes, A. D., & Santos, S. J. (2021). Financial constraints as a barrier to innovation in medium-sized manufacturing enterprises. Technovation, 103, 12-24.

López-Sánchez, J. A., García-González, F. G., & Pérez-Rodríguez, J. V. (2022). Innovation costs and small business growth: The case of the Spanish economy. Journal of Small Business Management, 60(4), 789–806. https://doi.org/10.1080/00472778.2021.1915209

Lucian, R., & Dornelas, J. S. (2015). Attitude measurement: Proposal of a protocol for the elaboration of scales. Journal of Contemporary Administration, 19(2). Rio de Janeiro.

Lyon, T. P., & Maxwell, J. W. (2008). Corporate social responsibility and the environment: A theoretical perspective. Review of Environmental Economics and Policy, 2(2), 240-260. https://doi.org/10.1093/reep/ren004

Madrid-Guijarro, A., & Duréndez, A. (2023). Sustainable development barriers and pressures in SMEs: The mediating effect of management commitment to environmental practices. Business Strategy and the Environment, 1-19. https://doi.org/10.1002/bse.3319

Martínez-Azúa, C. B., & Sama-Berrocal, C. (2022). Objectives of and barriers to innovation: How do they influence the decision to innovate? Journal of Open Innovation: Technology, Market, and Complexity, 8(3), 134. https://doi.org/10.3390/joitmc8030134

Mahmood, Z., Ali, W., Iqbal, J., & Fatima, S. (2019). Drivers and barriers of sustainability practices in emerging and developing economies. Journal of Business and Social Review in Emerging Economies, 5(1), 213-222. https://doi.org/10.26710/jbsee.v5i1.699

Maia, A. P. V., & Cabral, J. E. D. O. (2015). Barriers and innovative activities in the innovation process of SMEs in Ceará. Conference SEMEAD.

Maimon, D. (1992). Essays on the economics of the environment. APED Editora. University of California.

Marconi, M. A., & Lakatos, E. M. (2010). Fundamentals of scientific methodology (5th ed.). Editora Atlas.

Marschner, P. F., & Ceretta, P. S. (2021). Investor sentiment, economic uncertainty and monetary policy in Brazil. Accounting & Finance Magazine, 32(87). https://doi.org/10.1590/1808-057x202113220

Menezes, U. G. de, Kneipp, J. M., Barbieri, L. A., & Gomes, C. M. (2012). Innovation management for sustainable development: Behavior and reflections on the chemical industry. INMR - Innovation & Management Review, 8(4), 88-116.

Menne, F., Surya, B., Yusuf, M., Suriani, S., Ruslan, M., & Iskandar, I. (2022). Optimizing the financial performance of SMEs based on sharia economy: Perspective of economic business sustainability and open innovation. Journal of Open Innovation: Technology,

Market, and Complexity, 8(1), 18. https://doi.org/10.3390/joitmc8010018

Ministry of Development, Industry, Commerce and Services. (2023). Business Map Panel. https://www.gov.br/empresas-e-negocios/pt-br/mapa-de-empresas/painel-mapa-de-empresas. Accessed on 15 Nov. 2023.

Moreno, A., De Figueiredo, J. R., & Soares, L. F. (2020). Impact of environmental regulations on sustainability practices in small and medium-sized enterprises: Evidence from Brazil. Environmental Science & Policy, 108, 35-42. https://doi.org/10.1016/j.envsci.2020.03.012

United Nations. (2015). About the United Nations. https://brasil.un.org/pt-br/about/about-the-un. Accessed on 14 Oct. 2023.

Neri, A., Cagno, E., & Trianni, A. (2021). Barriers and drivers for the adoption of industrial sustainability measures in European SMEs: Empirical evidence from chemical and metalworking sectors. Sustainable Production and Consumption, 28, 1-17. https://doi.org/10.1016/j.spc.2021.07.016

Neto, P. L. D. O. C. (1977). Statistics. Publisher E. Blücher.

Oliveira, M., & Almeida, J. (2018). Barriers to sustainability in small and medium-sized enterprises: Evidence from Brazil. Journal of Cleaner Production, 172, 3565-3575.

Oliveira Neto, G. C. de, Leite, R. R., Shibao, F. Y., & Lucato, W. C. (2016). Framework to overcome barriers in the implementation of cleaner production in small and medium-sized enterprises: Multiple case studies in Brazil. Journal of Cleaner Production.

Organization for Economic Cooperation and Development (OECD). (2005). Oslo Manual: Guidelines for collecting and interpreting data on innovation (3rd ed., Brazilian version). FIEP.

Pacheco, D. A. J. (2020). An overview of sustainable innovation in small and medium-sized enterprises: Literature review and main challenges. Journal of Innovation and Sustainability, 11(2), 44-59. https://doi.org/10.21610/jis.2020.1102

Pachouri, A., & Sharma, S. (2016). Barriers to innovation in Indian small and medium-sized enterprises. Asian Journal of Research in Business Economics and Management, 6(1), 21-32.

Pereira, C. M., & Almeida, R. M. (2022). Financial barriers to innovation in small businesses: An empirical study of Brazilian SMEs. Small Business Economics, 59(1), 57-71. https://doi.org/10.1007/s11187-021-00470-1

Pereira, L. S., & Costa, E. M. (2020). Regulatory challenges and barriers to environmental sustainability in the chemical industry: A case study of SMEs in Brazil. Environmental Science & Policy, 114, 107-116.

Pérez-Sánchez, J. A., & García-Álvarez, J. (2022). The financial constraints on innovation in small businesses. International Journal of Entrepreneurial Behavior & Research, 28(6), 1023–1041. https://doi.org/10.1108/IJEBR-06-2021-0458

Prodanov, C. C., & Freitas, E. C. (2013). Methodology of scientific work: Methods and

techniques of research and academic work (2nd ed.). Novo Hamburgo/Rio Grande do Sul: Feevale.

Porter, M. E., & Kramer, M. R. (2021). Financial performance of environmental investments: The role of green innovation. Business & Society Review, 126(4), 479-506. https://doi.org/10.1111/basr.12204

Raghuvanshi, J., & Agrawal, R. (2020). Revitalization of Indian SMEs for sustainable development through innovation. Business Strategy & Development, 3(4), 461-473. https://doi.org/10.1002/bsd2.112

Rawindaran, N., Jayal, A., Prakash, E., & Hewage, C. (2023). Perspective of small and medium enterprises (SMEs) and their relationship with government in overcoming cybersecurity challenges and barriers in Wales. International Journal of Information Management Data Insights, 3(2). https://doi.org/10.1016/j.joim.2023.100102

Rodrigues, S. B., & Silva, D. A. (2020). Economic and political uncertainties as barriers to innovation in emerging economies: Evidence from Brazil. Journal of Business Research, 108, 249-258.

Roldan, V. P. S., Cabral, A. C. A., Silva Filho, J. C. L., Santos, S. M., & Pessoa, M. N. M. (2013). Innovation in services: Analysis of the case of a medium-sized company in the Brazilian Northeast. Industrial Management Journal, 9(1), 1-23.

Sachs, I. (1993). Transition strategies for the XXI century: Development and the environment. Editora Brasiliense.

Santolin, R. B., & Nonemacher, T. B. (2024). Barriers to the implementation of Circular Economy Business Models in the Brazilian Manufacturing Industry. Management & Sustainability Journal, 5(1).

SEBRAE. (2013). Research on sustainability – Final Report. https://sebrae.com.br/Sebrae/Portal%20Sebrae/Estudos%20e%20Pesquisas/Pesquisa_sustentabilidade.pdf. Accessed on 26 Oct. 2023.

Silva, R. A., & Lima, G. P. (2023). Alternative financing models for SMEs in Brazil: The role of crowdfunding and social loans in innovation. Entrepreneurship Theory and Practice, 47(6), 1428-1454. https://doi.org/10.1177/10422587221123372

Silva, A. R., & Lopes, M. A. (2019). The financial performance of sustainable practices in small enterprises: Barriers and challenges. Sustainability, 11(15), 4046.

Silva, F. D., & Oliveira, L. M. (2018). Cost barriers to innovation in chemical industry SMEs: A Brazilian case study. Technology Analysis & Strategic Management, 30(6), 650-661.

Silva, F. R., & Martins, P. L. (2019). Barriers to sustainability in the furniture industry: The role of financial constraints and investment costs. Journal of Sustainable Development, 12(3), 45-58

Siqueira, C., & Kodama, T. (2023). Innovation management: Enablers and barriers in companies. Quaestum, 4, 1-12. https://doi.org/10.13140/RG.2.2.17750.87369

Souza, C. L. (2013). Barriers and motivations to the adoption of Green Supply Chain Management practices: A case study in the automotive battery sector. Master's thesis in Production Engineering, UNESP – Bauru Campus.

Souza, J. C., & Faria, M. F. B. (2013). Innovation process in the organizational context: An analysis of facilitators and hinders. Brazilian Business Review, 10(3), 113-136. https://doi.org/10.15728/bbr.2013.10.3.6

Tata, J., & Prasad, S. (2022). Regulatory challenges for SMEs in adopting sustainable practices: An empirical analysis. Journal of Cleaner Production, 368, 133018. https://doi.org/10.1016/j.jclepro.2022.133018

Thi, N. N. (2022). SMEs survival and knowledge in emerging economies: Evidence from Vietnam. Heliyon, 8(11), e11366. https://doi.org/10.1016/j.heliyon.2022.e11366

Tidd, J., & Bessant, J. R. (2009). Managing innovation: Integrating technological, market and organizational change (4ª ed.). John Wiley & Sons.

Torugsa, N., & Arundel, A. (2016). Complexity of innovation in the public sector: A workgroup-level analysis of related factors and outcomes. Public Management Review, 18(3), 392-416. https://doi.org/10.1080/14719037.2015.1039170

Ullah, F., Degong, M., Anwar, M., Hussain, S., & Ullah, R. (2021). Supportive tactics for innovative and sustainability performance in emerging SMEs. Financial Innovation, 7(1), 1-31. https://doi.org/10.1186/s40854-021-00248-3

Wu, G. C. (2017). Effects of socially responsible supplier development and sustainability-oriented innovation on sustainable development: Empirical evidence from SMEs. Corporate Social Responsibility and Environmental Management, 24(6), 661-675. https://doi.org/10.1002/csr.1413

Zanella, L. C. H. (2009). Methodology of study and research in administration. Federal University of Santa Catarina (UFSC); Brasília: CAPES, UAB.

Zhao, X., & Zhang, J. (2023). Financial constraints and innovation in small and medium enterprises. Journal of Business Research, 158, 78–91. https://doi.org/10.1016/j.jbusres.2023.04.010

APPENDIX A – RESEARCH QUESTIONNAIRE APPLIED

Hello, you are being invited to participate in the research project "Barriers to innovation and sustainability in small and medium-sized manufacturing industries in Western Paraná", whose principal investigator is Guilherme Lustosa dos Santos, master's student in the Graduate Program in Administration - Master's and Professional Doctorate at the State University of Western Paraná (UNIOESTE). The objective of this project is to identify what prevents small and medium-sized industries in Western Paraná from investing in innovation and sustainability, and also to verify if there is a relationship between them. Professor Dr. Elizandra da Silva is the advisor of this research.

We guarantee the maintenance of the confidentiality and total privacy of your participation and the information collected by the questionnaire, with the sole objective of scientific study. Any questions or additional information can be directed to the researcher responsible for this project, Guilherme Lustosa dos Santos through the e-mailguilherme.santos3@unioeste.bror in person at the Cascavel Campus. Participation and responses are anonymous, confidential, and exclusive to the development of this survey. By deciding to participate, the respondent will automatically be authorizing consent to the processing of the computed data.

The questionnaire has a total of 20 questions, two of which are open and 16 of them using the Likert scale as a way to assess the level of proximity of the answer and comparisons between them. The estimated time to complete the answers is less than 5 minutes.

General questions:

1) What city is the company located in? (open)
2) What is the respondent's position?
    a) Owner;
    b) Director;
    c) Manager;
    d) Supervisor;
    e) Other.
3) What is the sector of activity? (open)
4) What is the total number of employees?
    a) Up to 09 employees;
    b) From 10 to 49 employees;
    c) From 50 to 99 employees;
    d) Of 100 or more employees.

Barriers to Innovation	I totally disagree	Disagree	Indifferent	Agree	I totally agree
05) The lack of financial resources prevents my company from investing in innovation.					
06) My employees are not technically prepared to conduct projects related to innovation.					
07) There is a lack of time available to think about innovation.					
08) Laws and legal regulations make it difficult to understand and prevent investments in innovation.					
09) The high initial cost makes it difficult to invest in innovation.					
10) Changes in government and political uncertainties hinder investments in innovation.					
11) Employees and managers are not open and receptive to changes involving innovation.					
12) I have difficulty measuring the financial return when investing in innovation.					

Barriers to Sustainability	I totally disagree	Disagree	Indifferent	Agree	I totally agree
13) The absence of financial resources prevents the company from making investments in sustainability					
14) Lack of employee qualifications prevents my company from investing in sustainability					
15) Employees have many tasks, preventing the development of topics such as sustainability.					
16) There is a lot of bureaucracy to invest in sustainability					
17) The very high investment value prevents the company from investing in sustainability.					
18) The country's economic situation hinders investment in sustainability					
19) My company's employees are resistant to change when it comes to sustainability.					
20) The difficulty of quantifying the financial return prevents my company from investing in sustainability.					

Table 27
Correlations between barriers

Innovation	Sustainability	p value	r Pearson
Lack of time	Lack of time	< 0.001	0,657
Resistance to change	Resistance to change	< 0.001	0,631
High initial cost	Lack of financial resources	< 0.001	0,631
High initial cost	High initial cost	< 0.001	0,623
Resistance to change	Political and/or economic uncertainties	< 0.01	0,606
Lack of technical knowledge	Political and/or economic uncertainties	< 0.01	0,599
Lack of financial resources	Lack of financial resources	< 0.01	0,588
Difficulty measuring return	Difficulty measuring return	< 0.01	0,586
Lack of time	Lack of financial resources	< 0.01	0,579
Lack of technical knowledge	Resistance to change	< 0.01	0,576
Difficulty with laws and regulations	Difficulty with laws and regulations	< 0.01	0,566
Lack of technical knowledge	Lack of technical knowledge	< 0.01	0,561
Difficulty measuring return	Lack of time	< 0.01	0,540
Difficulty with laws and regulations	Lack of time	< 0.05	0,495
High initial cost	Difficulty with laws and regulations	< 0.05	0,493
High initial cost	Lack of time	< 0.05	0,492
Political and/or economic uncertainties	Difficulty with laws and regulations	< 0.05	0,482
Political and/or economic uncertainties	High initial cost	< 0.05	0,481
Lack of financial resources	High initial cost	< 0.05	0,479
Lack of time	Lack of technical knowledge	< 0.05	0,474
Lack of time	Resistance to change	< 0.05	0,450
Difficulty measuring return	Political and/or economic uncertainties	< 0.05	0,432
Difficulty measuring return	Lack of financial resources	< 0.05	0,415
Lack of technical knowledge	Difficulty measuring return	< 0.05	0,399
Resistance to change	Lack of technical knowledge	< 0.05	0,396
Resistance to change	Difficulty with laws and regulations	< 0.05	-0,478

Source: Prepared by the author.