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Carbon Clarity: Empowering Sustainability Choices in Organizations

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Masters in, Computer Science and Business Management

Supervisor: PhD Luís Filipe da Silva Rodrigues, Invited Assistant Professor, ISCTE-IUL

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Department of Information Science and Technology

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Dedico este trabalho à minha avó Quitéria, que me deixou durante este percurso, mas a sua força, dedicação e coragem permitiu a sua resolução!

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Resumo

Num cenário contemporâneo caracterizado por desafios ambientais e uma crescente consciência social, as organizações encontram-se numa conjuntura crítica em que as escolhas sustentáveis se tornaram imperativas. Esta Revisão Sistemática da Literatura (SLR) embarca com o objetivo de aprofundar o conceito e clarificar o tema da Pegada de Carbono, uma noção que transcende a mera redução das emissões de carbono com a intenção de abrir o espetro da sustentabilidade.

Através desta SLR envolvemos a síntese da análise de uma rica tapeçaria de estudos académicos, relatórios e estudos de caso. O foco permanece firmemente fixado na capacitação e empoderamento das tomadas de decisão sustentáveis por parte das organizações, com a revisão é destilar conhecimento de trabalhos desenvolvidos, esforçando-nos por fornecer uma perspetiva lúcida e holística sobre como estas podem navegar habilmente no intrincado terreno da sustentabilidade.

Em suma, pretendemos servir como uma possível luz orientadora às organizações, fornecendo-lhes um roteiro para práticas sustentáveis, defendo a capacitação e o empoderamento da sustentáveis através da fomentação de uma cultura corporativa onde a responsabilidade ambiental, social e económica convergem. Dirigindo assim para um caminho de um futuro onde as organizações não apenas lideram no que toca ao sucesso económico, mas também em relação à gestão ambiental, motores de impacto social e bastiões de prosperidade no longo prazo.

Palavras-chave: Organizações; Sustentabilidade; Ambiente; Pegada de Carbono.

Abstract

In a contemporary landscape characterized by pressing environmental challenges and a growing societal consciousness, organizations find themselves at a critical juncture where sustainable choices have become imperative. This Systematic Literature Review (SLR) embarks on a quest to delve into the concept of Carbon Clarity, a notion that transcends the mere reduction of carbon emissions to encompass a more comprehensive spectrum of sustainability considerations.

Through this all-encompassing SLR, we engage in the synthesis and analysis of a rich tapestry of academic studies, reports, and case analysis. Our focus remains steadfastly fixed on the empowerment of sustainability choices within organizations. The primary objective of this review is to distill insights and knowledge from existing research, striving to provide a lucid and holistic perspective on how organizations can adeptly navigate the intricate terrain of sustainability. In tandem, it aspires to serve as a guiding light for organizations, furnishing them with a roadmap towards sustainable practices.

At its heart, this work ardently champions the empowerment of sustainable decisions and the nurturing of a corporate culture where environmental, social, and economic responsibility seamlessly converge. Our aim is to illuminate a path towards a future where organizations not only lead in economic success but also shine as beacons of environmental stewardship, engines of social impact, and bastions of long-term prosperity.s

Keywords: Organizations; Sustainability; Environment; Carbon Footprint

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CHAPTER 1 Introduction

1.1. Framing the Topic

In the contemporary landscape marked by unprecedented environmental challenges and rapid societal, economic, technological, and environmental transformations worldwide (Evans, 2021), organizations face an imperative to embrace novel concepts, perspectives, and strategies to effectively tackle these complexities (Martinho & Mourão, 2020). Chief among these challenges looms the issue of the carbon footprint, emblematic of humanity's escalating impact on the environment. Carbon emissions, integral to global warming, engender a spectrum of local environmental quandaries encompassing solid waste generation, containment failures, and repercussions on air, ground, and water quality, as well as on flora and fauna (Christmann, 2021). Moreover, they exacerbate critical challenges such as droughts and diseases (Akpanke et al., 2024), with climate change identified as the paramount global health threat of the 21st century (Rath et al., 2021; Evans, 2021).

Although the challenges posed by carbon emissions are not new, research on the topic dates to the early 19th century, with pioneers like Joseph Fourier, Macedonio Melloni, and Svante Arrhenius laying the groundwork for our understanding of the link between carbon dioxide and climate change (Mohan et al., n.d.). The importance of addressing these environmental challenges gained momentum in the 1980s with the World Commission on Environment and Development's call for sustainable development, popularizing the term itself (Valls-Val & Bovea, 2022). The 1990s saw heightened social awareness and concern about the carbon footprint and global warming, culminating in the establishment of the Kyoto Protocol by the United Nations, which aimed to reduce greenhouse gas emissions globally (Ghosh et al., 2020), where creating a sustainable environment had become a significant world goal in the global context (Zahra & Badeeb, 2022).

The advent of the Fourth Industrial Revolution and the widespread adoption of technology have further accelerated the digitalization of businesses, leading to increased storage and energy consumption and consequently, higher carbon emissions (Jackson & Hodgkinson, 2023). Similarly, traditional sectors such as the building industry, responsible for over 30 per cent of the world's final energy use, contributing significantly to carbon emissions (Räihä et al., 2024) or in the healthcare sector, being responsible for the equivalent to 4.4 per cent of global net missions (Evans, 2021) and even with the increase in tourism we have seen an increase in

carbon emissions (Adedoyin et al., 2022). In response to these challenges, the United Nations reiterated the importance of achieving global sustainable development, advocating for measures to alter production patterns and promote sustainable consumption, including the sustainable management of water resources, utilization of renewable energies, and conservation of terrestrial and marine ecosystems (Carfí & Donato, 2022). Amid the increasing concern about environmental policy failure highlighted in the Global Risks Report of 2019, where the world continues to face challenges such as climate change, pollution, and resource depletion (Carfí & Donato, 2022). Consequently, since sustainable development is one of the essential themes surrounding organizations nowadays, because of its essential role in the profitable growth of the companies as well as the preservation of social and environmental value and, among the those pillars of sustainability, the concern for environmental degradation is predominately influencing the practices of global industries and governmental policies (Ghosh et al., 2020), and stakeholders recognizing the interconnectedness of their actions with the planet's wellbeing, integrating sustainable materials into various production, distribution, and consumption aspects has become a vital pathway toward achieving a more sustainable future (Casandra Okogwu et al., 2023) the industry began to shift towards a sustainability business model, recognizing it as essential for profitable growth and the preservation of social and environmental value (Jayarathne et al., 2021).

Clarity in carbon emissions is crucial for organizational transparency, accountability, and sustainability. Beyond regulatory compliance, it promotes environmental stewardship, innovation, and responsible business practices (Dubey & Singh, 2023). Effective carbon accounting methodologies help organizations understand their carbon footprint, identify emission reduction opportunities, and set science-based targets. Transparent reporting builds stakeholder trust, reduces reputational risks, and encourages collaboration. (Popescu et al., 2021).

This synthesis of best practices across various sectors aims to help combat carbon emissions, positively influencing environmental management, corporate governance, and decision-making. By analyzing data from the articles, reports and case studies, this effort highlights trends, challenges, and strategies in carbon accounting, hopping to offer valuables insights to enhance resilience, competitiveness, and long-term value amid climate uncertainty.

1.2. Motivation

In the dynamics of today's business environment, sustainability is emerging not just as a consideration, but as a fundamental imperative for organizations around the world. Growing environmental, social, and economic challenges amplify the urgency for organizations to commit to intentional and impactful sustainable choices (Casandra Okogwu et al., 2023). Amid growing challenges, the power of making conscious and sustainable choices is a transformative force, it's a statement that transcends profit margins and embraces a broader responsibility towards planet Earth and every deliberate choice made in the direction of sustainability is a ripple that not only contributes to a healthier and more vibrant planet, but also unleashes a cascade of benefits for the organization itself.

The benefits of sustainability extend beyond altruism, as they are tangible and strategic. When sustainability choices are woven into the core of business operations, they act as catalysts for cost savings, driving operational efficiency and resource optimization (El Hathat et al., 2023). This not only enhances reputation, appealing to conscious consumers seeking responsible and ethically managed organizations, but also fosters a positive impact within the organization itself. Sustainable practices promote employee engagement, instilling a sense of purpose and pride among team members who become integral partners in the collective effort for positive change (Iqbal et al., 2023).

Therefore, embracing sustainability is more than just a concept; it represents a strategic evolution aligning organizations with the urgent needs of our planet (Räihä et al., 2024). It signifies a deliberate move towards a future where organizations flourish not only financially, but also regarding sustainability (Addai et al., 2023).

1.3. Research Questions and Objectives

This work aims to assess the impact of carbon emissions from organizations and the need to analyze and clarify the effect of this is fundamental given the environmental concerns and thus allow us to understand what measures have been implemented by organizations with a greater sustainable content. It raised two research questions; the primary one was:

 What challenges and barriers do organizations face in relation to their Carbon Footprint? The secondary research question was: What strategies and practices have organizations implemented to improve their carbon emissions and promote sustainable choices?

These research questions aim to deepen and clarify the aspects of carbon and their implications for organizational sustainability, decision-making and overall performance, providing a framework for research. But, this research, it will not discover new knowledge but unlock a vision of organizations as catalysts for positive change, exploring how companies can harness their vast resources, innovative spirit, and entrepreneurial culture to become beacons of informed, sustainable, and effective decision-making. The main objective is to provide valuable knowledge and practical guidance for organizations seeking not only to embrace sustainability, but also to empower their stakeholders to actively participate in building a more sustainable future. By understanding the dynamics of sustainability choices, we can collectively work towards a world in which companies are catalysts for positive change, contributing to a more equitable, environmentally conscious, and economically sustainable global society.

1.4. Methodological Approach

This research will be using two methods of approach: qualitative and quantitative. Initially, the qualitative method relates to the part of data collection, consisting of analyzing articles from repositories suitable for scientific documentation. Secondly, the quantitative approach relates to the analysis of the articles collected, carried out using Leximancer software, which will enable semantic and lexical analysis, as well as graphic representation in concept maps.

CHAPTER 2 Theoretical Background

2.1. Overview on Organizations Carbon Emissions

The concept of a carbon footprint entails a precise quantification of greenhouse gas emissions, predominantly carbon dioxide, resulting directly or indirectly from human activities. This metric provides a standardized method for comprehensively assessing the environmental impact of organizations regarding their carbon emissions (Nidhi, 2023).

Organizational carbon emissions originate from various activities, including the combustion of fossil fuels for energy generation (Akpanke et al., 2024), transportation and storage networks (Babagolzadeh et al., 2020), industrial processes, and land-use changes such as deforestation (Räihä et al., 2024). These emissions significantly contribute to the intricate dynamics of climate change (El Hathat et al., 2023) and the broader phenomenon of global warming (Ulucak et al., 2020). Assessing an organization's environmental degradation requires a thorough examination of emissions from diverse sources across its operational spectrum (Ulucak et al., 2020). This assessment necessitates a multifaceted approach, incorporating initiatives aimed at enhancing energy efficiency, integrating renewable energy sources into operational frameworks (Menon & V, 2021), implementing strategic modifications in transportation practices (Gawusu et al., 2022), and promoting sustainable land-use management practices (Räihä et al., 2024). Additionally, leveraging emerging technologies such as artificial intelligence optimizes energy use and predicts maintenance needs, while blockchain ensures data integrity in carbon reporting (Camaréna, 2021; Chaudhari et al., 2022).

Collectively, these measures aim to reduce the carbon emissions associated with organizational operations and activities. The increasing recognition among governments and businesses of the need to quantify and reduce carbon footprints underscores the crucial role organizations play in the collective effort to combat climate change and advance towards a more sustainable future (Akpanke et al., 2024). Furthermore, adherence to regulatory and policy frameworks, coupled with transparent communication, enhances an organization's reputation among stakeholders (Gawusu et al., 2022). Sustainability reports and environmental disclosures foster trust and can influence consumer and investor behavior, encouraging support for greener practices (Pinaki et al., n.d.; Shahid, n.d.). By implementing concerted and proactive measures,

organizations can leverage their influence to drive meaningful change and contribute significantly to the global goal of environmental sustainability (Dwivedi et al., 2023).

2.2. Environmental Impact of Organizations Carbon Footprint

The concept of a carbon footprint involves the precise quantification of greenhouse gas emissions, predominantly carbon dioxide, resulting directly or indirectly from human activities (Varón-Hoyos et al., 2021). This metric provides a standardized method for comprehensively assessing the environmental impact of various activities, highlighting the significant contribution of human activities to climate change and environmental deterioration, particularly global warming (Valls-Val & Bovea, 2022).

Organizational carbon emissions originate from various sources, including the combustion of fossil fuels for energy generation, transportation and logistics, industrial processes (Rath et al., 2021). These emissions have significant repercussions on human health, contributing to respiratory and cardiovascular diseases (Rath et al., 2021; Nidhi, 2023), and they also lead to the loss of freshwater resources, biodiversity, and the exacerbation of social inequalities (Jurić & Ljubas, 2020; Rath et al., 2021). Furthermore, carbon emissions decrease air quality and contribute to the occurrence of extreme weather events (Popescu et al., 2021). These events have catastrophic impacts on communities (Pinaki et al., n.d.), agriculture (El Hathat et al., 2023), and infrastructure worldwide (Dwivedi et al., 2023).

Mitigating organizations' carbon footprint and in that way the environmental impacts is crucial for charting a more sustainable trajectory (Carfí & Donato, 2022). Such efforts are essential for safeguarding the planet for present and future generations, ensuring a resilient and sustainable future. This requires enhancing regulatory frameworks (Domingues et al., 2023), and promoting international cooperation (Khan et al., 2022). By implementing these measures, organizations can significantly reduce their carbon footprint, contribute to global sustainability goals, and play a pivotal role in the collective effort to combat climate change (Shahid, n.d.).

2.3. Organizations Carbon Footprint Challenges and Barriers

Organizations striving to manage and reduce their carbon footprint face numerous challenges and obstacles that can hinder their progress towards sustainability (Díaz-López et al., 2023). These obstacles cover several areas, including measurement and monitoring (Popescu et al., 2021), financial constraints (Janssen et al., 2022), supply chain complexities and regulatory compliance (Gawusu et al., 2022), and technological limitations (Jackson & Hodgkinson, 2023). Accurate measurement and tracking of carbon emissions is a primary challenge, this is due to the lack of standardized methodologies and the complexity of data collection. Financial constraints and resource limitations further hinder effective carbon management (Rath et al., 2021), as implementing reduction strategies often requires significant upfront investments and smaller organizations may lack the financial capacity for such investments (Janssen et al., 2022). The nature of supply chains adds other complexities to carbon management, requiring extensive collaboration and transparency to ensure that suppliers and partners adhere to environmental standards and navigating a diverse and frequently changing environmental regulations across countries presents another significant barrier, especially for multinational corporations (Gawusu et al., 2022).

Achieving meaningful reductions in carbon emissions often necessitates significant changes in organizational behavior and culture. Encouraging sustainable practices involves overcoming resistance to change and fostering environmental responsibility (Huda, 2024). Additionally, technological limitations can prevent organizations from accessing and implementing the latest green innovations, particularly in industries requiring specialized equipment or processes (Chaudhari et al., 2022; Jackson & Hodgkinson, 2023).

Balancing economic growth with sustainability is another complex challenge, organizations must consider the broader ecological impact of their operations, including land use and natural resource depletion, integrating these considerations into business strategies (VanBoxtel et al., 2023). Increasing consumer pressure for sustainable practices also presents a challenge, as organizations must align their products and services with these expectations without compromising quality or profitability (Evans, 2021). Outdated infrastructure and transportation systems further complicate efforts to reduce carbon emissions. Transitioning to sustainable infrastructure and transportation options requires substantial investment and policy support, which can be difficult to obtain (Mohan et al., n.d.; Rashmi & Preeti, 2023).

Despite these challenges, organizations are becoming more aware of the necessity to manage their carbon emissions to combat climate change and achieve sustainability goals. Overcoming these barriers requires a collective effort, investment in green technologies, regulatory support, and a cultural shift towards more sustainable practices (Nanath & Pillai, 2021). By addressing these obstacles, organizations can make substantial progress in reducing their carbon footprint and contributing to global environmental sustainability.

2.4. Organizations Strategies and Practices to Promote Sustainable Choices

Organizations are adopting strategies and practices with the aim of promoting sustainability and thus reducing their carbon emissions. Increasing energy efficiency is a key approach, which involves investing in energy-efficient technologies and optimizing operations to reduce energy consumption. In addition, many organizations are transitioning to renewable energy sources, such as solar and wind, to power their operations and decrease dependence on fossil fuels (Numan et al., 2023).

Sustainable supply chain management plays a crucial role, with organizations working closely with suppliers to ensure adherence to environmental standards and promoting transparency (Gawusu et al., 2022). Circular economy practices are also being implemented to minimize waste, maximize resource efficiency, and create closed-loop systems where waste is repurposed. Sustainable transportation practices are emphasized, including optimizing logistics, investing in fuel-efficient vehicles, and using alternative transportation methods like electric vehicles. Environmental management systems provide a framework for setting environmental goals, monitoring progress, and ensuring compliance with regulations (Menon & V, 2021). Employee engagement and training are essential for fostering a culture of sustainability (Iqbal et al., 2023), while green building practices focus on designing energy-efficient and environmentally friendly buildings (Pórólfsdóttir et al., 2023). Organizations are also investing in innovation and technology to improve sustainability (Dwivedi et al., 2023).

Sustainable product design aims to create products with lower environmental impact throughout their life cycle, using sustainable materials and minimizing resource use. Collaboration and partnerships with stakeholders, including industry partners and governments, are critical for addressing sustainability challenges and driving collective action (Chaudhari et al., 2022). Transparent reporting and policy advocacy are important practices, with organizations disclosing environmental performance through sustainability reports and engaging with policymakers to support sustainability initiatives (Jayarathne et al., 2021). Overall, these strategies and practices help organizations mitigate environmental impact, enhance resilience, and create long-term value in the face of climate change.

CHAPTER 3 Research Methodology

3.1. Methodology Method Overview

Conducting a thorough systematic literature review is essential for understanding carbon emissions within organizations and advancing sustainability initiatives. This method allows for the identification of existing knowledge, areas needing improvement, and the refinement of organizational carbon management strategies (Wondimagegn et al., 2020). Unlike traditional reviews, a systematic literature review employs rigorous, replicable, and transparent methodologies to gather relevant documentation and address key research questions.

This approach minimizes bias at every stage, using the Search, Appraisal, Synthesis, and Analysis (SALSA) framework to establish search protocols, ensuring methodological accuracy, systematization, comprehensiveness, and reproducibility. When conducted meticulously, it yields reliable findings and conclusions (Mengist et al., 2020). This is followed by two additional steps: the Protocol and the Report (PSALSAR).



Research Approach

Figure 1 - Research approach

(Source: adapted from the advisor by the author)

The PSALSAR framework integrates elements from two established review methodologies: the literature search protocol, PRISMA guidelines (Albhirat et al., 2024), and the SALSA framework (Wondimagegn et al., 2020). By combining these approaches, the PSALSAR framework comprises six distinct steps, as outlined in Table 1, to effectively guide the review process.

Steps	Outcomes	Methos
Protocol	Define research scope.	Carbon emissions within organizations (carbon footprint).
Search	Define search strategy.	Define searching strings (keywords).
	Define search studies.	Select and search databases.
Appraisal	Selecting studies.	Define inclusion and exclusion criteria.
	Studies quality assessment.	Quality criteria.
Synthesis	Extract data.	Extraction template.
	Categorize the data.	Organize the data by refining its definition iteratively and
		prepare it for further analysis.
Analysis	Data analysis.	Quantitative categories, description, and narrative analysis of
		the organized data.
	Results and discussions.	Based on the analysis, present the trends, identify any gaps, and
		summarize the results.
Report	Conclusion.	Formulating conclusions and recommendations.
	Report writing.	PRISMA methodology.
	Journal article production.	Summarizing the report findings for a broader audience.

Table 1 - The frameworks for systematic and meta-analysis studies.

Source: Method for conducting systematic literature review and meta-analysis for environmental science research.

Essentially, a well-executed systematic literature review is fundamental for thorough planning before any analysis and (Mengist et al., 2020), meta-analysis further improves understanding by statistically combining results from various studies, providing more accurate estimates (Rodrigues et al., 2019). Both share key characteristics that contribute to their effectiveness, including clear research questions and objectives, transparent and replicable methods, comprehensive search strategies, evaluation of research quality and validity, systematic organization, and synthesis of data, and making findings accessible for scientific use and decision-making (Wondimagegn et al., 2020).

3.2. Methodology Framework

3.2.1. Step 1 - Protocol

Ensuring transparency, transferability, and replicability as key principles for conducting this review was established a research protocol to define the scope, formulate the research questions, maintaining methodological rigor, and aiding in the identification of relevant literature (Albhirat et al., 2024).

The Population, Intervention, Comparison, Outcome, and Context (PICOC) framework has a crucial role in defining the research scope (Wondimagegn et al., 2020). In Table 2 its outline the PICOC framework along with the definitions given for each concept.

Concept	Definition	SLR application
Population	This research focuses on	Scientific research on carbon emissions within organizations
	organizations carbon emissions.	aims to understand and mitigate their environmental impact.
Intervention	The current methods used to	However, gaps still exist, highlighting the need for robust
	address the identified issue.	methodologies to accurately measure and report across
		various sectors. Challenges include ensuring transparency
		and consistency in reporting. Further research is necessary to
		assess the effectiveness of carbon management strategies,
		understand their socio-economic implications, and refine
		measurement methodologies, reporting practices, and
		strategy effectiveness.
Comparison	Comparing interventions that	Differentiating among the various methods used to measure,
	assess carbon emissions to	evaluate, or map different environmental sustainability
	differentiate between methods	metrics.
	used to measure various metrics.	
Outcome(s)	Procedures to evaluate the	Current understanding of carbon emissions within
	information and pinpoint gaps	organizations, including the most and least studied aspects,
	highlighted in the selected	categories, methodologies, data types, purposes, and scales of
	publications on carbon	studies. Identified gaps encompass limitations in
	emissions studies.	methodology, modeling, data quality, and a scarcity of studies
		on trade-offs and synergies.
Context	The environments or domains	Patterns in research, current understanding in studies,
	within the organizations.	obstacles and gaps, geographic distribution of existing
		studies, and research distribution based on carbon categories
		assessed.

Table 2 - SLR research scope based on the application of the PICOC framework to the determined objectives.

Therefore, the refined research questions were:

- What are the predominant challenges and barriers that organizations encounter in managing their carbon emissions?
- What strategies and practices have organizations adopted to mitigate their carbon footprint and foster sustainable decision-making?

These questions will provide a focused framework for conducting this systematic literature review relating to carbon clarity in organizations, enabling a comprehensive examination of current knowledge, development trajectories, gaps, and challenges.

3.2.2. Step 2 - Search

The search step involves identifying relevant sources of information through a systematic search strategy. The search strategy assists in selecting appropriate search keywords and determining the databases to collect the relevant scientific articles. Therefore, the search terms and string definition should be based on the terminology identified for the population in the systematic literature review application in the PICOC framework (Wondimagegn et al., 2020). For this review, Scopus, EBSCO, and Web of Science were chosen as the databases.

Prior to commencing the definitive search, a pilot search was conducted to refine the search terms. Initially the keywords used were "Organizations" and "Carbon Footprint", as listed in Table 3. The first set of results from the three selected databases yielded a substantial number of articles, potentially obscuring the presence of relevant literature. To address this, two more search terms were added, including "Sustainability" and "Environment," were employed.

Databases	Keywords, searching strings and searching terms	Nº of Articles	
Scopus	Scopus "Organizations" AND "Carbon Footprint"		
	"Organizations" AND "Carbon Footprint" AND	153	
	"Sustainability" AND "Environment"		
EBSCO	"Organizations" AND "Carbon Footprint"	2126	
	"Organizations" AND "Carbon Footprint" AND	362	
	"Sustainability" AND "Environment"		
Web of	"Organizations" AND "Carbon Footprint"	806	
Service	"Organizations" AND "Carbon Footprint" AND	140	
	"Sustainability" AND "Environment"		

Table 3 - The search terms used and the total number of publications from each database.

Source: Developed for this research by the author.

The search was limited to articles published between 2020 and 2024. Furthermore, strict inclusion and exclusion criteria were applied, as shown at Table 4, to filter the results and focus on the most relevant papers that align with the objectives of this review.

Criteria	Decision
Between 2020 and 2024	Inclusive
Pertinence for the reviewed theme.	Inclusive
Relevance on Abstract and Conclusion.	Inclusive
Only open-source Articles.	Exclusive
Articles not in English language.	Exclusive
Duplicated Articles.	Exclusive

Table 4 - SLR research selection of literature using inclusion and exclusion criteria.

Source: Developed for this research by the author.

3.2.3. Step 3 - Appraisal

During the appraisal step, the selected articles were evaluated based on the objectives of the review. This involved screening the literature to identify papers relevant to the research scope and assess their validity. The process includes two basic steps: selecting studies using inclusion and exclusion criteria and conducting a quality assessment (Wondimagegn et al., 2020).

I. Selection studies using inclusion and exclusion.

Utilizing the inclusion and exclusion criteria, papers that met the inclusion criteria were selected for further investigation and content assessment, while the others were excluded. The predefined literature inclusion and exclusion criteria for this systematic review were presented in Table 4. For example, papers that were not open source, published in 2019 or earlier, and not in English were omitted. In the initial stage, a total of 655 records were found (153 from Scopus, 362 from EBSCO, and 140 from Web of Science). After the filtering in the databases according with the criteria's, such as not open source, from 2019 or below, and non-English language papers the number of literatures was reduced to 124 articles retained for further analyzation.

The final dataset list was saved in an Excel spreadsheet with information as the title and link for the publication for further investigation. However, some of the scientific articles were not open source, limiting the final number of published articles included for more assessments. Only 67 articles remained for the abstract and conclusion reading. Throughout the main body analysis, redundant articles and those lacking a clear focus on the subject were meticulously eliminated. Ultimately, 50 publications meeting all inclusion criteria outlined in this systematic literature review were selected, downloaded onto the hard drive, and manually evaluated, reading it for the next phase of analysis.

II. Conducting a quality assessment.

Each publication was evaluated using the following criteria which are based on three quality assessment:

- Are the review's inclusion and exclusion criteria described and appropriate?
- Is the literature search likely to have covered all relevant keywords on the topic?
- Was the type of carbon footprint mentioned in the publication derived by organizations?

3.2.4. Step 4 - Synthesis

The synthesis step entails the identification and extraction of pertinent data from the chosen papers. Like methodologies utilized in survey research, systematic literature reviews coupled with meta-analysis studies employ data coding techniques (Wondimagegn et al., 2020).

Data pertinent to each selected paper was systematically extracted and amalgamated into a database utilizing an Excel spreadsheet for data processing. The variables of interest were arranged in columns, categorized by title, keywords, abstract, and conclusion, with articles arranged horizontally. Keywords were utilized as tags to enhance data analysis efficiency. Subsequently, the database file was saved in TEXT (MS-DOS) format, an easily readable extension file suitable for upload to the Leximancer portal.

3.2.5. Step 5 - Analysis

The analysis step involves a thorough evaluation of the synthesized data to extract significant insights from the selected studies. During this step, the research questions formulated earlier were addressed, encompassing both qualitative and quantitative interpretations and narrations of the results (Wondimagegn et al., 2020).

Before commencing the analysis using the Leximancer tool, the initial step involved uploading the document in MS-DOS format under the "Select Documents" section to initiate the data analysis process. Subsequently, the following steps, namely "Text Processing Settings"

and "Concept Seeds Setting," retained the default options provided by the tool. Upon reaching the "Generate Concept Seeds" phase, the "Concept Seeds" option was chosen. Here, the generated seeds underwent scrutiny, and non-essential terms for the research, such as "factors" and "further," were eliminated. Additionally, words deemed synonymous or contextually related were merged, such as "economic" and "economy," "growth" and "increase," and "carbon" with "footprint" and "footprints." Both the "Thesaurus Settings" and "Topic Guide Settings" levels remained unchanged with the default options. Following the completion of "Generate Thesaurus," the subsequent steps— "Compound Concepts," "Concept Coding Settings," and "Project Output Settings"— similarly retained the default configurations.

To conclude, the "Generate Results" step was selected post data optimization, leading to the generation of a concept map. The generation process, typically semi-automatic, iteratively continues until the output aligns with our research questions and theoretical conceptual literature review.

3.2.6. Step 6 - Report

For the last step, the report implies the description and presentation of the methods and results of the research conducted. Two steps were determined for this phase: (i) description of the main elements in a literature review under a standard form (PRISMA report) and (ii) research summary for public presentation (Journal article).

The PRISMA report step comprised the presentation of the methods and results of this review as well as the description of any step in the process using a standardized method, PRISMA (Albhirat et al., 2024). This step resulted in the creation of a more detailed report that has been used to write this journal article.

CHAPTER 4

Results

With the Leximancer analysis finalized, it was produced a concept map, conceived as a birdseye perspective of the data, illustrating how the main concepts extracted from the documentation are grouped into themes and connected, where it can be found twenty-six concepts, clustered in five themes (Fig. 2). The concepts are represented by dots and, the larger the dot, the more important the concept is for the theme. The themes, the colored bands, are constituted by concepts clusters, meaning that they relate to each other. The most important theme is colored red, and the colors progress around the color wheel (Rodrigues et al., 2019). Leximancer tool enables to set the sensitivity of subject and concepts output in a range of 0– 100. A default setting of 100% visible concepts and 60% theme size was employed displaying a manageable set of meaningful ideas.



Figure 2 - Concept map (Source: Developed for this research in Leximancer portal by the author).

The concept map (Fig. 2) shows the five main themes regarding the documentation gathered: Environmental (541 hits); Organizations (263 hits); Countries (146 hits); Carbon Emissions (120 hits); Supply Chain (86 hits). Reaching to these five themes covers many of the topics studied in the selected papers, as can be seen in the most prominent theme, "Environmental", addresses underlying concepts such as "sustainability", "green", "climate" and "resources". Therefore, the themes in the analysis do not directly correspond to single topics of the paper; instead, they indicate how concepts group together across the papers based on the selected topics.

Concepts	Count	Relevance (%)
sustainability	290	100
environmental	269	93
organizations	191	66
practices	154	53
energy	126	43
emissions	120	41
supply	86	30
green	85	29
countries	78	27
change	66	23
ecological	61	21
global	48	17
management	47	16
consumption	46	16
technologies	44	15
reduce	42	14
climate	38	13
resources	36	12
food	34	12
goals	33	11
products	30	10
world	29	10
life	27	9
social	27	9
behavior	24	8
transportation	23	8

Table 5- Concepts Results (Source: Developed for this research).

Source: Developed for this research by the author.

With the analysis of the concept results in Table 5, it's showed the twenty-six main concepts, published regarding: sustainability (290 hints); environment (269 hints); organizations (191 hints); practices (154 hints); energy (126 hints); emissions (120 hints); supply (86 hints); green (85 hints); countries (78 hints); change (66 hints); ecological (61 hints); global (48 hints); management (47 hints); consumption (46 hints); technologies (44 hints); reduce (42 hints); climate (38 hints); resources (36 hints); food (34 hints); goals (33 hints); products (30 hints); world (29 hints); life (27 hints). The data is divided into the five main

themes mentioned, with relevance determined by the frequency of text segments coded with that concept relative to the frequency of the most frequent concept in the list.

The connectivity measure depicted in Figure 2, provides an estimation of the coverage of the themes across the data. Therefore, the most frequent concept (sustainability) will always be 100% - what does not mean that all text segments contain that same concept. This meter is an index of the relative effectiveness of a concept's frequency. For instance, the environmental concept is included in the papers and has a relevance of 93% and, the organizations concept has a relevance of 66%, as mentioned in the following article extracts quotes in Table 6.

Theme	Concepts	Articles quotes (extracted by Leximancer)	
Environmental	Sustainability	" it is urgent to find new ways of life and new production systems that	
		make our ecological footprint compatible with global sustainability".	
	Environmental	"The EU's environmental footprint outside its borders is very high and	
		growing".	
	Practices	"Previous studies have shown that reducing costs is one of the drivers for	
		adopting practices to reduce environmental impacts"	
	Green	"Green energy is an essential factor in evaluating environmental	
		sustainability".	
Organizations	Organizations	"organizations did not care about environmental issues because it would	
		not affect their profit and competitiveness".	
	Management	"embrace the sustainable management of water, sustainable energies,	
		actions for combating climate change, sustainable consumption and	
		production patterns, the conservation and sustainable employment of the	
		oceans, and sustainable management of terrestrial ecosystems and forests".	
	Climate	"As a result of climate change, it is imperative to reduce carbon emissions	
		and waste generation".	
	Social	"social, and political aspects of globalization contribute to	
		environmental pollution in the country".	
Supply Chain	Supply	"Due to these factors in the dairy industry, modern supply chains face	
		many challenges, including sustainability issues and uncertainty"	
	Food	" result from increase in competition of food oils, food products and	
		palm oil to compensate the growing need substitution of consumption of	
		raw materials"	
	World	"The world is in a critical phase of transition towards more sustainable	
		development, and the measures taken in the next decade will determine the	
		way forward".	

Table 6 - Themes underlying, main concepts and illustrated with articles quotes.

	Transportation	"determination of variables such as inputs, drivers, and enablers	
		throughout the process, including production, transportation and	
		distribution"	
Carbon	Emissions	"there has been a significant increase in greenhouse gases and CO2	
Emissions		emissions".	
	Products	"The goal is to develop sustainable products and solutions, reduce the	
		carbon footprint of our own operations, and support our customers to meet	
		new regulations and achieve their sustainability goals".	
	Reduce	"would increase the production of renewable energy and reduce the	
		energy emissions of buildings".	
Countries	Energy	"Sustainability lowers pollution and the use of communal resources such	
		as water and energy".	
	Countries	"Low carbon transition is a global hotly debated issue that has been	
		proposed and highlighted by numerous countries".	
	Consumption	" the world has not accomplished an economic growth rate that ensures	
		sustainable resource consumption and waste".	
	Resources	"In today's world, consumption patterns are causing a pressure on natural	
		resources".	

Source: Developed for this research by the author.

CHAPTER 5 **Discussions**

5.1. General Discussions

Utilizing a systematic literature review and meta-analysis, this chapter explores the intricate dynamics of organizational carbon emissions. It evaluates the current state of comprehension, identifies the predominant challenges, and highlights effective strategies adopted by organizations. By synthesizing insights from the systematic literature review and empirical findings, this chapter aims to provide a comprehensive analysis that informs sustainable practices and policies within organizations. The discourse is structured around two pivotal research questions, each addressing a crucial aspect of carbon management and sustainability.

Utilizing the Leximancer tool, the research identified the main topics covered in the final 50 scientific documents collected through the methodological review process. These articles, gathered from three databases, were analyzed using predefined criteria as detailed in Chapter 3. The selected timeframe of 2020 to 2024 ensures that the research addresses contemporary issues, providing a relevant and current understanding of carbon emissions within organizations. This systematic approach reveals the most frequently appearing concepts and their correlations, offering a nuanced view of the challenges and strategies related to carbon clarity in modern organizational contexts. Consequently, the research questions have been comprehensively addressed.

What are the predominant challenges and barriers that organizations encounter in managing their carbon emissions?

Organizations face several predominant challenges and barriers in managing their carbon emissions, impacting their sustainability efforts and overall environmental performance.

- Measurement and Tracking One of the primary challenges is accurately measuring and tracking carbon emissions (Varón-Hoyos et al., 2021). Many organizations lack the necessary tools and technologies to monitor their energy use and consumption effectively (Ghosh et al., 2020).
- Costs and Resources: Implementing sustainable practices often requires significant financial investment and human resources (Christmann, 2021). Many organizations, especially small and medium-sized enterprises, struggle to allocate sufficient resources for sustainability initiatives and the high costs associated with greener opportunities

such as a more efficient use and conserve natural resources, lower cost of disposal (Alpdemir et al., 2024) or even the need for skilled personnel to manage these initiatives (Domingues et al., 2023).

- Supply Chain Complexity: The global nature of supply chains adds another layer of complexity (Gawusu et al., 2022). Organizations need to ensure that their suppliers and partners adhere to the same environmental standards. Managing supply chain emissions requires extensive collaboration and transparency, which can be difficult to achieve across different countries and regulatory environments (Shahid, n.d.).
- Regulatory Compliance: Navigating the myriads of environmental regulations and standards across different regions is another significant barrier (Zahra & Badeeb, 2022). Organizations must comply with local, national, and international regulations, which can vary widely. This compliance burden can be particularly challenging for multinational corporations operating in multiple countries (Nidhi, 2023).
- Behavioral Change: Achieving meaningful reductions in carbon emissions often requires significant changes in organizational behavior and culture, encouraging to adopt more sustainable practices (Evans, 2021).
- Technological Limitations: While there are many green technologies available, not all
 organizations have access to the latest advancements. Technological limitations can
 prevent organizations from implementing the most effective solutions for reducing their
 carbon footprint (Nidhi, 2023).
- Ecological Impact: Balancing economic growth with ecological sustainability is a complex challenge. Organizations must consider the broader ecological impact of their operations, including land use, food production, and natural resource depletion. Striking this balance is essential for achieving sustainable development (Kitamura, Ichisugi, et al., 2020).
- Consumer Expectations: There is increasing pressure from consumers for organizations to adopt more sustainable practices. While this can drive positive change, it also presents a challenge as organizations must align their products and services with these expectations without compromising on quality (Menon & V, 2021).
- Infrastructure and Transportation: The existing infrastructure and transportation systems in many regions are not conducive to low-carbon operations. Organizations often depend on outdated systems that contribute significantly to carbon emissions (Kitamura, Ichisugi, et al., 2020). Transitioning to more sustainable options requires substantial investment and policy support (Peters et al., 2021).

Although organizations are becoming more conscious of the necessity to manage their carbon emissions to combat climate change and reach sustainability targets, they face various challenges. Overcoming these obstacles demands a collective effort, investment in green technologies, regulatory backing, and a cultural shift within organizations towards more sustainable practices.

What strategies and practices have organizations adopted to mitigate their carbon footprint and foster sustainable decision-making?

Organizations have adopted a variety of strategies and practices to mitigate their carbon footprint and foster sustainable decision-making. These efforts span across multiple areas, emphasizing sustainability and environmental responsibility.

- Energy Efficiency: Many organizations focus on improving energy efficiency as a primary strategy (Akpanke et al., 2024). This includes upgrading energy-efficient lighting, heating, and cooling systems, optimizing manufacturing processes, and implementing IoT/smart technologies to reduce energy consumption (Chaudhari et al., 2022).
- Renewable Energy: By sourcing their energy from green alternatives, organizations can drastically reduce their carbon emissions and support the transition to a low-carbon global economy (Akpanke et al., 2024).
- Sustainable Supply Chain Management: Organizations are increasingly integrating sustainability criteria into their supply chain practices. This involves selecting suppliers based on their environmental performance, promoting green logistics, and collaborating with partners to reduce emissions across the supply chain (Alinezhad et al., 2022; Ghosh et al., 2020).
- Circular Economy Practices: Implementing circular economy principles is another effective strategy. Organizations design products for longevity, reuse, and recyclability, thereby reducing waste and the overall ecological impact (Martinho & Mourão, 2020). This includes practices like product take-back programs, remanufacturing and using recycled materials in production (Shahid, n.d.; Chaudhari et al., 2022).
- Sustainable Transportation: Reducing the carbon footprint of transportation is a key focus. Organizations are optimizing logistics routes, investing in electric and hybrid vehicle fleets, and encouraging the use of public transport, cycling, and walking among

employees to cut down on travel-related emissions (Ghosh et al., 2020; Peters et al., 2021).

- Environmental Management Systems: Implementing these systems, such as ISO 14001/20121, helps organizations systematically manage their environmental impact (Casandra Okogwu et al., 2023; Kitamura, Karkour, et al., 2020). These systems provide a framework for setting sustainability goals, monitoring performance, and continually improving environmental practices (El Hathat et al., 2023).
- Employee Engagement and Training: Organizations recognize the importance of involving employees in sustainability efforts. They conduct training programs to raise awareness about sustainable practices and encourage eco-friendly behavior in the workplace (Alpdemir et al., 2024).
- Green Building Practices: Constructing and retrofitting buildings to meet green building standards is another strategy. These buildings are designed to be energy-efficient, use sustainable materials, and provide healthy indoor environments, contributing to lower emissions and improved quality of life (Pórólfsdóttir et al., 2023; Alpdemir et al., 2024).
- Innovation and Technology: Investing in innovative technologies and practices is crucial. Organizations are exploring advanced materials, AI-driven energy management systems, and other cutting-edge technologies to enhance sustainability. These innovations help in identifying inefficiencies and implementing more effective carbon reduction strategies (Panduru et al., 2021).
- Sustainable Product Design: Designing products with a focus on sustainability involves considering the entire lifecycle, from sourcing raw materials to end-of-life disposal. Organizations are developing eco-friendly products that use fewer resources and generate less waste (Casandra Okogwu et al., 2023).
- Collaboration and Partnerships: Collaborating with other organizations, governments, and NGOs is essential for broader impact. Through partnerships, organizations can share best practices, leverage resources, and collectively work towards common sustainability goals (Addai et al., 2023; Domingues et al., 2023; Alinezhad et al., 2022).
- Reporting and Transparency: Many organizations are enhancing transparency by publicly reporting their environmental performance. Sustainability reports, based on frameworks help stakeholders understand an organization's sustainability efforts and progress (Popescu et al., 2021; Christmann, 2021).
- Policy Advocacy: Engaging in policy advocacy to support sustainable legislation and regulations is another strategic practice. Organizations can influence policy to create a

more favorable environment for sustainability initiatives and green technologies (Numan et al., 2023).

Organizations are employing a multifaceted strategy to reduce their carbon footprint and promote sustainable decision-making. By embedding sustainable practices throughout their operations, embracing innovation, and involving stakeholders, they are helping to create a more sustainable world and tackling the urgent issue of climate change.

5.2. Comparative Analysis with Prior Research

Comparing the findings of this research with prior findings offers a deeper understanding of the nuances and complexities involved in managing carbon emissions in organizations. While many challenges and strategies are well-documented, our research presents a refined perspective that integrates various dimensions of sustainability, regulatory compliance, and technological advancement.

Previous research, such as those by Varón-Hoyos et al. (2021) and Ghosh et al. (2020), have consistently highlighted the difficulties in accurately measuring and tracking carbon emissions due to inadequate tools and technologies. The research supports these findings but further elaborates on the substantial financial and resource investments required to implement effective carbon management practices, which are particularly burdensome for small and medium-sized enterprises. The complexity of supply chain management is another area that aligns with and expands upon existing literature. Zahra & Badeeb (2022) and Nidhi (2023) have discussed the regulatory challenges faced by multinational corporations, emphasizing the need for extensive collaboration and transparency across different countries and regulatory environments. This underscores the global nature of supply chain emissions and the critical importance of international cooperation in addressing environmental standards. Behavioral changes within organizations are identified as essential for achieving significant reductions in carbon emissions, resonating with Evans (2021), who stresses the importance of cultivating a culture of sustainability, the necessity for organizations to shift towards more sustainable practices and the internal resistance that can impede this transition. Technological limitations remain a persistent challenge, as noted by Kitamura, Ichisugi, et al. (2020). The research concurs, identifying these limitations as significant barriers to the implementation of effective carbon reduction solutions. Moreover, the balance between economic growth and ecological sustainability, discussed by Kitamura, Ichisugi, et al. (2020), is a complex issue that our research reaffirms, emphasizing the broader ecological impacts of organizational operations.

Consumer expectations for sustainable practices, as highlighted by Menon & V (2021), are another challenge the research addresses, the pressure to meet these expectations without compromising product quality is a significant concern for organizations, necessitating innovative approaches to product design and service delivery.

In terms of solutions, the research supports the findings of Akpanke et al. (2024) and Alinezhad et al. (2022), advocating for a multifaceted approach to sustainability that includes energy efficiency, renewable energy adoption, and sustainable supply chain management. Energy efficiency, achieved through investments in advanced technologies and optimization of operational processes, is essential for reducing overall energy consumption and lowering carbon emissions. This aligns with Akpanke et al. (2024), who emphasize the importance of energy-efficient technologies in achieving significant emission reductions, such as renewable energy, as highlighted by Alinezhad et al. (2022). By transitioning to renewable energy sources such as solar, wind, and hydroelectric power, organizations can drastically reduce their reliance on fossil fuels and minimize their carbon footprint. This shift not only supports environmental sustainability but also enhances energy security and reduces long-term energy costs. Sustainable supply chain management is critical in addressing the environmental impact of production and distribution processes. This involves selecting suppliers based on their environmental performance, promoting transparency, and fostering collaboration across the supply chain. These practices ensure that sustainability is integrated into every step of the supply chain, from raw material sourcing to product delivery. The research also emphasizes the implementation of circular economy principles, which aim to minimize waste and maximize resource efficiency, by designing products for durability, reuse, and recyclability, organizations can reduce their environmental impact and create a more sustainable lifecycle. This approach is in line with the insights of Martinho & Mourão (2020), who advocate for circular economy practices to enhance sustainability. Sustainable transportation practices, such as optimizing logistics routes and investing in electric and hybrid vehicles, are also highlighted as effective strategies for reducing emissions. Ghosh et al. (2020) supports these practices, noting that efficient transportation systems are vital for lowering the carbon footprint associated with the movement of goods and personnel. Green building practices, which focus on designing and retrofitting buildings to meet high environmental standards, are crucial for reducing energy consumption and improving indoor environmental quality. This approach not only contributes to lower emissions but also enhances the health and well-being of building occupants. Furthermore, the research highlights the importance of environmental management systems, which provide a structured framework for setting sustainability goals, monitoring performance, and ensuring compliance with environmental regulations. The implementation of this framework, such as ISO 14001, helps organizations systematically manage their environmental impact and continuously improve their sustainability practices. Employee engagement and training are essential components of a holistic sustainability strategy. By educating and involving employees in sustainability initiatives, organizations can foster a culture of environmental responsibility and innovation. Casandra Okogwu et al. (2023) emphasizes the role of employee engagement in driving sustainable practices and achieving organizational sustainability goals. Continuous innovation is also crucial for developing effective solutions to sustainability challenges. This involves investing in research and development to explore new technologies, materials, and processes that can reduce carbon emissions and enhance environmental performance. Pórólfsdóttir et al. (2023) highlight the importance of innovation in advancing sustainability and addressing the dynamic challenges posed by climate change.

Concluding, the study underscores the imperative of embracing a comprehensive approach to sustainability. This entails integrating various elements such as energy efficiency, renewable energy adoption, sustainable supply chain management, circular economy principles, sustainable transportation, green building practices, environmental management systems, employee engagement, and continuous innovation. By implementing these diverse strategies, organizations can actively diminish their carbon footprint and play a significant role in advancing global environmental sustainability. Moreover, this comparative analysis illuminates the multifaceted landscape of managing carbon emissions within organizations. By synthesizing insights from previous research and introducing novel perspectives, the study offers a robust framework that can inform future investigations and aid organizations in formulating more effective sustainability management.

5.3. Analysis of Divergences

Upon overlaps this research findings with previous ones, distinct patterns emerge regarding the challenges and solutions associated with managing carbon emissions in organizations. While earlier research frequently underscores technical and financial impediments, this research sheds light on the intricate nature of supply chain management. It underscores the imperative for extensive collaboration across diverse countries and regulatory landscapes.

Previous studies, such as those by Varón-Hoyos et al. (2021) and Ghosh et al. (2020), underscore the difficulty in accurately measuring and tracking carbon emissions due to inadequate tools and technologies. Corroborating this and adding that the financial and resource

investments required pose significant hurdles, particularly for small and medium-sized enterprises. Furthermore, the research expands on the work of Zahra & Badeeb (2022) and Nidhi (2023) by highlighting the intricate nature of regulatory compliance across multiple regions, which presents a unique challenge for multinational corporations. This aligns with earlier research but adds a layer of understanding about the need for behavioral changes within organizations, as emphasized by Evans (2021). Technological limitations, another critical barrier identified in the research, are consistent with findings from Kitamura, Ichisugi, et al. (2020), which discuss the challenges in accessing and implementing advanced green technologies, also mirroring the concerns of consumer expectations and the pressure on organizations to adopt sustainable practices without compromising quality, as noted by Menon & V (2021).

In terms of solutions, our research supports the effectiveness of strategies like enhancing energy efficiency, transitioning to renewable energy, and implementing sustainable supply chain management, as discussed in studies by Akpanke et al. (2024) and Alinezhad et al. (2022). Additionally, the findings underscore the importance of circular economy practices and sustainable transportation, consistent with Martinho & Mourão (2020) and Ghosh et al. (2020). Employee engagement, green building practices, and the integration of environmental management systems are also highlighted in the research as crucial for fostering a culture of sustainability, resonating with the conclusions of Casandra Okogwu et al. (2023) and Pórólfsdóttir et al. (2023). The role of innovation and technology in developing sustainable solutions aligns with Panduru et al. (2021), emphasizing the ongoing need for research and development in this field.

The research adds to the body of knowledge by providing a comprehensive analysis of these challenges and solutions, emphasizing the multifaceted approach required to manage carbon emissions effectively. This the research findings contribute valuable insights that can guide future research and help organizations refine their strategies to enhance resilience, competitiveness, and long-term sustainability in an era of climate uncertainty.

CHAPTER 6 Conclusions

6.1. General Conclusions

Organizations face numerous challenges in managing their carbon emissions, significantly impacting their sustainability efforts and overall environmental performance. One of the primary challenges is the accurate measurement and tracking of carbon emissions due to inadequate tools and technologies. Additionally, the substantial financial and resource investments required for these efforts pose significant obstacles. The complexity of supply chains further complicates the issue, as it necessitates extensive collaboration and transparency across different countries and regulatory environments, compliance with the myriads of environmental regulations and standards across various regions adds another layer of difficulty, especially for multinational corporations. Achieving meaningful reductions in carbon emissions also requires a significant behavioral shift within organizations towards more sustainable practices. Technological limitations hinder the implementation of effective solutions for reducing carbon footprints. Balancing economic growth with ecological sustainability presents a complex challenge, as organizations must consider the broader ecological impact of their operations. Moreover, organizations face increasing pressure from consumers to adopt more sustainable practices, which can be challenging without compromising quality. The existing infrastructure and transportation systems are not conducive to low-carbon operations, necessitating substantial investment and policy support for transitioning to more sustainable options.

Despite these challenges, organizations are adopting various strategies and practices to mitigate their carbon footprint and foster sustainable decision-making. Enhancing energy efficiency through investments in energy-efficient technologies and transitioning to renewable energy sources, such as solar and wind, is another crucial strategy to optimizing operations. Sustainable supply chain management involves selecting suppliers based on their environmental performance and promoting transparency and collaboration, implementing circular economy principles helps to minimize waste and maximize resource efficiency. Sustainable transportation practices, such as optimizing logistics and investing in non-pollutant vehicles. Environmental management systems provide a framework for setting sustainability goals, monitoring performance, and ensuring compliance with regulations. Employee engagement and training are essential for fostering a culture of sustainability and green building

practices focus on designing energy-efficient and environmentally friendly buildings. Innovation and technology also play's a critical role in developing solutions that reduce carbon emissions. Sustainable product design involves creating products with lower environmental impact throughout their life cycle. Collaboration and partnerships with stakeholders, including industry partners and governments is crucial to address sustainability and driving collective action with transparent reporting and policy advocacy, also important practices with organizations disclosing their environmental performance and engaging with policymakers to support sustainability initiatives.

By addressing these challenges and barriers through a range of strategic initiatives, organizations can significantly reduce their carbon footprint and contribute to global environmental sustainability. Ongoing research and continuous improvement are crucial for refining these strategies and overcoming residual barriers, ultimately enhancing organizational resilience, competitiveness, and long-term value creation in an era marked by climate uncertainty. The research importance lies in its comprehensive analysis of the challenges and solutions associated with managing carbon emissions within organizations, providing valuable insights for future efforts in sustainability.

6.2. Contributions of the Research

This research makes significant contributions to the field of carbon emissions management within organizations through a thorough systematic literature review and meta-analysis. It addresses critical gaps by examining the predominant challenges organizations face, such as accurate measurement and tracking of emissions, high costs and resource investments, supply chain complexities, regulatory compliance issues, and the need for substantial behavioral changes within organizations.

The research highlights effective strategies that organizations are adopting to mitigate their carbon footprint and promote sustainable decision-making. These strategies include enhancing energy efficiency, transitioning to renewable energy sources, implementing sustainable supply chain management, adopting circular economy practices, and promoting sustainable transportation. Additionally, the research underscores the importance of environmental management systems, employee engagement and training, green building practices, and the role of innovation and technology in developing sustainable solutions. A key contribution is the proposed conceptual model that provides a structured framework for future research and organizational efforts in carbon management.

The model integrates best practices and innovative solutions, offering a comprehensive approach to managing carbon emissions. The PSALSAR methodology enhances the robustness and reproducibility of its findings, offering reliable insights for policymakers, industry leaders, and sustainability practitioners, by emphasizing the importance of collaboration, transparency, and innovation, the research provides a roadmap for organizations to make informed decisions and adopt best practices. In practical terms, the research identifies areas for future research, such as exploring the socio-economic implications of carbon management strategies and developing advanced measurement methodologies. It also highlights the need for continuous improvement and commitment from organizations to integrate sustainable practices, embrace innovation, and engage stakeholders in their sustainability efforts.

6.3. Limitations of the research

This research, while comprehensive in its analysis of carbon emissions management in organizations, has several limitations. Firstly, the reliance on existing literature may introduce bias, as the quality and scope of the reviewed studies can vary. The diverse methodologies and metrics used across different studies make it challenging to compare results and draw uniform conclusions. Additionally, the research's focus on certain regions or industries might limit the generalizability of its findings to other contexts.

The complexity of supply chains and the variability in regulatory environments across countries add another layer of difficulty in providing universally applicable recommendations. The rapidly evolving nature of green technologies and sustainable practices means that some strategies discussed may quickly become outdated. Furthermore, the research acknowledges the challenge of capturing the full socio-economic implications of carbon management strategies, which are often complex and multifaceted.

Future research should address these limitations by incorporating longitudinal studies to track changes over time, expanding the scope to include underrepresented regions and industries, and developing more standardized measurement and reporting methodologies. Despite these limitations, the research provides valuable insights and a robust framework for understanding and improving carbon management practices within organizations.

6.4. Future research proposals of the research

Future research should aim to address the limitations identified in this research and expand the understanding of carbon emissions management in organizations. One important area for future research is the development of standardized methodologies for measuring and reporting carbon emissions, which would allow for more consistent and comparable data across different studies and industries. Longitudinal studies are also needed to track the effectiveness of various carbon management strategies over time and to understand the long-term socio-economic impacts of these practices.

Exploring the integration of emerging technologies, such as artificial intelligence and blockchain, could provide innovative solutions for more accurate tracking and transparent reporting of carbon emissions. Additionally, research should focus on underrepresented regions and industries to ensure a more comprehensive understanding of global carbon management practices. Collaboration between academia, industry, and governments is crucial for developing effective strategies and policies that support sustainable practices. Investigating the role of policy advocacy and its impact on organizational behavior and compliance can provide insights into how regulatory environments can be optimized to encourage sustainability.

Finally, future studies should also consider the broader ecological and social implications of carbon management strategies, including the trade-offs and synergies between economic growth, environmental sustainability, and social well-being. This holistic approach will be essential for developing balanced and effective solutions to the complex challenge of carbon emissions management.

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