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# A Bibliometric Analysis on Sustainability and Managerial Strategies. Research Trends and Key Insights

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Received: May 1, 2025
Revised: May 25, 2025
Accepted: June 11, 2025
Published: June 25, 2025

**Abstract:** The integration of sustainability within managerial strategies has become a pivotal research domain in the Knowledge Economy, reflecting the increasing necessity for organizations to adopt environmentally and socially responsible business models. This study conducts a bibliometric analysis of sustainability research, emphasizing its impact on organizational performance and strategic management. By analyzing scholarly outputs from 2000 onwards, up to present times, this paper maps the evolution of sustainability discourse and identifies key research clusters, thematic trends, and citation networks in the field. Using data extracted from the Scopus database, this study applies bibliometric methodologies, including co-word analysis, citation mapping, and Bradford's and Lotka's laws, to trace the intellectual structure of sustainability research. The findings reveal a steady increase in academic contributions, with a notable acceleration in the past decade, indicating the growing relevance of sustainability as a strategic pillar for organizations. Core themes identified include corporate social responsibility, green innovation, stakeholder engagement, and regulatory adaptation. Consequently, this paper contributes to the scientific and managerial discourse by offering a structured synthesis of sustainability research within the Knowledge Economy framework. The results provide insights into theoretical advancements, research gaps, and potential directions for future studies, guiding policymakers, academics, and business leaders in shaping sustainable business strategies. The study also highlights the role of collaborative research networks in fostering innovation and driving sustainable change in disruptive times.

**Keywords:** sustainability research; green innovation; strategic management; bibliometric analysis; knowledge economy.

## Introduction

In an era defined by rapid technological evolution and socio-economic shifts, sustainability has emerged as a critical pillar of strategic management. The contemporary Knowledge Economy necessitates not only innovative business models but also an acute awareness of sustainable practices that can drive long-term organizational success. With sustainability becoming a defining feature of corporate strategies, there is a pressing need to examine how academic research has evolved in this field, identifying key themes, trends, and intellectual contributions (Biclesanu & Dima, 2021; Ille, 2022; Lupoae et al., 2023; Malik et al., 2020; Müller et al., 2022; Stiegler, 2021; Ştefan et al., 2021; Popescu et al., 2022; Tawfig & Kamarudi, 2022; Vodă et al., 2021).

Accordingly, this study presents a bibliometric analysis of sustainability research, emphasizing its intersection with managerial strategies, corporate responsibility, and performance outcomes (Adu et al., 2022; Bumbac et al., 2020; Dobre et al., 2021; Purcarea et al., 2022); in doing so, we are offering a structured overview of the intellectual landscape in sustainability-oriented management studies.

**How to cite**

Ciuciuc, V.E., Bilan, Y., & Konhäusner, P. (2025). A Bibliometric Analysis on Sustainability and Managerial Strategies. Research Trends and Key Insights. *Management Dynamics in the Knowledge Economy, 13*(2), 168-194. DOI 10.2478/mdke-2025-0010
ISSN: 2392-8042 (online)
www.managementdynamics.ro
https://content.sciendo.com/view/journals/mdke/mdke-overview.xml

Vol.13 (2025) no.2, pp.168-194; DOI 10.2478/mdke-2025-0010

In terms of research objectives, the primary aim of this study is to map the knowledge structure of sustainability research within the managerial domain by addressing the following scopes: firstly, it is our purpose to analyse the growth trajectory of sustainability-related publications from 2000 to 2023. Subsequently, we intended to identify core research clusters and thematic developments in sustainable management strategies. Thirdly, it was our purpose to assess the impact of high-impact journals, influential authors, and key publications in shaping sustainability discourse. By doing so, we aimed at highlighting methodological advancements in sustainability research and their implications for future studies. Notwithstanding, our ultimate goal was to explore the practical relevance of bibliometric findings for business leaders, policymakers, and academics.

To ensure a rigorous assessment, we utilized the search string "sustainability OR sustainable development AND performance AND reputation" to search for relevant articles within the Elsevier-founded Scopus database, targeting titles, abstracts, and keywords. By utilizing Boolean operators OR and AND, we ensured the inclusion of all pertinent articles discussing sustainability and sustainable development in the context of business outcomes. Subsequently, we applied the PRISMA guidelines (Page et al., 2021) to guide the methodological rigor of the research, as depicted in Figure 1.

Altogether, understanding the evolution of sustainability research is essential for both academia and industry. By synthesizing bibliometric insights, this paper provides a comprehensive roadmap for future research, helping organizations navigate the complexities of integrating sustainability into their strategic frameworks. Furthermore, this study contributes to the Knowledge Economy discourse by demonstrating how sustainability research influences managerial decision-making in an era of disruptive change by identifying citation patterns, co-occurrence networks, and thematic clusters, thereafter, offering a structured overview of the intellectual landscape in sustainability-oriented management studies.

## Literature review

Sustainability, a multifaceted concept, has evolved from an ecological perspective into a strategic imperative for businesses (Brundtland, 1987). The classical definition by the Brundtland Commission describes sustainable development as meeting the needs of the present without compromising future generations. In the managerial realm, sustainability integrates economic, social, and environmental dimensions into corporate strategies (Elkington, 1994). Nevertheless, Elkington's (1997) Triple Bottom Line (TBL) framework remains a dominant paradigm in sustainability research, advocating for a balanced focus on people, planet, and profit. This model underscores the necessity of aligning corporate responsibility with long-term profitability and environmental stewardship, demanding therefore a more proactive take on the regulatory discourse and a commitment to continuous innovation in sustainability practices from business's point of view (Chen et al., 2020; García-Marco et al., 2020; Ma et al., 2022; Shao et al., 2020).

The Knowledge Economy (KE), characterized by digital transformation, innovation, and information exchange, has reshaped how businesses approach sustainability, since Machlup's information theory (1962), through Drucker's "knowledge society" (1969), to the theories of post-industrialism (Bell, 1973), all the way up to OECD's definition which highlighted the creation and distribution of knowledge and information as the very base of such an economy (1996). For all that, and in-line with this paper's goal, we will adopt the Oxford Dictionary's definition of KE (Stevenson, 2010), viewing it as an economy that goes beyond means of production, and is interdependently linked with the amount, the quality and the population's accessibility of the available information.

Thereupon, research highlights that companies leveraging knowledge-based resources are more adept at embedding sustainable business models (Cioca et al., 2020; Kodasheva et al., 2020; Manaswi et al., 2023; Mustapha & Hassan, 2022; Schulte & Hallstedt, 2018).

Sustainability in this context is increasingly linked to intellectual capital, technological advancement, and collaborative networks (Brătianu et al., 2024). Completing this narrative, institutional theory posits that organizations adopt sustainability practices due to coercive, normative, and mimetic pressures (Alafeshat & Tanova, 2019; Castillo-Villar, 2020; Çuhadar & Rudnák, 2022; Hallinger &Suriyankietkaew, 2018; Naciti et al., 2021; Tan, 2021) Studies reveal that regulatory frameworks, stakeholder expectations, and competitive forces shape corporate sustainability strategies (Hu et al., 2023). Contrariwise, the Resource-Based View (RBV) (Kshetri, 2007) explains sustainability as a means of achieving a competitive edge by leveraging unique intangible assets, such as corporate reputation, innovation capacity, and human capital, in the pursuit of securing long-term success (Azizi, 2022; Chan et al., 2022; Saleem et al., 2021).

As we will try to put forth, bibliometric analyses indicate a significant rise in sustainability-related publications, particularly in high-impact journals such as the *Journal of Cleaner Production* and *Business Strategy and the Environment* (Cantele & Zardini, 2018; Wolf, 2014; Zhu & Sarkis, 2007). Trends show that sustainability research has expanded from niche corporate social responsibility (CSR) studies to broader strategic management perspectives. The focal point here would be that, despite extensive literature on sustainability, gaps remain in cross-disciplinary integration and the quantification of sustainability's impact on firm performance. Emerging research calls for more empirical validation of sustainability metrics and a stronger focus on knowledge-based economies (Vaio et al., 2020).

## Methodology

In order to comprehensively address the multifaceted reality of sustainability in business, a bibliometric analysis focused on sustainable development and its subjacent effects across all business levels was conducted. In doing so, our aim was to systematically explore sustainability research with a specific focus on its intersections with organizational performance and reputation.

To conduct this analysis, we utilized the search string "sustainability OR sustainable development AND performance AND reputation" to search for relevant articles within the Elsevier-founded Scopus database, targeting titles, abstracts, and keywords. By utilizing Boolean operators OR and AND, we ensured the inclusion of all pertinent articles discussing sustainability and sustainable development in the context of business outcomes. This approach enabled the capture of a wide array of studies examining the implications of sustainability-informed business decisions.

Subsequently, we applied the PRISMA guidelines to guide the methodological rigor of the research, as depicted in Figure 1. This systematic process not only enhances the reliability of our findings but also provides a clearly defined framework for analysing the trends, core metrics, and thematic developments in the field of sustainability research. The present study adhered to the PRISMA guidelines (Page et al., 2021) to ensure a systematic and rigorous approach in selecting studies for this meta-analysis (Figure 1). It is worth noting that this methodological rigour underpins the credibility and replicability of the presented findings.

For this analysis, data were extracted from the Scopus database, which Elsevier founded. As a result, a comprehensive collection of the pertinent literature within the sustainable development field (which encompasses more than 87 million documents from over 7,000 international top-ranked publishers) was ensured.

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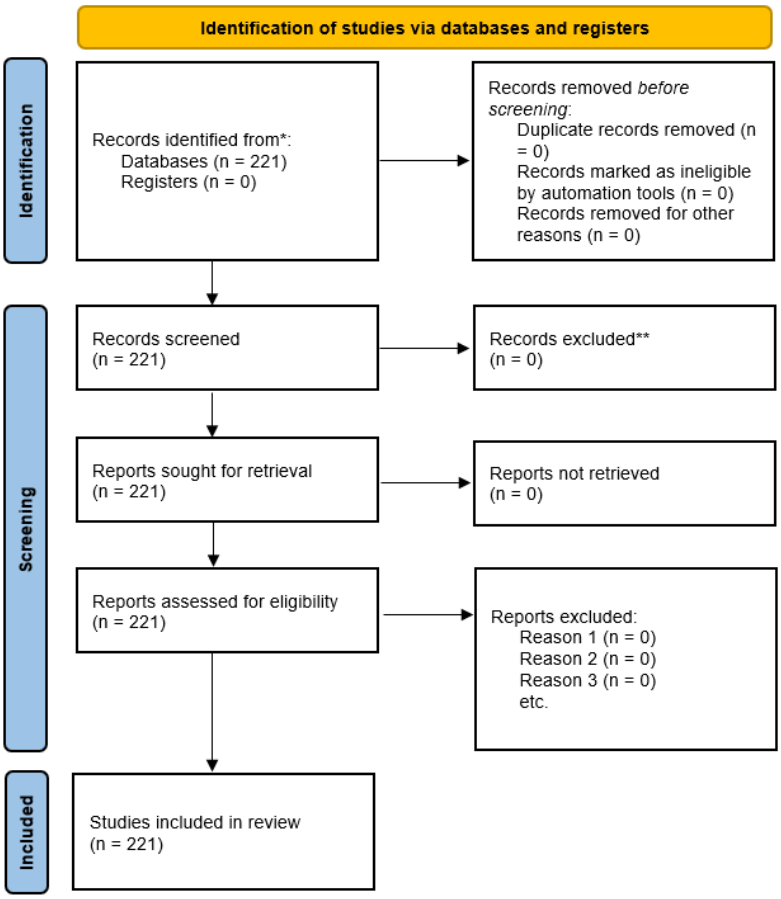


***Figure 1. Systematic literature review procedure, according to PRISMA guidelines***
Source: adapted from (PRISMA Group, n.d.)

The bibliometric data presented herein showcases a research timeline that spans from 2000 to 2023, capturing a collection of 221 documents with an annual growth rate of 14.38%. This rate is indicative of a burgeoning interest in the intersection of managerial strategies and sustainable development, a field that is gaining momentum as companies worldwide, and particularly within Romania, grapple with the pressures and demands of sustainable practice integration. Given the expansive and cross-disciplinary nature of management and sustainable development, the present analysis includes all types of documents. The data set comprises a predominant number of articles (137), supplemented with conference papers (58), book chapters (10), and other varied document types, reflecting a polymath approach to the subject. Moreover, the data gathered emanates from various disciplines, underscoring the all-encompassing nature of the present research (Table 1).

***Table 1. General information about the extracted records***

| Description | Results |
|---|---|
| Timespan | 2000:2023 |
| Sources | 160 |
| Documents | 221 |
| Annual Growth Rate% | 14,38 |
| Average age of the document | 5,98 |
| Average citation per doc | 19,91 |
| References | 10.225 |

Source: own processing

The mean age of the documents (5.98 years) and the average citations per document (19.91) suggest a dynamic field with influential research outputs that have garnered substantial academic attention. This indicates that the strategies and practices that fall within the purview of the present research are of significant interest and impact in the

broader scholarly and practitioner communities. The breadth and depth of the existing literature are quite apparent, with a substantial collection of 10.225 references.

Bradford's Law (Figure 2) reveals that the core literature sources for the present thesis are concentrated within a select group of journals that significantly contribute to sustainable development and managerial strategies. The "Journal of Cleaner Production" leads with the highest frequency of articles, underscoring its pivotal role in disseminating research relevant to the present study's focus. The subsequent sources, such as "Business Strategy and the Environment" and "Sustainability (Switzerland)", also form part of this core group, showcasing their importance in academic discourse related to sustainability in business.

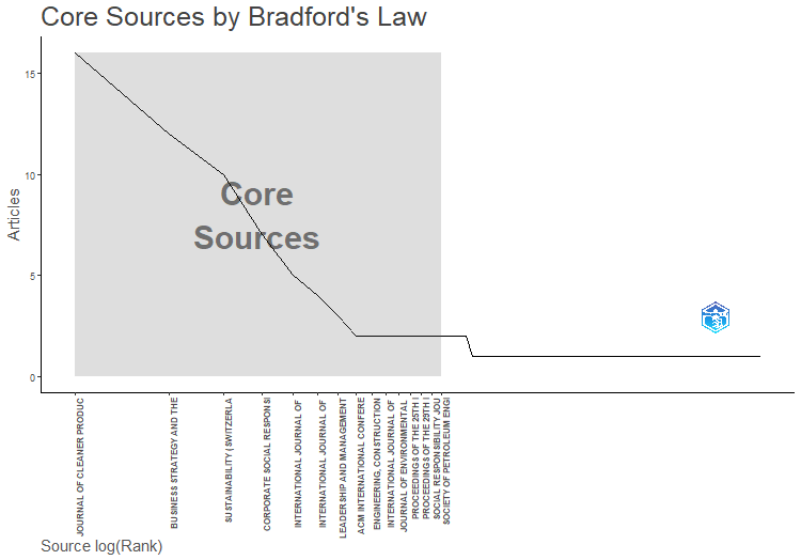


***Figure 2. Bradford's law grouping of sources***
Source: own processing

The clustering of articles within a relatively small number of journals indicates that these publications are central to the research community interested in the nexus of management and sustainability. This distribution aligns with Bradford's Law, which suggests that a few core journals typically account for the most significant publications within a specific domain, while a larger number of journals contribute progressively fewer articles (Wei, 2018). The distribution of articles in the present case suggests that the most impactful and relevant research on sustainable development in managerial practices is concentrated within the aforementioned core journals, affirming their influence and importance in shaping academic discourse in this area (Table 2).

***Table 2. Calculations for Lotka's law***

| No. articles | No. authors | Freq |
|---|---|---|
| 1 | 542 | 0.9426087 |
| 2 | 27 | 0.04695652 |
| 3 | 3 | 0.00521739 |
| 4 | 3 | 0.00521739 |

Source: own processing

The bibliometric analysis of literature on sustainable development strategies in managerial contexts reveals a select number of highly influential articles, in line with Lotka's Law, which posits that few researchers contribute to the majority of significant publications in a given field. The preeminent article by Zhu and Sarkis (2007) in "International Journal of Production Research" garners the most citations (815), underscoring its pivotal role in the domain (Zhu, 2007). Notable works by Wolf (2014) in "Journal of Business Ethics" and Cantele and Zardini (2018) in "Journal of Cleaner

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Production" follow, with substantial citations (330 and 163, respectively), indicative of their significant impact on integrating ethical and sustainable prevalence in managerial practices (Cantele & Zardini, 2018; Wolf, 2014).

The citation frequency corroborates the relevance of these articles and points to sustained scholarly engagement. This pattern is further reinforced by Lotka's Law, with many authors contributing singularly to the discourse, demonstrating the concentrated nature of scholarly contributions within this field. Consequently, the bibliometric findings affirm a distinct focus on sustainability, with most authors dedicating their research to core topics within the domain while a smaller number delve into related, yet distinct, areas. This highlights the field's maturity and the catalytic role of key scholarly works in shaping ongoing and future research directions.

When examining author productivity in the context of narrowing the scope of research on how sustainable development impacts managerial strategies, it becomes apparent that a select group of scholars have been contributing frequently and significantly to the academic narrative. Daddi, Iraldo, and Marrucci stand out as key players in this field, each having published four influential articles that have advanced our understanding of sustainable practices within management. Their work is indicative of a growing trend towards sustainable practices in management research, reflecting a heightened global awareness and a strategic local response to sustainability challenges. This shift towards a greater emphasis on sustainability in management research signals not only an expanding field but also an evolving one, with these authors at the forefront of shaping its trajectory (Table 3).

***Table 3. Quantitative bibliometric indicators: synthesis***

| Quantitative bibliometric indicator | Main takeaways |
|---|---|
| Lotka's Law | The concentration of single-paper authors suggests diverse perspectives, enriching the study of managerial sustainability. |
| Bradford's Law | Core journals identified guide the literature review, ensuring focus on the most impactful sources within the sustainability discourse. |
| Most Relevant Authors | Frequent contributions by key authors inform the study with relevant work on sustainability practices in management. |
| Core Sources | Journals identified as core sources provide authoritative insights and appropriate methodologies. |
| Most Cited Articles | Highly cited articles shape the theoretical framework and best practices in sustainable development, directly applicable to the business context. |
| Annual Scientific Output | Increasing research output reflects a heightened academic and practical interest in integrating sustainability across all business levels. |

Source: own processing

The table below presents the main bibliometric indicators derived from the analysis, which are relevant to the study on the influence of sustainable development strategies on managerial practices. These indicators provide a framework for understanding the academic influence and thematic focus of the literature, which underpins the research's exploration into the integration of sustainability within managerial practices.

## Results and discussions

### *From keywords to clusters: tracing the thematic pulse of sustainability research*

In order to analyze the key themes related to sustainable development and their impact on managerial strategies, a visual representation has been provided in Figure 3. This represents the main themes being discussed and highlights the conceptual complexity of the thematic that is intended to be approached in the present thesis. Distinct clusters have been accordingly generated by the "Bibliometrix" software. The keyword co-occurrence map has identified 12 clusters, each designated by a set of keywords, such as

"sustainability", "sustainable development", "commerce", "forestry" and "supply chains", reflecting the diverse facets of the field under study. These clusters showcase the various aspects of sustainability within the broader business context, covering economic, social, environmental, and technological dimensions. The most substantial cluster, consisting of "sustainability" and "sustainable development", emphasizes their central role in the discourse. On the other hand, the "distributed computer systems" cluster, while the smallest, highlights the technological aspect of sustainable strategies in management (Figure 3).

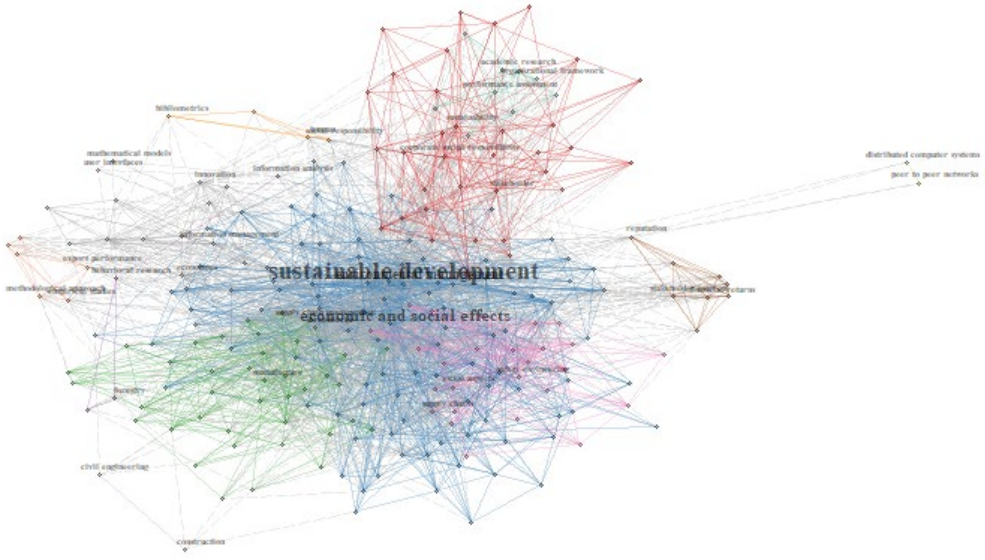


***Figure 3. Keyword co-occurrences***
Source: own processing

Expanding on the quantitative data, the thematic examination of sustainable development in managerial strategies exposes a convoluted, yet predictable, interconnection of themes. The analysis, illustrated in the strategic diagram (Figure 4) and corroborated by corresponding cluster data, classifies these themes into four quadrants based on centrality (relevance) and density (degree of development), thus providing an intricate comprehension of the field. The Motor Themes, characterized by high centrality and density, such as "sustainable development", "economic and social effects", and "environmental management", indicate well-established areas of research that are fundamental to the discourse on sustainability in business practices. These are mature themes that continue to be central to the field and suggest a well-developed network of academic contributions with extensive interconnections between various research areas.

The Basic Themes, such as "sustainability", "corporate social responsibility" and "stakeholder", have high centrality despite lower density, highlighting their foundational role in the research domain. These themes represent the broad concepts that underpin much of the research in sustainability, offering far-reaching implications for managerial strategies. The Emerging or Declining Themes, with low centrality but high density, such as "distributed computer systems", reflect specialized yet well-developed research areas that may be gaining momentum or losing prominence within the scope of the field. They indicate newer avenues of research or areas that may have been thoroughly explored but are now giving way to new trends.

Lastly, the Niche Themes, characterized by low centrality and density, such as "empirical studies" and "export performance" foresee specialized topics that may be in their nascent stages of development or reflect the particular interests of a smaller segment of the research community. These themes could represent the cutting edge of research or areas ripe for further exploration (Figure 4).

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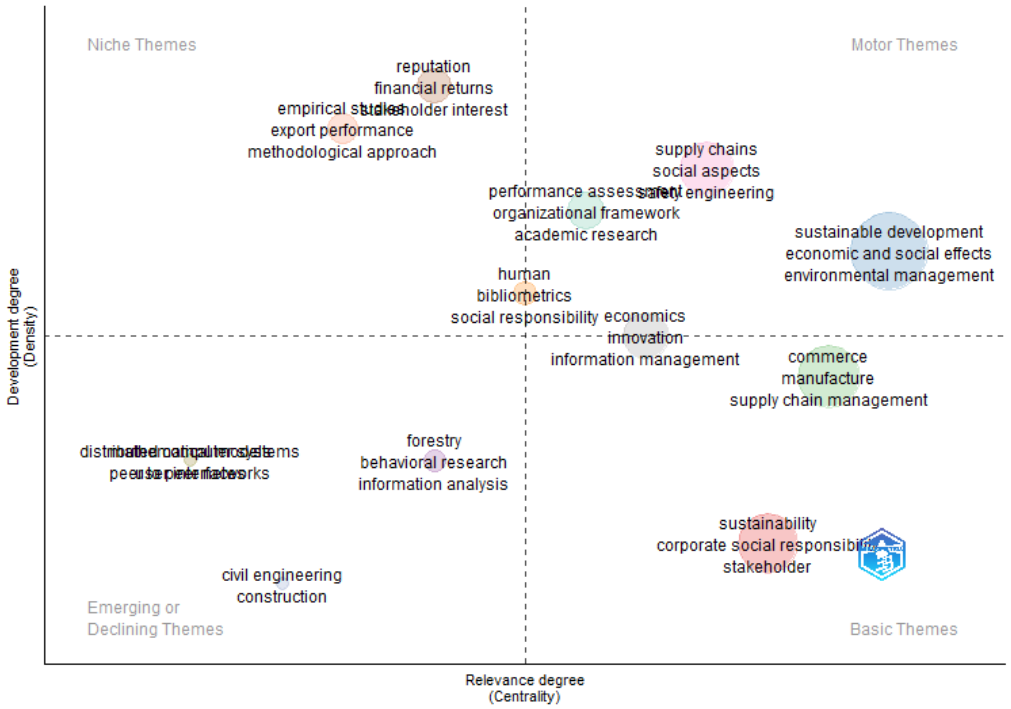


***Figure 4. Thematic evolution: growth areas***
Source: own processing

On top of this, a structured overview of the various themes emerging from the literature on sustainable development and its integration within management strategies is being presented in Table 4. Each theme is evaluated on the basis of five key bibliometric indicators:

a) centrality (it refers to the significance or influence of a theme within the network);
b) density (it measures the strength of connections within a cluster of research);
c) centrality level (it represents the rank or quantified position of a theme compared to others);
d) density level (it indicates the theme's density relative to others);
e) theme frequency (it is a simple count of how often a theme appears within the literature, providing insight into its prevalence or popularity within the research landscape) (Aria & Cuccurullo, 2017).

Put it in other words, it could be stated that a theme with high centrality is often referenced or built upon in other studies, indicating its foundational nature. On the other hand, density measures how well-developed a theme is in terms of internal coherence and connectivity between individual papers or works (Cobo et al., 2011). When a theme has both high centrality and a high centrality level, it suggests that the theme is not only influential but also consistently ranks as a primary focus across multiple studies. Similarly, when a theme has a high density and a high-density level, it indicates that the research within the theme is not only interconnected but also consistently complex or comprehensive compared to other themes. If a theme has a high theme frequency in addition to high centrality and density levels, it suggests that the theme is not only foundational and well-developed but also frequently explored in the literature. In summary, themes with high centrality, density, and frequency levels are likely to be important and well-established areas of research in a given field (Dimitrovski et al., 2021; Husereau et al., 2013).

***Table 4. Works on topics of interest***

| Thematic | Centrality | Density | Centrality level | Density level | Theme frequency |
|---|---|---|---|---|---|
| Sustainability | 13.17 | 71.63 | 1 | 2 | 139 |
| Sustainable development | 31.27 | 90.91 | 13 | 9 | 569 |
| Commerce | 15.12 | 75.34 | 12 | 6 | 175 |
| Forestry | 1.42 | 75.00 | 5.5 | 4 | 8 |
| Human | 1.44 | 85.42 | 7 | 8 | 9 |
| Reputation | 1.42 | 129.34 | 5.5 | 13 | 20 |
| Supply chains | 10.05 | 106.00 | 10 | 8 | 92 |
| Economics | 5.51 | 80.49 | 9 | 7 | 50 |
| Performance assessment | 1.68 | 104.23 | 8 | 10 | 24 |
| Empirical studies | 0.78 | 127.78 | 4 | 12 | 15 |
| Civil engineering | 0.25 | 62.50 | 3 | 1 | 4 |
| Mathematical models | - | 75.00 | 15 | 4 | 4 |
| Distributed computer systems | - | 75.00 | 15 | 4 | 4 |

Source: own processing

More precisely, as we can see in Table 4, "Sustainability" and "Sustainable Development" sit prominently in the table, likely due to their high Centrality and Density levels. This reflects their broad influence across the literature and their intricate connections within the network of sustainability research, mirroring their significance in shaping corporate strategies and policies. Their high centrality indicates that these themes are central to the discourse in business literature, suggesting that companies are increasingly recognizing sustainability as integral to their operational and strategic frameworks. The high density reflects a well-established body of interconnected research, indicating a rich exchange of ideas and practices that businesses can draw upon for implementing sustainable development.

It is surprising to note that the themes of "Commerce", "Forestry", "Human", and "Reputation" emerge in varying degrees of Centrality and Density from the bibliometric analysis, indicating their varying prominence and cohesiveness within the academic landscape. This variance highlights the multifaceted nature of the "triple bottom line" (TBL), a concept coined by Elkington in 1994, which lies at the foundation of sustainable business practice. Analyzed from this standpoint, "Commerce" might be correlated with the profit and loss account, within the evolving business models that incorporate the TBL's environmental and social considerations alongside economic objectives. On the other hand, "Forestry" might be associated with the environmental dimension of the TBL, emphasizing the adoption of sustainable resource management practices. The "Human" theme might align with the social aspect of the TBL, entangling the critical role of human capital and organizational behavior in realizing sustainable outcomes. Furthermore, "Reputation" is notably interwoven with the TBL ethos, underlining how sustainable practices contribute to corporate reputation. This is not merely as a regulatory compliance mechanism, but as a strategic asset to build brand value and foster trust among stakeholders.

In other respects, "Supply Chains" and "Economics" are likely to showcase substantial centrality, illustrating their integral role in discussions about how companies manage resources and economic outcomes within the sustainable framework. Instead, "Performance Assessment", "Empirical Studies", "Civil Engineering", "Mathematical Models", and "Distributed Computer Systems" might represent more specialized areas of the field, with potentially lower centrality but varying density, suggesting differing levels of research development and interconnections between studies. Notwithstanding, the lower centrality but varying density of these specialized themes suggests that they are emerging areas of interest within the sustainable discourse, representing niche but potentially transformative approaches that businesses could adopt for competitive

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advantage and innovation in sustainability. These areas, while currently less central, may hold the key to new business methodologies and strategic breakthroughs in sustainability.

Built upon the resulted occurrences inside each cluster, Table 5 presents the analysis of themes and keywords lumped together into the "Driving Themes" and "Emerging Themes" for each cluster. The table represents a combined-synthesis of the detailed data retrieved from R-studio, showcasing the most concentrated areas of research within the extracted dataset and reflect the current and the forecastable focus of sustainability in the business context, as depicted in the specialized literature.

It is important to note that this table presents key themes derived from a cluster analysis of the bibliographic data. Hence, the "Occurrences", "Centrality Measures" and "Page rank Centrality" columns represent aggregated values for each cluster label, summarizing the detailed analysis performed using Bibliometrix software. Nevertheless, aiming at presenting an academic overview of the thematic pillars shaping research in the business sustainability domain, Table 5 highlights two categories of themes: Driving Themes and Emerging Themes.

***Table 5. Identified themes from clustered data***

| Theme type | Cluster label | Occurrences | Centrality measures | Page rank centrality |
|---|---|---|---|---|
| Driving Themes | Sustainable Development | 142 | Betweenness: 428.933; Closeness: 0.001818 | 0.094 |
| | Economic and Social Effects | 26 | Betweenness: 2425.616; Closeness: 0.002358 | 0.024 |
| | Environmental Management | 18 | Betweenness: 1991.702; Closeness: 0.002309 | 0.016 |
| Emerging Themes | Corporate Social Responsibility | 12 | Betweenness: 578.046; Closeness: 0.002100 | 0.007 |
| | Commerce | 12 | Betweenness: 1060.348; Closeness: 0.002207 | 0.011 |
| | Supply Chain Management | 12 | Betweenness: 643.648; Closeness: 0.002100 | 0.009 |

Source: own processing

On one hand, Driving Themes represent well-established areas with a high frequency of research activity, denoting foundational concepts that are central to the discourse on sustainability. These themes exhibit strong centrality measures, signifying their core role in connecting various research topics and influencing the direction of scholarly inquiry. For instance, "Sustainable Development" with the highest "Occurrence" and "Pagerank Centrality", is evidently the hypostasis of current sustainability research, emphasizing its expansive influence.

On the other hand, Emerging Themes, while presented less frequently, highlight areas of growing interest and potential future significance. These are topics gaining momentum within the academic sphere, as indicated by their centrality measures, which, while lower than the driving themes, still represent a considerable impact. "Corporate Social Responsibility", "Commerce" and "Supply Chain Management" suggest a research trajectory that is increasingly attentive to the integration of sustainability into business operations and strategy.

Moving to the next dataset retrieved from the "Bibliometrix" R-studio-powered-software, the visual representation we're examining in Figure 5 is a network map that highlights the interconnectivity of various research topics within the panoramic perspective of sustainable development. Each node, varying in size and color intensity, represents a keyword from the bibliometric dataset, and its size is indicative of the node's degree—a measure of how many connections or edges it has to other nodes within the network. This gives us a qualitative sense of the prominence and influence of each topic in the academic specialized literature.


***Figure 5. Node degree mapping***
Source: own processing

Thereby, the map provides a snapshot of the thematic landscape, identifying which areas within the sustainable paradigm have been receiving the most attention from scholars, as well as how these areas are interconnected. Though, its quantitative counterpart details various nodes representing research topics within the sustainability domain, classified by cluster, with associated bibliometric indicators like "Betweenness centrality", "Closeness centrality", and "PageRank". To provide a more comprehensive understanding of the studied phenomena, we have synthesized key data points from the bibliometric analysis, assigning a name for each cluster, in function of its components and their conceptual delimitation within the broader theoretical framework. Hence, these tables contextualize the prominence and connectivity of various themes, grouping them for a clearer, synthetic birds' eye view.

By all appearances, Table 6 clearly shows that cluster 1 is the most extensive and complex cluster within the network, serving as a focal point in the discourse of sustainability. The cluster encapsulates a broad spectrum of topics that intersect across economic, social, and environmental dimensions, adding up to its interdisciplinary nature, and putting under the limelight the necessity of sustainability studies. This cluster inextricably weaves together a narrative wherein sustainable development is at the core, connecting diverse research themes such as economic impacts, corporate social responsibility, environmental management, and strategic planning. The richness of this cluster is evident in its ability to address sustainability from multiple angles, ranging from theoretical frameworks and principles of sustainable development to practical applications and strategies for implementation in various sectors like manufacturing, supply chain management, and the construction industry.

In short, this first cluster embodies the complexity and multi-dimensionality of the sustainability field. It presents a holistic view that encompasses both macro-level considerations of sustainable development principles and micro-level discussions on their implementation across different sectors. This cluster's expansive nature plays up to the diverse, yet interconnected, pathways through which sustainability impacts and is integrated into our economic systems, societal structures, and environmental policies. Through its entangled network of nodes and their interactions, cluster 1 highlights the depth and breadth of sustainability research, marking its indelible importance in shaping future academic inquiry and practical action towards a more sustainable world. Therefore, the comprehensive coverage and interdisciplinary nature of the sustainable phenomenon justify the need for further research and practical solutions, making a

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compelling case in laying the conceptual foundations in which the present research is demarcated.

***Table 6. Cluster 1: Central sustainability constructs (in red)***

| Node | Betweenness | Closeness | Page rank | Network map interaction |
|---|---|---|---|---|
| Sustainable Development | 9.005.531,00 | 0.020408 | 0.2134 | Core node with extensive reach across the network |
| Economic and Social Effects | 342.133,00 | 0.014705 | 0.05732 | Influential in discussions on sustainable economic development |
| Planning | 60.684,00 | 0.012345 | 0.02880 | Significant role in strategic planning for sustainability |
| Environmental Management | 52.184,00 | 0.012345 | 0.03249 | Central to discussions around managing environmental impact |
| Manufacture | 29.188,00 | 0.012048 | 0.02501 | Involved in discussions on sustainable manufacturing practices |
| Supply Chains | 23.730,00 | 0.011764 | 0.02158 | Crucial for understanding the role of supply chains in sustainability |
| Profitability | 22.501,00 | 0.012048 | 0.02436 | Links economic gains to sustainable practices |
| Corporate Social Responsibility | 15.586,00 | 0.010869 | 0.01332 | Reflects the role of corporations in sustainable development |
| Environmental Impact | 15.258,00 | 0.011494 | 0.01774 | Important for assessing sustainability on environmental terms |
| Sales | 0.9879 | 0.011627 | 0.01860 | Connects commercial success with sustainable products and practices |
| Risk Assessment | 0.8922 | 0.011363 | 0.01615 | Essential for evaluating potential risks in sustainability initiatives |
| Costs | 0.7911 | 0.011494 | 0.01406 | Concerns the cost-efficiency aspect of sustainability practices |
| Benchmarking | 0.5809 | 0.010989 | 0.01245 | Used to compare sustainability performance against standards |
| Safety Engineering | 0.5440 | 0.010989 | 0.01253 | Deals with designing systems that ensure safety and sustainability |
| Risk Management | 0.5352 | 0.010869 | 0.01242 | Concerns the management of sustainability risks |
| Social Aspects | 0.5171 | 0.011235 | 0.01570 | Highlights the social dimensions of sustainable development |
| Supply Chain Management | 0.4270 | 0.010989 | 0.01427 | Pertains to the management of resources in a sustainable manner |
| Environmental Performance | 0.3786 | 0.011235 | 0.01877 | Relates to how actions and policies perform from an environmental perspective |
| Investments | 0.1773 | 0.010989 | 0.01085 | Connects financial investments with sustainable outcomes |
| Societies and Institutions | 0.1239 | 0.010752 | 0.00962 | Reflects the societal and institutional frameworks of sustainability |
| Decision Making | 0.0359 | 0.010638 | 0.00939 | Reflects the importance of informed decisions in sustainability |
| Project Management | 0.0333 | 0.010526 | 0.00741 | Involves organizing and managing projects with sustainability objectives |
| Construction Industry | - | 0.010526 | 0.00674 | Less central, focused on sustainability in construction |
| Product Design | - | 0.010638 | 0.00933 | Focuses on creating sustainable products |

Source: own processing

Moving on, as it can be initially seen in Figure 5, and further corroborated by data in Table 7, the second cluster holds a significant position in the research network, with its primary focus revolving around Environmental Management and Economics. It is a thematic aggregate that bridges the gap between environmental stewardship and economic considerations, highlighting the crucial role of sustainability within organizational frameworks and strategic planning. The cluster's composition presents a nuanced narrative that sustainability is a foundational element of contemporary business and

economic practices, rather than just an ethical or regulatory requirement. To that point, the inclusion of nodes such as "Environmental Protection", "Sustainability", and "Stakeholder" dwells on the cluster's orientation towards a holistic understanding of sustainability. It suggests a growing integration of environmental protection into the core strategy of organizations, influenced by both internal motivations and external stakeholder pressures. The high "Betweenness" scores associated with these nodes indicate their pivotal role in the discourse, acting as bridges that connect various sub-themes and facilitate a comprehensive dialogue on sustainability.

***Table 7. Cluster 2: Environmental and organizational sustainability (in blue)***

| Node | Betweenness | Closeness | Page rank | Network map interaction |
|---|---|---|---|---|
| Environmental Protection | 26.121 | 0.011494 | 0.01928 | Strong influence in environmental sustainability discussions |
| Sustainability | 17.357 | 0.011363 | 0.02228 | Key node with extensive connections to various sustainability aspects |
| Environmental Economics | 0.3376 | 0.010989 | 0.01426 | Central to discussions on the economic impact of environmental policies |
| Performance Assessment | 0.2339 | 0.010869 | 0.01200 | Related to assessing the performance of sustainability measures |
| Stakeholder | 0.1793 | 0.010869 | 0.01237 | Important for stakeholder theory in sustainability |
| China | 0 | 0.010526 | 0.00786 | Represents the geographical focus on sustainability practices in China |
| Strategic Planning | 0 | 0.010416 | 0.00611 | Involves long-term planning for sustainable development |

Source: own processing

Briefly put, cluster 2 represents a convergence point where environmental concerns intersect with economic and strategic planning within the sustainability discourse. Its complexity lies in the interplay between these elements, offering insights into how sustainability is operationalized within various organizational contexts. The cluster serves as a testament to the increasing conceptual tapestry of sustainability research, pointing out its critical role in shaping future economic policies and practices. The nodes within this cluster, through their metrics and interactions, present a dynamic field where sustainability has a catalytic role in driving innovation and strategic change across sectors.

Subsequently, the third cluster emphasizes the transformative role of innovation in driving sustainable economic strategies across regions. The synergy between economic development and sustainability is highlighted through the lens of innovation. The nodes within this cluster signify critical pathways through which innovation acts as a catalyst for integrating sustainability into economic practices. The cluster's focus on innovation emphasizes the forward-looking nature of sustainability research, while its connection to regional planning and information management underscores the importance of localized strategies and effective information management in achieving sustainable outcomes. Through its exploration of these themes, Cluster 3 offers insights into the complexity of integrating sustainability into economic frameworks, emphasizing the need for innovative, informed, and regionally adapted strategies (Table 8).

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***Table 8. Cluster 3: Innovation and regional development (in green)***

| *Node* | Betweenness | Closeness | Page rank | Network map interaction |
|---|---|---|---|---|
| Innovation | 13.436 | 0.011235 | 0.01614 | Drives forward-thinking approaches in sustainable development |
| Economics | 0.5509 | 0.010989 | 0.01613 | Connects economic theory with practical sustainability efforts |
| Information management | 0.1060 | 0.010869 | 0.01512 | Key in managing data and information for sustainability |
| Regional planning | 0.1060 | 0.010869 | 0.01467 | Important for sustainable urban and regional development planning |

Source: own processing

Moving onwards, cluster number four explores the relationship between Corporate Social Responsibility (CSR) and Finance (Table 9). It holds forth how businesses can incorporate social and environmental responsibilities into their strategic and financial frameworks, stressing the shift towards sustainable business models. The cluster focuses on CSR, competition, finance, and corporate reputations, and their respective metrics, bridging the gap between theoretical sustainability concepts and practical corporate applications.

***Table 9. Cluster 4: Corporate strategies and finance (in purple)***

| Node | Betweenness | Closeness | Page rank | Network map interaction |
|---|---|---|---|---|
| Competition | 66.297 | 0.01234 | 0.03211 | A pivotal concept linking sustainable development with market dynamics |
| Corporate Social Responsibilities (CSR) | 18.088 | 0.01176 | 0.02090 | Reflects the growing importance of CSR in corporate strategy |
| Social Responsibilities | 17.925 | 0.01176 | 0.01906 | Indicates the role of social responsibility in sustainability discourse |
| Finance | 16.353 | 0.01149 | 0.01801 | Central to discussions on funding sustainable initiatives |
| Competitive Advantage | 0.1494 | 0.01098 | 0.01494 | Represents the strategic benefit of sustainability in business |
| Financial Performance | 0.1407 | 0.01086 | 0.01062 | Ties financial outcomes to sustainable practices |
| Corporate Reputations | 0.1257 | 0.01075 | 0.00972 | Relates the impact of sustainability on corporate image |

Source: own processing

This cluster is all the more relevant in light of the global emphasis on sustainable development goals and the growing demand for corporate transparency and responsibility. It emphasizes that sustainable business practices are essential to achieving long-term corporate success and financial resilience. That is to say, we find ourselves in front of a lookout on how CSR, financial performance, and sustainability intertwine. It contributes to a wider sweeping grasp of the role of businesses in advancing sustainability, singling out the critical importance of blending CSR and financial strategies within the extensive sustainability agenda.

The fifth cluster brings forth the commercial and empirical research dimensions, as part of the sustainable conceptual framework (Table 10). It traces out the intersection between market-oriented practices and rigorous analysis that endorse and back up sustainable development. Despite its smaller size, it plays an utterly important role in translating

sustainability principles into actionable business strategies and practices, closing the gap between theoretical concepts and their real-world implementation. The centrality of "Commerce'", doubled by its "Betweenness" score showcases the hypostatical position of commercial activities in promoting and integrating sustainable practices within business models and consumer behavior.

***Table 10. Cluster 5: Commerce and empirical research (in orange)***

| Node | Betweenness | Closeness | Page rank | Network map interaction |
|---|---|---|---|---|
| Commerce | 64.196 | 0.01219 | 0.02450 | Central node, likely indicating commerce's role in sustainability |
| Surveys | 0.9277 | 0.01123 | 0.01533 | Important for empirical research within the field |
| Marketing | 0.1655 | 0.01075 | 0.01012 | Relates to the dissemination and promotion of sustainable practices |
| Efficiency | 0 | 0.01052 | 0.00601 | Less central, possibly focuses on efficiency in sustainable operations |

Source: own processing

Therewith, "Surveys" and "Marketing" heighten the importance of empirical research and strategic communication in advancing sustainability, tailoring approaches to fit with both businesses and consumers. Simply put, the fifth cluster raises the profile of the mechanisms through which sustainability can be promoted, realized, and integrated into the fabric of everyday business operations and consumer choices.

In line with the previously mentioned bridging the divide, the sixth and last cluster resulted sets forth the translation of sustainability principles into actionable strategies and their effective communication within organizational frameworks. This cluster brings forward how sustainability is implemented and accounted for in business practices. It emphasizes the importance of reporting and evaluating sustainable initiatives for transparency and progress towards sustainability goals (Table 11).

***Table 11. Cluster 6: Sustainability integration and reporting (in brown)***

| Node | Betweenness | Closeness | Page rank | Network map interaction |
|---|---|---|---|---|
| Performance | 0.4683 | 0.01086 | 0.01355 | Strongly influential in linking sustainability with performance metrics |
| Sustainability Performance | 0.1393 | 0.01063 | 0.00950 | Important for measuring and assessing sustainability efforts |
| Sustainability Reporting | 0.0895 | 0.01075 | 0.01030 | Critical for transparency and accountability in sustainability |
| Management Systems | 0 | 0.01041 | 0.00654 | Peripheral, suggesting a supportive role in sustainability integration |

Source*:* own processing

The cluster'' concentration on sustainability performance, reporting, and management systems highlights the determinative intersection between sustainability theory and practical application. In spite of its limited size, the nodes within this cluster play a significant role in narrowing down the sustainability narrative within organizations. They illustrate the dynamic operationalization and cognizance of sustainability as a constitutive component of organizational performance metrics, strategic planning, and reporting mechanisms. Passing over sustainability commitments into tangible actions and outcomes is, in a nutshell, what this last cluster sets ahead. Thereon, it makes a special point out of the necessity for businesses to inlay sustainable practices into their core operations, performance evaluation, and stakeholder communication strategies. This discussion can be extended into driving the agenda of transparent, accountable, and effective sustainability practices in business, with the purpose of reflecting a deepened commitment to embedding sustainability into the operational DNA of organizations.

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Ergo, the bibliometric analysis of sustainable development and its impact on business, as depicted from the clustering of key themes and concepts, reveals a pluriperspective landscape of sustainability research and practice. Each cluster, from the foundational discussions of sustainable development to the strategic applications, attest to the depth and diversity of sustainability as an academic and practical field (Table 12).

***Table 12. Clustered data: Synthesis***

| Cluster | Focus | Main takeaways |
|---|---|---|
| 1 | Integrative Foundation of Sustainability | Highlights the holistic lens through which sustainability integrates economic, social, and environmental dimensions, emphasizing foundational importance. |
| 2 | Economic and Environmental Interplay | Underscores the critical balance between economic development and environmental management, stressing the synergy between economic policies and environmental conservation. |
| 3 | Innovation as a Catalyst | Points to the transformative potential of innovation in driving sustainable outcomes, emphasizing the role of technology and innovative strategies. |
| 4 | Corporate Responsibility and Strategic Finance | Illustrates the evolving role of businesses in sustainability, integrating social and environmental considerations into financial strategies. |
| 5 | Market Dynamics and Empirical Insights | Emphasizes the importance of market-oriented strategies and transparency in sustainability efforts, underlining the role of empirical research. |
| 6 | Strategic Application and Communication | Focuses on the operationalization and communication of sustainability within organizations, highlighting the need for actionable strategies and effective reporting. |

Source: own processing

The main takeaways from this part of the literature offer insightful reflections on how sustainability is conceptualized, operationalized, and communicated across various dimensions. Summing up, Table 12 encapsulates the aforesaid landscape of sustainable development, sustainable research, and practice, as raised up by the bibliometric analysis, presenting a concise overview of the diverse themes and their implications for sustainable development and its business implications.

### *Turning clusters into knowledge: Understanding sustainability through thematic and factorial insights*

Moving towards the thematic evolution, the bibliometric analysis captures the evolution and current state of sustainability-focused research with an emphasis on organizational practices and environmental concern, as it can be clearly observed in Figure 6. The data depicts a shift from foundational concepts like “environmental aspects” and “sustainable development” towards more actionable and nuanced themes such as “sustainability reporting” and “knowledge management”. This trajectory suggests a maturing field. Early research in the 2000s laid the groundwork with broad sustainability themes, while recent studies delve deeper into specific areas of action and reporting.

A noteworthy observation from the data is the enduring presence of “sustainable development" across both timeframes. This highlights its continuing relevance in academic discourse. However, the emergence of associated terms like “economic and social effects” and “competitive advantage” indicates a shift towards a more holistic approach. Sustainability now encompasses a wider range of business functions and outcomes, extending beyond profitability and sales to encompass supply chain management and product design (Figure 6).

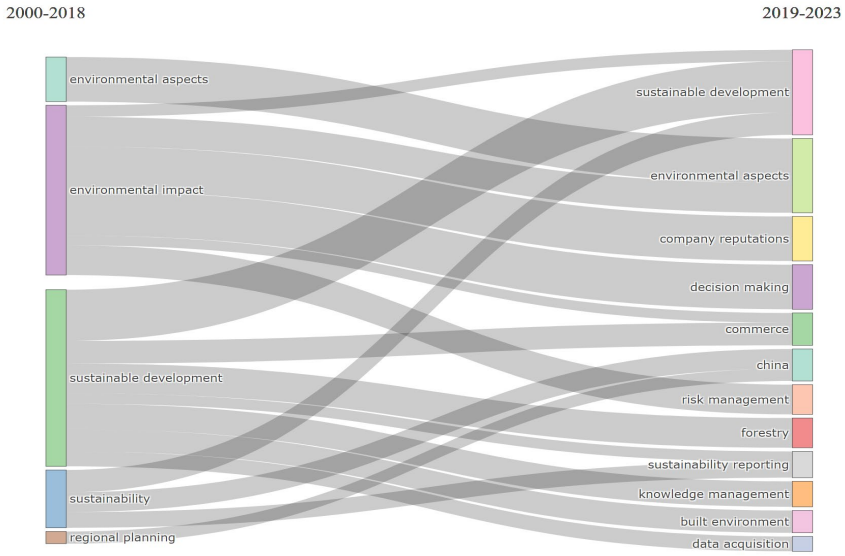


***Figure 6. Thematic evolution: topic shifts***
Source*:* own processing

Interestingly, the recent focus on the intersection of "environmental impact" and "decision making" wields a more integrated approach to environmental considerations within organizational strategic planning. Additionally, the emphasis on "risk management" related to environmental impact signals a shift towards proactive and preventive strategies in corporate policies.

What is more, the analysis also reflects a growing concern for "company reputations" linked with environmental stewardship. Consequently, it might entail a stronger connection between corporate identity and sustainable practices. Notwithstanding, the incorporation of "commerce" and the specific mention of "China" as a regional focus raise up the global and economic dimensions of sustainability. By doing so, the way in which geographic and market dynamics influence sustainability trends is being set forward.

The following table (Table 13) presents a streamlined version focused on showing the transition of themes from 2000-2018 to 2019-2023, the weighted importance of each theme (extracted from the initial "Inc_Weighted" indicator), and their occurrences (extracted from the initial "Occ" indicator). The stability factor will also be included to reflect the consistency of each theme over time.

As we can clearly infer, scholars' focal point puts under the limelight a clear shift in emphasis, moving from a narrower focus on "environmental aspects" towards a more comprehensive understanding of how sustainability integrates with commerce and organizational practices. Themes with high importance scores (close to 0.5), such as "environmental aspects" and "environmental impact", remained significant throughout the analyzed period, highlighting their enduring relevance. Nevertheless, the dynamic nature of the field is evident in the "stability" column, where predominantly low values indicate a continual emergence of new concepts. Hence, "Sustainability reporting" and "knowledge management" exemplify this trend, gaining traction in recent research. What is more, the term "sustainable development" exhibits a significant increase in occurrences (67) in the later period yet possesses a low stability score (0.01). This suggests a potential expansion in the term's usage, encompassing a broader range of implications within the contemporary discourse on sustainability. However, the table serves as a microcosm of the field's evolution, capturing the growing complexity and interconnectedness of sustainability with various facets of business and society as a whole (Table 13).

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***Table 13. Streamlined version of themes transition***

| From (2000-2018) | To (2019-2023) | Central themes | Importance | Occurrences | Stability |
|---|---|---|---|---|---|
| Environmental Aspects | Environmental Aspects | Environmental Concepts | 0.5 | 2 | 0.25 |
| Environmental Impact | Commerce | Economic Influence | 0.11 | 3 | 0.02 |
| Environmental Impact | Company Reputations | Health Concerns | 0.5 | 3 | 0.03 |
| Environmental Impact | Decision Making | Impact and Decisions | 0.5 | 6 | 0.03 |
| Environmental Impact | Environmental Aspects | Management Systems | 0.33 | 4 | 0.03 |
| Environmental Impact | Environmental Tech | Benchmarking | 0.1 | 5 | 0.03 |
| Environmental Impact | Risk Management | Risk Management | 0.33 | 4 | 0.03 |
| Environmental Impact | Sustainable Development | Social and Risk Factors | 0.13 | 4 | 0.01 |
| Regional Planning | China | Innovation | 0.14 | 3 | 0.05 |
| Sustainability | China | Sustainability Economics | 0.22 | 7 | 0.04 |
| Sustainability | Sustainability Reporting | Reporting Practices | 0.18 | 4 | 0.04 |
| Sustainability | Sustainable Development | CSR and Strategy | 0.25 | 6 | 0.01 |
| Sustainable Development | Built Environment | Project Management | 0.25 | 5 | 0.02 |
| Sustainable Development | Commerce | Business Performance | 0.25 | 4 | 0.02 |
| Sustainable Development | Data Acquisition | Construction Industry | 0.17 | 3 | 0.02 |
| Sustainable Development | Forestry | Modeling Techniques | 0.33 | 3 | 0.02 |
| Sustainable Development | Knowledge Management | Knowledge Strategies | 0.29 | 2 | 0.02 |
| Sustainable Development | Sustainability Reporting | Reputation | 0.12 | 2 | 0.02 |
| Sustainable Development | Sustainable Development | Comprehensive Sustainability | 0.57 | 67 | 0.01 |

Source: own processing

In essence, up to this point, the bibliometric data reveals a significant evolution in sustainability research. Foundational concepts have matured into detailed strategies, reflecting an increased integration of sustainability into the core operations and strategic vision of organizations. This trajectory mirrors not only the growing complexity and urgency of sustainability challenges but also the corresponding sophistication of solutions and strategies being developed and implemented within the business world.

Stepping forward, towards the last part of the bibliometric analysis, the factorial analysis, akin to a Conceptual Structure Map, utilizes Multiple Correspondence Analysis (MCA) – a technique suitable for nominal data – to identify and visualize underlying structures within the dataset (Meghana, Mamdapur & Sahoo, 2021). Namely, the software employs MCA to generate a two-dimensional map ("Dim 1" and "Dim 2") reflecting the level of similarity between keywords based on their co-occurrence patterns. Applied to this research, these dimensions illuminate the interconnectedness of various sustainability-related terms, as shown in Figure 7.

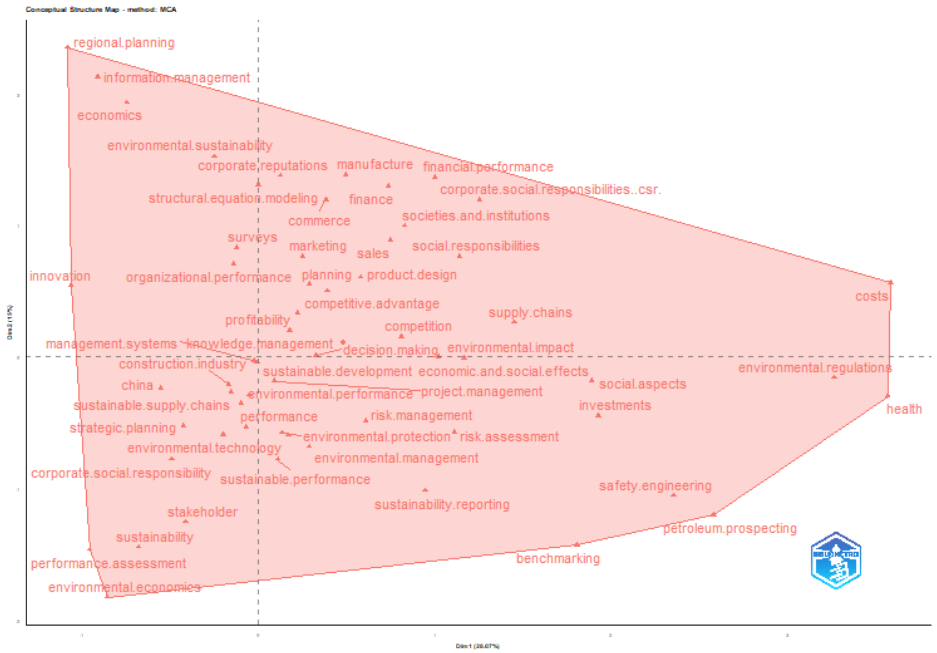


***Figure 7. Factorial analysis***
Source: own processing

Albeit, for improved clarity and readability when it came to quantitatively analyze the co-occurrence pattern (Table 14), we have decided to rename the dimensions as follows: "Dim.1" - Primary Trend (Major Theme), and "Dim.2" - Secondary Trend (Supporting Theme). Subsequently, our interpretation focuses on the evolving focus and directional shifts within sustainability research over time.

Therefore, a high positive value on the "Primary Trend" axis indicates a growing emphasis on a specific area in recent studies. For instance, "Economic and Social Effects" has become increasingly central to sustainability discussions. Similarly, the strong positive movement in this dimension for "Commerce" and "Manufacture" suggests a substantial link between sustainable practices and these sectors' growth or adaptation in the current period. Moreover, "Environmental Regulations", "CSR - Corporate Social Responsibility", and "Risk Assessment" occupy the top positions, indicating their prominence in contemporary research. In all likelihood, we face a trend that holds out a growing emphasis not only on conceptualizing and approaching sustainability, but also on its practical implementation and integration into business practices and regulatory frameworks.

In the same vein, a high positive value on the "Secondary Trend" axis entails an upward trajectory in a complementary facet or an emerging area of interest. Specifically, a high value for "Information Management" might indicate the growing importance of managing information within sustainable practices, putting forward the integration of data analysis and information and communication technology (ICT) tools in environmental management. Furthermore, it is worth mentioning that concepts like "CSR - Corporate Social Responsibility" and "Commerce" score high values on both axes. This suggests that these themes are multifaceted and experiencing growth not only in prominence but also in their interconnectedness with other research areas.

Evenhandedly, concepts like "Environmental Impact" and "Social Responsibilities" hold strong positions in the "Primary Trend" but display a near-neutral "Secondary Trend". This implies that these well-established areas remain central to the discourse, but their relative growth in connection with other areas might be stabilizing (see Table 14).

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***Table 14. Streamlined version of themes transition***

| Concept | Primary trend (Major theme) | Secondary trend (Supporting theme) |
|---|---|---|
| Environmental Regulations | 46.447 | -0.16 |
| CSR - Corporate Social Responsibility | 45.658 | 43.466 |
| Risk Assessment | 45.597 | -0.57 |
| Economic and Social Effects | 45.323 | 0.00 |
| Environmental Impact | 42.736 | -0.01 |
| Social Responsibilities | 41.640 | 0.76 |
| Investments | 33.970 | -0.44 |
| Social Aspects | 32.509 | -0.18 |
| Benchmarking | 29.587 | -1.43 |
| Costs | 21.610 | 0.56 |
| Petroleum Prospecting | 21.217 | -1.20 |
| Health | 20.880 | -0.30 |
| Supply Chains | 16.438 | 0.26 |
| Safety Engineering | 13.181 | -1.05 |
| Financial Performance | 1.00 | 13.516 |
| Sustainability Reporting | 0.95 | -1.02 |
| Societies and Institutions | 0.83 | 1.00 |
| Competition | 0.81 | 0.15 |
| Sales | 0.75 | 0.88 |
| Finance | 0.74 | 47.119 |
| Risk Management | 0.61 | -0.48 |
| Product Design | 0.58 | 0.60 |
| Manufacture | 0.49 | 14.246 |
| Competitive Advantage | 0.39 | 0.50 |
| Commerce | 0.38 | 43.466 |
| Decision Making | 0.33 | 0.01 |
| Environmental Management | 0.29 | -0.68 |
| Planning | 0.29 | 0.55 |
| Marketing | 0.25 | 0.76 |
| Profitability | 0.22 | 0.34 |
| Knowledge Management | 0.18 | 0.20 |
| Sustainability Performance | 0.17 | -0.59 |
| Environmental Protection | 0.13 | -0.58 |
| Corporate Reputations | 0.12 | 13.881 |
| Sustainable Performance | 0.11 | -0.78 |
| Project Management | 0.09 | -0.18 |
| Structural Equation Modeling | 0.00 | 11.324 |
| Regional Planning | -1.08 | 12.816 |
| Innovation | -1.06 | 0.54 |
| Performance Assessment | -0.96 | -1.46 |
| Information Management | -0.91 | 45.628 |
| Environmental Economics | -0.86 | -1.83 |
| Economics | -0.75 | 33.970 |
| Sustainability | -0.68 | -1.44 |
| China | -0.55 | -0.24 |
| Corporate Social Responsibility | -0.49 | -0.78 |
| Strategic Planning | -0.42 | -0.52 |
| Stakeholder | -0.41 | -1.25 |
| Environmental Sustainability | -0.25 | 18.994 |
| Environmental Technology | -0.20 | -0.59 |

Source: own processing

On the flipside, negative values on the “Primary Trend” axis, such as those observed for keywords like “Sustainability”, or “Corporate Social Responsibility”, which may disclose a shift in the discourse, where the concept is being integrated into broader frameworks or

explored in more comprehensive conceptual frameworks, rather than remaining the sole, isolated focus. In this particular case, we could witness an emerging subjacent trend declined from the initial one (i.e. "Sustainability" and "Corporate Social Responsibility"), such as "sustainable business models" or "corporate governance", respectively (Table 15).

***Table 15. Factorial analysis: A synthesis***

| Concept | Primary trend (Growth & Importance) | Secondary trend (Interconnectedness) |
|---|---|---|
| Economic and Social Effects | High positive value | Neutral value |
| | (Central to discussions) | (Interactions may be stabilizing) |
| Commerce | High positive value | High positive value |
| | (Substantial link with sustainability) | (Growing interconnectedness) |
| Manufacture | High positive value | Neutral value |
| | (Integral in sustainable adaptation) | (Interactions may be stabilizing) |
| Environmental Regulations | High positive value | Negative value |
| | (Prominent in research) | (Focused specialization) |
| Corporate Social Responsibility | High positive value | High positive value |
| | (Essential in business practices) | (Broadening scope) |
| Risk Assessment | High positive value | Negative value |
| | (Prominent in research) | (Less emphasis on connections) |
| Information Management | Neutral value | High positive value |
| | (Consistent focus) | (Emerging importance) |
| Environmental Impact | High positive value | Near-neutral value |
| | (Continuing central theme) | (Stable growth) |
| Sustainability | Negative value | Negative value |
| | (Integrating into broader frameworks) | (Shifting focus) |
| Environmental Technology | Negative value | Negative value |
| | (Evolving association with sustainability) | (Holistic environmental management) |
| Benchmarking | Neutral value | Negative value |
| | (Steady importance) | (Changing methodologies) |
| Sustainability Reporting | Neutral value | Negative value |
| | (Consistent relevance) | (Evolving practices) |
| Environmental Economics | Negative value | Negative value |
| | (Pivoting to specific themes) | (Paradigmatic change) |
| Innovation | Negative value | Negative value |
| | (Moving towards advanced themes) | (Shifting scholarly focus) |

Source: own processing

Following the same pattern, a negative value on the "Secondary Trend" axis for a concept like "Environmental Technology" could suggest that, while the technology remains relevant, its direct association with sustainability might be evolving towards a more holistic approach to environmental management, one that doesn't solely showcase technology. A very akin situation is the one of the concepts "Benchmarking" and "Sustainability Reporting": their values may result in a change in how these concepts are applied or a need for novel methodologies as the field progresses. Nevertheless, the cases of "Environmental Economics" and "Innovation", which bear negative values on both axes, could be accompanied by a pivot towards more specific or advanced themes within these broad areas, or a paradigmatic change in scholarly focus to other emergent topics.

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Further nuancing the analysis, a positive primary trend coupled with a negative secondary trend suggests that a concept is gaining prominence within the field (primary trend) while its connections with other research areas or its multifaceted development might be decreasing (secondary trend). This pattern can be observed in concepts like "Environmental Regulations". To wit, while it's becoming a central theme, its interaction with other sustainability-related areas may be diminishing. This aftermath could be due to a specialization within environmental regulations, focusing on specific issues rather than broad integration. In a resembling way, the term "Investments" presents a positive primary but negative secondary trend, which sets ahead a focus on the financial aspects of sustainability, with less emphasis on the complexity of connections between investments and other sustainability concerns. A possible explanation for this outcome might be the fact that it may reflect a period of consolidation where investments are viewed as a distinct topic. "Social Aspects" is a concept that falls within the same pattern, which might denote an increased focus on the social dimension, but potentially with less emphasis on its connection with economic or environmental aspects. By inference, Table 15 aims to systematically categorize and clearly display the key trends within sustainability research, particularly the rise in thematic complexity and the multifaceted nature of concepts.

All things considered, from a broader theoretical perspective, these patterns highlight a stage where certain themes are solidifying their importance but may require further exploration of their wider implications. A positive primary trend with a negative secondary trend suggests a need for renewed interdisciplinary approaches or integration into larger, system-wide analyses. This can encourage researchers to delve deeper into how these concepts connect with others, fostering a holistic approach to sustainability that reflects the interconnectedness of social, economic, environmental and cultural issues. Simply put, one could state that the end-result of the factorial analysis resulted captures the dynamism of the sustainability research landscape.

## Conclusions and recommendations

### *Bridging knowledge gaps in sustainable-oriented managerial research*

In the present bibliometric analysis, we pursued to map the over-complicated network of interconnected dimensions that jointly build upon the conceptualization of sustainable development at the present time. This mapping underscores the dynamic and multifaceted nature of the field, holding out its resistance to compartmentalization and its interconnectedness across various domains.

The analysis delves into the sustainability literature, uncovering the evolution of themes over time and bringing to light the primary research core, molding the current understanding of sustainability, particularly within the business environment. We launched forth the potential need for foundational theories and frameworks to adapt and encompass the growing focus on sectors like commerce and manufacturing, as well as the increasing role of technological innovation within the sustainability discourse. However, the outlined evolution of themes suggests a strategic shift in sustainability research, progressing from individual concepts towards a more integrated approach within business practices and regulatory frameworks. Table 16 provides an integrative summary of the bibliometric analysis that underpins the first part of the literature review. The tools utilized serve various purposes in constructing a thorough examination of sustainability-related literature.

***Table 16. Bibliometric analysis: overall conclusions***

| Bibliometric Tool | Insight | Contribution to Literature Review |
|---|---|---|
| Bradford's Law | Identified core journals and seminal works | Ensures the review is based on influential sources, grounding the thesis in relevant literature. |
| Lotka's Law | Recognized key authors and contributions | Highlights central figures in sustainability, guiding a focused review of significant research. |
| Keyword Co-occurrences | Illuminated interconnected themes | Reveals the multidimensionality of sustainability, aiding in the exploration of complex relationships. |
| Thematic Evolution (Growth Areas) | Traced developments in sustainability research | Offers insights into emerging trends and literature gaps, informing areas for future investigation. |
| Works on Topic of Interest | Provided a focused view on current research directions | Enables a targeted review of methodologies and findings specific to Romanian companies' sustainability practices. |
| Clustering | Structured overview of sustainability themes | Presents a comprehensive landscape of sustainability research, from foundational principles to strategic applications. |
| Thematic Evolution (Topic Shifts) | Traced shifts in focus within sustainability research | Identifies historical and current trends ("hot topics") in the field. |
| Factorial Analysis (Primary Trend) | Revealed primary directions and emerging priorities in sustainability | Provides a structured view on leading sustainability trends |
| Factorial Analysis (Secondary Trend) | Indicated supporting themes complementing the primary trends | Adds depth to the understanding of sustainability's multiparadigmatic nature |

Source: own processing

The analysis of primary and secondary trends offered a nuanced picture of emerging priorities and interconnected fields within sustainability studies. These findings push the boundaries of current academic understanding, venturing into new areas of exploration. The secondary trend analyses, in particular, suggest a potential multiparadigmatic approach to sustainability. Put it in other words, this subchapter not only synthesizes the comprehensive bibliometric analysis but also lays the groundwork for the subsequent in-depth literature review, by pinpointing research gaps and suggesting potential areas for further investigation.

Upon the whole, this study provides a comprehensive bibliometric analysis of sustainability research within the Knowledge Economy, offering valuable insights into emerging trends, foundational theories, and research gaps. The findings reveal that sustainability has become an essential component of modern business strategies, with increased focus on innovation, CSR, market dynamics, and sustainability reporting. However, significant research gaps remain, particularly in understanding the dynamism of sustainability applications within transitional economies like Romania.

***Charting future directions in sustainable-oriented managerial research***

Future research should prioritize the development of adaptive sustainability frameworks that address sector-specific challenges. Investigations into the integration of technology and innovation in sustainability efforts, the evolving role of CSR, and consumer behavior in sustainable markets will provide valuable contributions to both academia and industry. Moreover, empirical studies focusing on the application of global sustainability standards in Romania's unique economic context can further bridge the knowledge gap (Table 17).

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***Table 17. Bibliometric analysis: overall conclusions***

| Aspect | Synthesis of existing knowledge | Identified research gaps | Areas for further investigation |
|---|---|---|---|
| Foundational Theories | Integration of sustainability within economic, social, and environmental dimensions, and their evolving interplay, particularly noted in the positive primary trend for "economic and social effects". | Theories may not yet fully encompass the dynamism identified in shifts towards commerce and manufacture sectors, or account for the negative secondary trend in "sustainability". | Develop dynamic frameworks that address how foundational sustainability concepts are applied uniquely within Romania's transitional economy, with particular attention to sectors showing primary growth. |
| Innovation and Technology | Acknowledges innovation's role, evidenced by its shift in thematic evolution, and the increased focus on technology's role in driving sustainability. | Lack of depth in research exploring how technological innovation is integrated within sustainability efforts, specifically within different sectors in Romania. | Dive into the forces driving innovation within Romanian sectors showing primary growth and investigate how technology adoption influences sustainability. |
| Corporate Social Responsibility (CSR) | Reiterates CSR and finance as central themes, as shown by their positive primary trend, in sustaining ethical, social, and environmental business practices. | Requires deeper investigation into the specific impact of CSR initiatives in the Romanian context, where the negative secondary trend might indicate evolving CSR approaches. | Examine the balance between financial performance and CSR's evolving nature in Romania, and how this impacts the overall corporate strategy for sustainability. |
| Market Dynamics and Consumer Behavior | The importance of understanding market dynamics and consumer behavior towards sustainability, which may be inferred from the thematic shift towards sectors like commerce and the changing discourse on sustainability. | A noted absence of detailed consumer response analysis, particularly within sectors showing a positive primary trend. | Explore how Romanian consumer behaviors are adapting to the sustainability paradigm shift and the influence on corporate sustainability strategies. |
| Sustainability Reporting and Communication | The growing importance of transparency and communication in sustainability efforts, suggested by the positive secondary trend in "information management". | Sparse research on the effectiveness of Romanian companies' communication strategies concerning their sustainability efforts. | Investigate how Romanian companies are adapting their sustainability communication to align with the emerging importance of information management. |
| Empirical and Applied Research | Highlights empirical research's role in practical sustainability applications, as seen in the positive primary trends of sectors like commerce and finance. | There are gaps in empirical studies on the application of global sustainability standards in the Romanian business landscape. | Conduct sector-specific empirical research that probes into the practicalities of applying global sustainability standards in Romania, considering the primary growth sectors. |

Source*:* own processing

In the aggregate, by synthesizing key research themes and identifying emerging gaps, this study serves as a roadmap for future scholarly endeavors, offering strategic insights that can inform corporate sustainability policies and business practices in the face of disruptive economic changes.

***Acknowledgments**: The authors (Y. Bilan) express their gratitude to the project titled "Cluster for innovative energy" in the frame of the program "HORIZON-MSCA-2022-SE-01" under the Grant agreement number 101129820.*

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