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Bibliometric analysis of Sustainable Business Models: Emerging trends and future developments

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Abstract

This research investigates the trends in sustainable business models (SBMs), tackling the existing lack in comprehensive literature analysis despite huge amount of studies related to this topic. By analysing 1085 publications on SBM from 2002 to 2021 using Elsevier's Scopus database, the research provides an empirical overview of the field, highlighting key contributions, authors, and journals. This approach not only ensures the creation of a rich, multidimensional dataset across different fields but also unveils the intricate networks of research clusters that define the SBM domain. Advanced network analysis using VOSviewer software identifies main research clusters in the SBM literature. The analysis includes citation analysis, bibliographic coupling, and keyword co-occurrence. Findings indicate that many studies concentrate on innovations and value creation at the heart of SBMs. Moreover, the research trends identified in SBMs encompass several crucial areas: the integration of circular economy principles into business models, innovative approaches in sustainable supply chains, the intersection of entrepreneurship with corporate social responsibility, and the role of new technologies and artificial intelligence in enhancing environmental management. Finally, this work not only synthesizes the current state of SBM research but also identifies gaps and suggests directions for future investigations, emphasizing the importance of a multidisciplinary approach to developing SBMs that are economically viable, environmentally sustainable, and socially responsible. Through this enhanced understanding, the paper aims to inspire continued exploration and innovation in the field, supporting the global transition towards more sustainable business practices and operations.

Keywords – Sustainable Business Model; Bibliometric Analysis; Bibliographic Coupling; Co-citation Analysis; Clusters Analysis.

Paper type – Bibliometric Review

Sommario

Analisi bibliometrica dei modelli di business sostenibile: tendenze emergenti e sviluppi futuri. – La ricerca indaga le tendenze dei modelli di business sostenibile (Sustainable Business Models – SBMs), a fronte della carenza di un'analisi completa della letteratura nonostante l'enorme quantità di studi relativi a questo argomento. Prendendo in esame 1085 pubblicazioni in materia di SBM, dal 2002 al 2021, e utilizzando il database Scopus di Elsevier, la ricerca fornisce una panoramica empirica del campo, evidenziando contributi-chiave, autori e riviste. Questo approccio non solo consente la creazione di un set di dati ricco e multidimensionale in diversi campi, ma ricostruisce anche i principali cluster di ricerca nella letteratura SBM mediante l'impiego del software VOSviewer. Il lavoro include l'analisi delle citazioni, l'accoppiamento bibliografico e la ricorrenza delle parole chiave. I risultati indicano che molti studi si concentrano sulle innovazioni e sulla creazione di valore. Inoltre, le tendenze di ricerca identificate negli SBMs comprendono diverse aree cruciali: l'integrazione dei principi dell'economia circolare nei modelli di business, gli approcci innovativi nelle catene di fornitura sostenibili, l'intersezione tra imprenditorialità e responsabilità sociale delle imprese e il ruolo delle nuove tecnologie e dell'intelligenza artificiale nel migliorare la gestione ambientale. Infine, il lavoro non solo sintetizza lo stato attuale della ricerca, ma identifica le lacune e suggerisce le direzioni per le indagini future, sottolineando l'importanza di un approccio multidisciplinare allo sviluppo di SBM che siano economicamente ed ambientalmente sostenibili nonché socialmente responsabili. Attraverso questa migliore comprensione, l'articolo mira a sollecitare la continua esplorazione e innovazione nel campo, supportando la transizione globale verso pratiche e operazioni aziendali maggiormente sostenibili.

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1 Introduction

In recent years, there has been a growing interest in sustainable business models (SBMs) within both academic and economic sectors. Initially, SBMs aimed to guide firms toward a sustainable economic structure and circular approaches (Stubbs & Cocklin, 2008). The importance of SBMs has grown, with many businesses adopting them to enhance sustainability and performance (Nidumolu et al., 2015; Porter & Kramer, 2011). This shift is reflected in the increasing volume of scholarly studies, marking a departure from earlier times when sustainability was often overlooked in business model innovation (Schaltegger et al., 2012). Research has identified various subtypes and practices of sustainable and circular business models (Bocken et al., 2014; Geissdoerfer et al., 2018).

The concept of 'business models' evolved into SBMs during the late 1990s with the internet's rise, altering traditional financial and economic rationales (Boons & Lüdeke-Freund, 2013). Developing new business models, rather than just products or services, became seen as a pathway to competitive advantage (Zott & Amit, 2010). Business models serve multiple purposes, including performance assessment and innovation (Osterwalder et al., 2010; Zilia et al., 2023). Traditional models focused on efficiency and profit, but recent shifts have emphasized social and environmental impacts (Yip & Bocken, 2018; Lewandowski, 2016). This change aligns with growing awareness of corporate social responsibility and the circular economy (White et al., 2019).

Innovations in business models can facilitate significant shifts in business goals and value creation (Evans et al., 2017; Hernández-Chea et al., 2021). Sustainable models help manage and communicate a firm's value proposition, balancing ecological, societal, and economic aspects (Schaltegger et al., 2012). However, Upward and Jones (2016) noted that decision-making attributes in business models often do not align with holistic sustainability. SBMs,[1] incorporating a triple bottom line approach, address a range of stakeholder objectives, including community and environmental concerns (Geissdoerfer et al., 2018; Joyce and Paquin, 2016; Zilia et al., 2021) and are instrumental in integrating sustainability into corporate strategies (Bocken et al., 2014).

Recent reviews in the field have been numerous. Bocken et al. (2014) and Boons and Lüdeke-Freund (2013) explored sustainable business model archetypes and contexts, respectively. Upward and Jones (2016) developed a theoretical model of SBMs, while Geissdoerfer et al. (2018) identified a research gap in the application of business model innovation. Schaltegger et al. (2012)

[1] The evolution from traditional BM to SBM signifies a shift towards integrating environmental, social, and economic considerations into the core of business operations. An SBM not only aims for financial profitability but also seeks to address societal needs and environmental sustainability, creating value across multiple dimensions. This transformation is extensively discussed in the works of Schaltegger et al. (2016) and Bocken et al. (2014), who define SBMs as frameworks for businesses to operate in a manner that ensures long-term ecological balance and social equity alongside economic viability.

discussed the history and future directions of SBMs. Despite many high-quality reviews, bibliometric analyses in this field are limited (Bilan et al., 2020; Marczewska & Kostrzewski, 2020; do Carmo et al., 2023; Pan, 2023).

This study aims to understand SBM literature's conceptual interpretations, current state, and future directions using bibliometric analysis. It examines 1085 publications from Scopus' between 2002 and 2021, identifying influential articles, authors, journals, and study trends in SBMs. The research focuses on the pace of scholarly publications, influential sources and authors, significant research trends, and future directions in SBM research.

The research employs bibliometric analysis for an objective review of the literature, contributing to sustainability and SBM fields by identifying major articles, frequently used keywords, pioneers in the field, and key emerging sub-fields (Wallin, 2005; Nosratabadi et al., 2019; Pilarczyk, 2018).

The manuscript is organized as follow: Section 2 discusses the study methodology and data, and Section 3 describes the application of bibliometric approaches and graphically shows network results. Finally, Section 4 discusses the managerial implications of SBMs and Section 5 underlines the study's conclusion with future perspective and limitations of the work.

2 Methods and data

2.1 Search strategy

The strategy for conducting bibliometric analysis in our study was meticulously planned to ensure a comprehensive and precise understanding of the research progression in SBMs. This method aligns with the management research approach, as outlined by Donthu et al. (2020), focusing on understanding the social, cognitive, and conceptual structures of specific domains.

We began by selecting the appropriate resources database, a crucial step in effective bibliometric analysis. Our choices included Google Scholar, Web of Science (WoS), and Scopus, each with its unique strengths and limitations. Google Scholar, noted for its extensive archives (Levine-Clark & Gil, 2008), was considered less suitable due to its inability to distinguish true scholarly matches effectively, as critiqued by Jacsó (2010). WoS, while being a principal bibliometric source in many universities (Harzing & Alakangas, 2016), was compared against Scopus for its broader journal coverage. As observed by Marczewska and Kostrzewski (2020) and supported by Baier-Fuentes et al. (2019) and Mongeon and Paul-Hus (2016), Scopus emerged as a viable alternative to WoS, offering a comparable range of literature retrieval and citation analysis capabilities.

Our analysis procedure, as detailed in Table 1, involved specific retrieval conditions. The initial step was selecting relevant keywords, derived from a pre-research literature review. This process led to the identification of "sustainable business model" as a key term. To refine our search, we tested various keyword combinations in Scopus and WoS, eventually settling on "sustainable business model*" OR "business model AND sustainability" OR "business model* for sustainability" as our final search query.[2]

The comparative analysis of search results from both WoS and Scopus databases highlighted Scopus's superior journal coverage and volume of publications, largest citations, and abstract database covering (Alharthi et al., 2022), leading us to choose it for further analysis. Following this selection, we applied filters based on language, source type, and subject area, resulting in 1065 documents initially retrieved from Scopus. This number was further refined to 962 English language references. These references were predominantly articles, conference papers, reviews, and conference reviews, indicating their relevance to our research focus.

In terms of subject area classification, we discovered that the majority of pertinent SBM research fell within the Scopus topic categories of Business, Management, and Accounting; Environmental Science; Energy; Economics, Econometrics, and Finance. Indeed, in Scopus, papers are divided into broader and multidisciplinary categories, posing a risk of encompassing more general articles that only marginally address the topic under investigation. From a comparison between databases, it was discovered that searching for the topic 'sustainable business model' in Scopus reveals articles across 25 categories, whereas in WoS, it extends to 105 categories. Moreover, in Scopus, all these categories are grouped into four broad areas: Health, Social, Physical, and Life Sciences (see Baas et al., 2020). Consequently, we only considered categories that fall within the Social Sciences class.

For this reason, most of the articles analysed in this study are categorized in this class we identified as relevant, leaving out articles that merely mention the topic indirectly in fields not related to our goal (e.g. Nursing, Chemistry, Pharmacology etc.).

Accordingly, we selected studies from these domains, yielding a final sample of 692 records. The timeframe for our research spanned from December 2002, marking the inception of SBM research (Saeed et al., 2002), to December 2021. This period was chosen to capture the evolution and current state of SBM research comprehensively.

[2] For the execution of our query, we utilized the 'TITLE-ABS-KEY' search field in Scopus, targeting the titles, abstracts, and keywords of documents to identify relevant articles. Conversely, in WoS, we employed the 'Topic field' search criterion, which similarly encompasses the examination of document titles, abstracts, and keywords, ensuring a comprehensive coverage and retrieval of pertinent studies.

Table 1 – Sample data retrieval conditions

Retrieval condition category	Retrieval condition setting
Keyword	"Sustainable business model"
Retrieval strategy	"Sustainable business model*" OR "Business model AND sustainab*" OR "Business model* for sustainability"
Time span	December, 2002 – December, 2021
Database	Scopus (a total of 1085 valid studies were retrieved from the literature)
Publication stage	Final
Source type	Article, Conference Paper, Review, Conference Review
Subject areas	*i.* Business, Management and Accounting *ii.* Environmental Science *iii.* Energy *iv.* Economics, Econometrics and Finance
Code applied in Scopus	*TITLE-ABS-KEY ("Sustainable business model*" OR "Business model AND sustainab*" OR "Business model* for sustainability") AND (LIMIT-TO (DOCTYPE, "ar") OR LIMIT-TO (DOCTYPE, "cp") OR LIMIT-TO (DOCTYPE, "re") OR LIMIT-TO (DOCTYPE, "cr") AND (LIMIT-TO (SUBJAREA, "BUSI") OR LIMIT-TO (SUBJAREA, "ENVI") OR LIMIT-TO (SUBJAREA, "ENER") OR LIMIT-TO (SUBJAREA, "ECON") AND (LIMIT-TO (LANGUAGE, "English")*

Source: Authors elaboration based on the data retrieval, 2022

2.2 Method of analysis

Section 2.2 of our study describes the bibliometric analysis methods used to examine sustainable business models. Bibliometrics involves managing and analysing bibliographic data from various publications using statistical techniques to enhance literature reviews (Ganzaroli et al., 2013). This approach helps identify key publications and analyses citation patterns through methods like author citation analysis, citation network mapping, and co-citation analysis (Ganzaroli et al., 2013; Gmür, 2003; Schildt & Mattsson, 2006).

We employed science mapping to understand the thematic focus within sustainable business models. Science mapping provides insights into a topic's scope, emerging themes, and evolution over time,

offering a comprehensive perspective with minimal researcher bias (Singh et al., 2022; Bhattacharyya & Verma, 2020).

The study utilized three primary methods of analysis: direct citation, co-citation, and bibliographic coupling (Belussi et al., 2019; Boyack & Klavans, 2010). Direct citation involves one paper citing another, co-citation occurs when a third paper cites two others, and bibliographic coupling happens when two articles are cited by a third. We focused more on Bibliographic coupling due to its accuracy in quantitatively assessing relationships between documents.

Bibliographic coupling measures the strength of the relationship between documents based on shared references (Boyack & Klavans, 2010; Zupic & Čater, 2015). Unlike co-citation, which tends to highlight earlier works, Bibliographic coupling is effective for exploring recent contributions as it is not constrained by the citation frequency of older papers (Ganzaroli et al., 2013; Vogel & Güttel, 2013). Additionally, we utilized co-occurrence of keyword analysis, employing text-mining algorithms on article titles, abstracts, and keywords to identify common themes (van Eck et al., 2010; Baker et al., 2020; Donthu et al., 2021). This method determines the association between keywords based on their frequency of appearing together in articles.

2.3 Clustering strategy

In our study, we adopted a clustering strategy using keyword co-occurrence, co-citation, and bibliographic coupling analyses. This approach aims to capture insights from both historical and contemporary research. We anticipated that these methods would yield clusters of articles with similar or related study topics. In the bibliometric network, each manuscript is represented as a node, and the connections, signifying either co-citations or bibliographic couplings, depend on the type of link being examined (Belussi et al., 2019). A standard approach in bibliometric analysis involves selecting a set of publications, applying bibliographic coupling or co-citation analysis to find similarities between pairs of documents, and using similarity indices for clustering (Boyack & Klavans, 2010; Donthu et al., 2021; Ellegaard & Wallin, 2015).

We used VOSviewer for visualization and analysis of bibliometric networks. Developed by van Eck and Waltman in 2010, VOSviewer excels in combining network visualization and clustering, with VOS standing for ‘visualization of similarities’ (van Eck & Waltman, 2010). It generates co-citation maps, bibliographic coupling, and clusters, employing a distance-based mapping method to denote the association strength between objects. In this mapping, the proximity of two items indicates the strength of their relationship, with closer distances suggesting stronger links (van Eck et al., 2010).

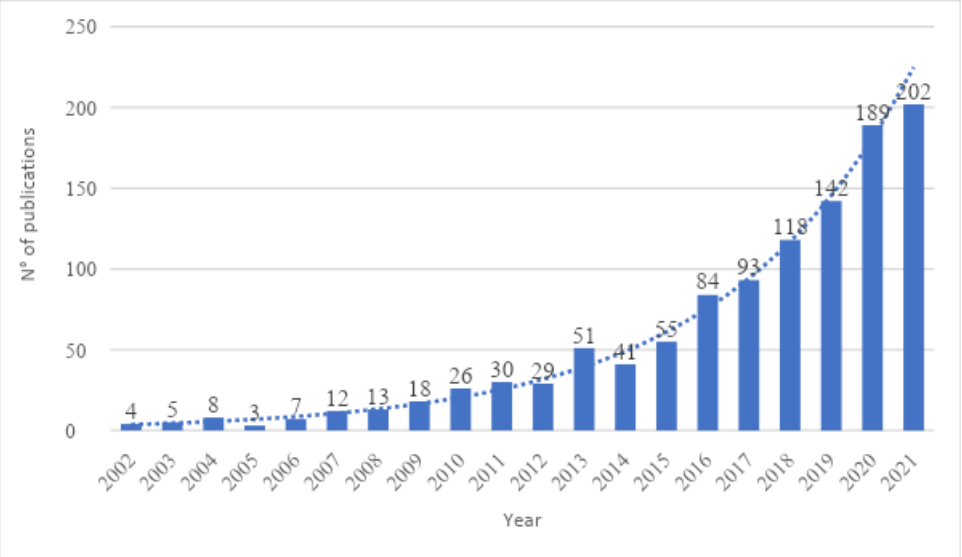
The benefits of this bibliometric technique are manifold. Firstly, it relies on quantitative statistical analysis and produces a credible dataset comprising a large number of peer-reviewed papers across various areas and specialties. Secondly, the visual network analysis facilitates a comprehensive understanding of the discipline's scope and structure. This is achieved by identifying prominent authors or articles and major clusters of ongoing studies. These insights are instrumental in outlining the main areas and trends within the subject field, providing valuable guidance for future research directions.

3 Results

3.1 Sample descriptive analysis

Sustainable business model research, initiated in 2002, has seen a significant increase in interest and publications over the past two decades. Figure 1 illustrates this growth, showing a modest start with fewer than 10 publications annually until a marked increase in 2013, when the number exceeded 50. This rising trend reflects the growing engagement of firms and scholars in this area.

Figure 1 – Yearly distribution and growth trend of publications (2002-2021) on sustainable business models



Source: Authors elaboration based on the Scopus Database, 2023

Globally, the research on sustainable business models is widespread, with key contributions from various countries, as detailed in Table 2. The United Kingdom, Italy, Germany, the USA, and the Netherlands are leading in this research area, alongside notable progress from developing nations like China and India.

Table 2 – Dispersion of the literature on sustainable business models over the world (2002-2021)

Country	Documents	% of documents
United Kingdom	96	12.8
Italy	77	10.3
Germany	72	9.6
United States	70	9.3
Netherlands	61	8.1
Sweden	53	7.1
Spain	41	5.5
China	35	4.7
India	32	4.3
France	26	3.5

Source: Authors elaboration based on the Scopus Database, 2023

For a focused analysis, a minimum of five papers per country, with at least 200 papers overall, was set as a criterion. This approach is reflected in the bibliometric mapping (Figure 2), where these countries are central to each cluster, showing strong links with other nations. In the United Kingdom, institutions like the University of Cambridge and the University of Manchester are prominent contributors, while the Delft University of Technology in the Netherlands and Lund University in Sweden each have a substantial number of publications. Italy also displays diverse contributions from universities like Università degli Studi di Torino and Università degli Studi di Napoli Parthenope.

Figure 2 – Bibliographic coupling of countries that publish in sustainable business models research

Source: Authors elaboration based on the VOSviewer software, 2022

Table 3 presents the top 10 journals in this field, with the *Journal of Cleaner Production* leading with 119 articles, followed by *Sustainability (Switzerland)* and *Business Strategy and the Environment*. These journals primarily focus on the business perspective, emphasizing long-term value generation and growth in sustainable business models. The British Food Journal also contributes by discussing sustainability in the food sector.

This increasing trend in publications is attributed to the growing recognition of sustainable business models in management circles, with researchers and journals exploring various aspects of this evolving concept. The *Journal of Cleaner Production*, known for its comprehensive coverage of sustainability,

exemplifies this trend, reflecting the broad interest in sustainable business models across different fields of study.

Table 3 – List of Top 10 Journals publishing articles on sustainable business models (2002-2021)

Journals	Number of documents
Journal of Cleaner Production	119
Sustainability (Switzerland)	105
Business Strategy and The Environment	19
Organization and Environment	11
Sustainable Production and Consumption	11
Energies	9
British Food Journal	8
Business and Society	7
Corporate Social Responsibility and Environmental Management	7
Management Decision	7

Source: Scopus Database, 2021

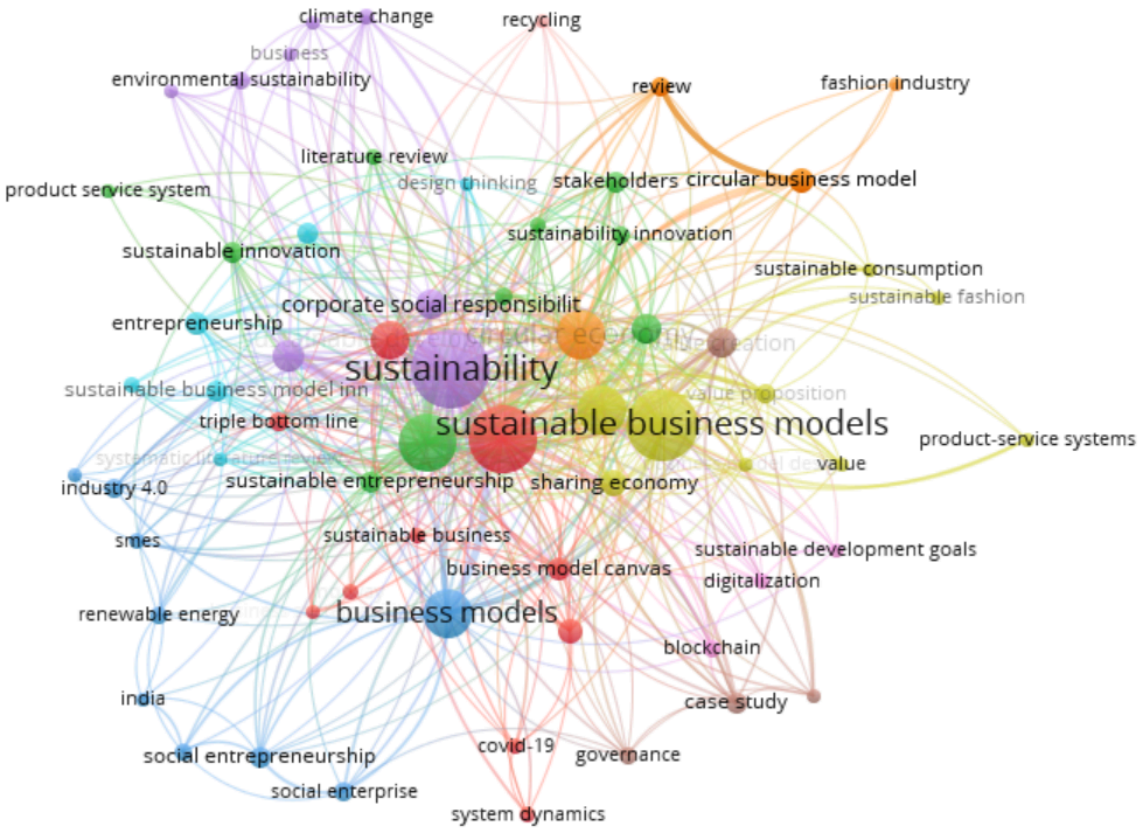
3.2 Co-occurrence analysis of authors keywords

Co-occurrence analysis of keywords is constructed for the study of sustainable business models (Figure 3). Based on an examination of 1844 keywords linked with all publications on sustainable business models, a keyword's minimum number of occurrences was set to 5 which yielded up to 64 major keywords. The term 'sustainability' is the most often used keyword in the research area with 135 occurrences. The terms 'sustainable business models' and 'sustainable business model' were repeated more than 200 times together. The keyword 'business model' was seen 77 times, whereas the keyword 'business model innovation' has 55 occurrences. The knowledge base related to the sustainable business models may be classified into 10 main clusters (Figure 3).

The top keywords indicate innovative approaches to sustainable business models used by firms that maximize long-term efficiency and enhance a massive advantage. The results display a variety of

technological terms like blockchain, digitalization, social media indicating that business models innovate along with the changing era for adapting a sustainable future.

Figure 3 – Co-occurrence of authors keywords of publications released in sustainable business models



Note: Clusters are divided into 10 colours: Red (sustainable development and sustainable business models); Green (sustainable entrepreneurship and business models); Blue (business models and industries transformation); Yellow (business model innovation and value creation); Purple (corporate social responsibility); Sky blue (strategy and design thinking); Orange (circular business models); Brown (value creation); Violet (blockchain and Web 3.0); Maroon (recycling).

Source: Authors elaboration based on the VOSviewer software, 2022

3.3 Citation network analysis

Citations are a key metric for assessing an author's credibility and the relevance of their work, serving as an indicator of quality. Table 4 highlights the most prominent sustainable business model publications based on their average annual citations. Notably, among the top five most-cited

publications, only one is a review paper, while the rest are articles, with no conference papers included. These influential publications predominantly date from 2013 to 2016.

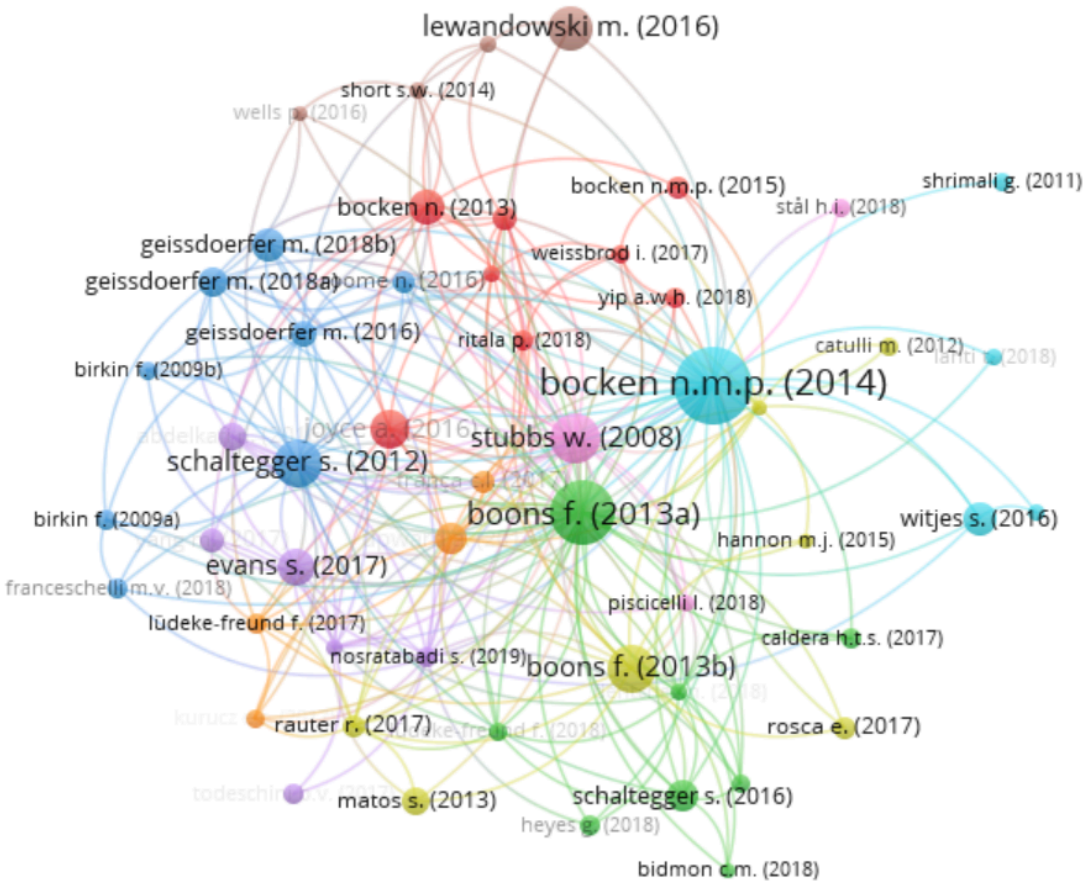
Leading the list is the study by Bocken et al. (2014), titled 'A literature and practice review to develop sustainable business model archetypes', which averages 157.12 citations per year (Table 4; Figure 4). This review underscores the significance of incorporating sustainability into business models and how innovations can transform business practices. The authors introduce a classification of sustainable business model archetypes, outlining structures and solutions that aid in developing sustainable business models. These archetypes are instrumental in driving innovation and delivering sustainability, yielding environmental, social, and economic benefits. Organizations can apply one or several of these archetypes to reorient their goals, thereby creating new avenues for developing sustainable value and enhancing the innovation process.

Table 4 – List of the Top 5 Articles by the number of citations

Rank	Authors	Source title	Contribution title	Year	Total citations	Average per year	Research direction
1	Bocken, Short, Rana, & Evans	*Journal of Cleaner Production*	A literature and practice review to develop sustainable business model archetypes	2014	1257	157.1200	Strategic research on sustainable business models
2	Boons, & Lüdeke-Freund	*Journal of Cleaner Production*	Business models for sustainable innovation: state-of-the-art and steps towards a research agenda	2013	901	100.11	Strategic research on sustainable business models and sustainable innovation
3	Lewandowski	*Sustainability (Switzerland)*	Designing the Business Models for Circular Economy – Towards the Conceptual Framework	2016	445	74.1	The design of circular economic models and sustainability
4	Evans, Vladimirova, Holgado, Van Fossen, Yang, Silva et al.	*Business Strategy and The Environment*	Business model innovation for sustainability: towards a unified perspective for creation of sustainable business models	2017	305	61	Strategic research on sustainable business models
5	Joyce, & Paquin	*Journal of Cleaner Production*	The triple-layered business model canvas: A tool to design more sustainable business models	2016	344	57.3	Processes and tools for business model innovation to design sustainable business models

Source: Authors elaboration based on the Scopus database, 2023

Figure 4 – Citation analysis of publications cited in sustainable business models research



Source: Authors elaboration based on the VOSviewer software, 2022

The second most cited paper in the field of sustainable business models is by Boons and Lüdeke-Freund (2013), titled 'Business models for sustainable innovation: state-of-the-art and steps towards a research agenda', receiving an average of 100.11 citations per year. This article explores the role of sustainable innovation within business models, viewing them as catalysts for innovation that integrate various aspects of production, consumption, and long-term investor expectations.

Lewandowski's (2016) paper, 'Designing the Business Models for Circular Economy-Towards the Conceptual Framework', with 74.1 citations per year, presents the circular economy as an innovative addition to business frameworks. It addresses the challenges of transitioning from linear to circular business models, offering a conceptual framework to guide this transformation.

Evans et al. (2017) contribute with 'Business Model Innovation for Sustainability: Towards a Unified Perspective for Creation of Sustainable Business Models', averaging 61 citations per year. This paper presents five propositions for establishing sustainable business models, identifying gaps and future research opportunities in the area of business model innovation for long-term sustainability.

Joyce and Paquin (2016) introduce the 'triple-layered business model canvas' in their article, receiving 57.3 citations per year. This tool aids in designing sustainable business models by outlining sustainability challenges and introducing new dimensions for analysis, such as horizontal and vertical coherence.

In addition to these prominent publications, other significant contributions in the field include works by Schaltegger et al. (2012); Witjes and Lozano (2016); Stubbs and Cocklin (2008); Boons et al. (2013); and Bocken et al. (2013), which have garnered substantial attention from both firms and researchers.

3.4 Co-citation analysis

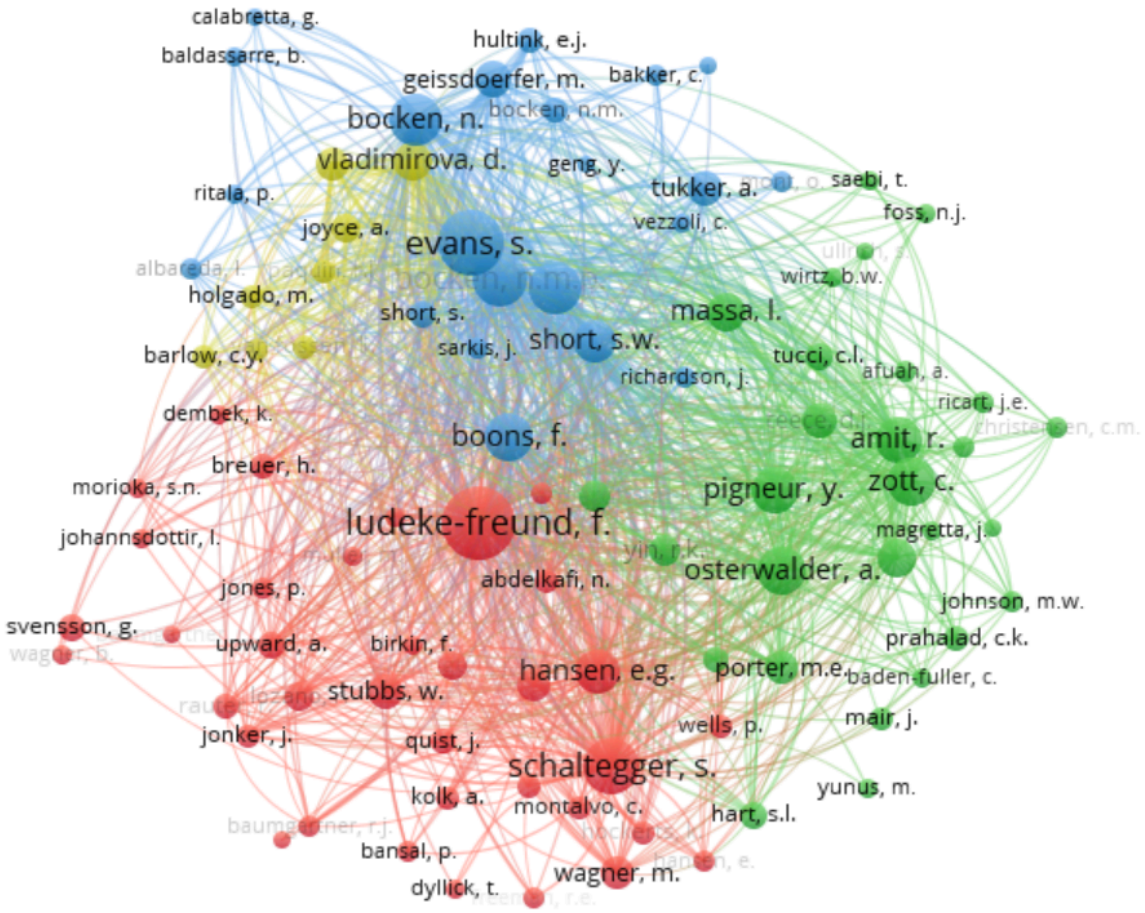
As discussed in the Section 2, co-citations are seen when two different publications are cited together by another publication, both publications appear to be in the cited references list of the publication. Co-citation analysis can identify and group articles that are not directly related to the sustainable business model theme because it finds matches in published citations of a sample of sustainable business model concepts. Co-citation analysis uses a retrospective approach and is extensively used to determine foundational work in specific fields of study. The degree of relevance of co-citation articles is calculated by applying the association strength of co-citations (Yaghtin et al., 2022).

Analysing the major studies and clusters, this study makes use of a co-citation analysis of 36,795 valid references, starting with a sample of 965 documents cited by the sustainable business model papers.

Because the number of references connected to the sustainable business model idea is very large, a final sample of 105 relevant references was selected to improve the quality of the publications, the authors set the threshold to make sure publications with at least 7 citations are included. In the literature, the choice of the threshold for references to be considered in co-citation analysis is discretionary and depends on several factors, such as the number of papers included in the analysis, the graphical visualization in VOSviewer, and the number of clusters obtained (see different thresholds: Belussi et al., 2019; Janssens et al., 2020; Tan, 2022). Therefore, given the extensive number of references associated with the SBM concept, we established a threshold of 7 citations to enhance the network's interpretability. This threshold reflects a judicious criterion for citation numbers, considering the topic's

maturity. It also strikes a balance between the diminished informational value resulting from an excessively high threshold and the rapid loss of potential relevance in cluster analysis observed with thresholds lower than 7.

Figure 5 – Co-citation of authors cited in sustainable business models research



Source: Authors elaboration based on the VOSviewer software, 2023

The potential of the authors can be known by the co-citation analysis. The study looked at the scholars who have got the most citations in the field of sustainable business models. In the co-citation analysis, there are 59 researchers with a minimum of 70 citations. A node in the mapping represents each author (Figure 5). The number of citations is proportional to the diameter of the node. Based on the output of Lüdeke-Freund (2020) this may be seen. The diameter of the node assigned to this author is

the biggest one, who is one of the most quoted authors in the field of sustainable business models research – together with Boons (2013). Both of the authors together published 'Business models for sustainable innovation: state-of-the-art and steps towards a research agenda' which is a major publication in the field of research with 940 citations. As a consequence of this, the papers of Lüdeke-Freund and Boons are among the most often mentioned works in the research field of sustainable business models (Figure 5). From the further analysis of the mapping, the most powerful participants in the sustainable business model study are: Lüdeke-Freund, Bocken, Schaltegger, Boons and Evans. They are designated as cluster leaders in the mapping analysis, which suggests that they draw other authors' attention to their study and, as a result, their articles are often referenced.

3.5 Bibliographic coupling analysis

Bibliographic coupling is a measure of the similarity between two documents, determined by the number of references they share (Ruggeri et al., 2018). Unlike co-citation, where two documents are linked through being cited by a third, bibliographic coupling links documents through their shared references to a third document. In bibliographic coupling, publications are associated because they cite the same documents. In addition, the bibliographic coupling uses a forward approach, since it looks at evolving trends in the literature and themes picked by authors who share the same bibliography (Belussi et al., 2019). Indeed, several authors suggest that bibliographic coupling is more appropriate for studying new fields and current research topics, improving the accuracy of results (Boyack & Klavans, 2010; Vogel & Güttel, 2013; Donthu et al., 2021). In summary, co-citation looks back at how documents are connected over time, while bibliographic coupling looks forward by linking documents through common citations. Moreover, using this method we do not examine the articles mentioned but investigate the growing sub-fields of the literature. This research employs a document bibliographic analysis of 692 documents that have been referenced by the sustainable business model publications included in this sample to analyse the major publications and the grouping of articles into distinct clusters.

Due to the large number of documents connected to the sustainable business models, the author established limits to include only articles with at least 20 citations to enhance the network's interpretability and concentrate on significant publications, resulting in a sample of 368 credible publications. As discussed in the co-citation analysis paragraph, in this case 20 citations reflect the optimal compromise between information loss owing to a too high threshold. The bibliographic coupling analysis of documents yielded 15 clusters. However, we only analyse the first 6 of them in size order based since the other 9 were relatively insignificant and remote (Table 5).

Table 5 – Bibliographic coupling analysis of documents classified in clusters

Documents in cluster and association strenght (in parentheses)	Label	Description	Cluster #	Size	Year
Geissdoerfer, M., 2020, (687); Ritala, P., 2018, (616); Hofmann, F., 2019, (485); Yang, M., 2017, (463); Bocken, N., 2019, (463); Stål, H.I., 2018, (451); França, C.L., 2017, (434); Bocken, N.M.P., 2018, (424); Yip, A.W.H., 2018, (398); Wells, P., 2016, (394); Mendoza, J.M.F., 2019, (348); Lewandowski, M., 2016, (340); Witjes, S., 2016, (335); Laukkanen, M., 2014, (289); Baldassarre, B., 2019, (253); Weissbrod, I., 2017, (250); Lahti, T., 2018, (247); Hannon, M.J., 2015, (220); Heyes, G., 2018, (198); Stål, H.I., 2017, (189); Sousa-Zomer, T.T., 2018, (177); Leipold, S., 2018, (141); Khan, M.A., 2018, (110); Ingemarsdotter, E., 2019, (88); Khmara, Y., 2018, (77); Zhang, W., 2018, (67); Scheepens, A.E., 2016, (61); Fonseca, L.M., 2018, (60); Chiappetta Jabbour, C.J., 2020, (56); Murray, A., 2017, (24); Catulli, M., 2012, (21); Bellos, I., 2017, (8); Mendoza, J.M.F., 2019, (2)	Circular Economy	Cluster 1 entails the circular economy and its potential in sustainable business models	1	33	2017
Morioka, S.N., 2017, (596); Pal, R., 2018, (547); Geissdoerfer, M., 2018, (537); Schaltegger, S., 2012, (491); Kozlowski, A., 2018, (323); Caldera, H.T.S., 2017, (207); Matos, S., (2013) 147; Boons, F., 2013, (144); Goyal, S., 2016, (114); Høgevold, N.M., 2014, (105); Svensson, G., 2015, (97); Schneider, A., 2015, (93); Stubbs, W., 2008, (90); Wasiluk, K.L., 2013, (84); Svensson, G., 2016, (70); Busse, C., 2017, (65); Goyal, S., 2017, (63); Barber, K.D., 2012, (52); Eriksson, D., 2015, (48); Birkin, F., 2009, (19); Høgevold, N.M., 2011, (14); Svensson, G., 2011, (13); Ho, H.P.Y., 2012, (8); Todeschini, B.V., 2017, (7); Jung, S., 2016, (6); Birkin, F., 2009, (6); Papies, D., 2008, (5); Steyn, M., 2014, (5); Tseng, M.L., 2013, (4); Atkins, J., 2015, (3); Dwivedi, Y.K., 2009, (1)	Sustainable supply chains	Cluster 2 entails that the concept of innovation evolved massively in this collection of papers proving a unique value proposition could pave way for successful business. Cluster 2 majorly deals with the value creation in business models and sustainable supply chains activity	2	31	2014
Geissdoerfer, M., 2018, (103); Geissdoerfer, M., 2016, (104); Biloslavo, R., 2018, (96); Lüdeke-Freund, F., 2020, (104); Lüdeke-Freund, F., 2018, (101); Boons, F., 2013, (96); Oskam, I., 2018, (102); Roome, N., 2016, (106); Bocken, N.M.P., 2014, (108); Evans, S., 2017, (105); Bidmon, C.M., 2018, (89); Yoyce, A., 2016, (98); Brehmer, M., 2018, (104); Rauter, R., 2017, (98); Barth, H., 2017, (95); Franceschelli, M.V., 2018, (101); Neumeyer, X., 2018, (98); Bocken, N., 2013, (92); Palomares-Aguirre, I., 2018, (97); Eppler, M.J., 2011, (73); Dentchev, N., 2016, (76); Yun, J.J., 2020, (74); Wells, P., 2013, (63); Peters, C., 2015, (65); Chandel, A.K., 2019, (50)	Innovations in the sustainable business models	Cluster 3 The articles in this cluster promote research on sustainable innovation via the use of a business model approach	3	25	2017
Schaltegger, S., 2016, (611); Täuscher, K., 2018, (552); Davies, I.A., 2019, (405); Upward, A., 2016, (401); Kurucz, E.C., 2017, (399); Jabłónski, A., 2016, (398); Davies, I.A., 2018, (383); Stubbs, W., 2017, (287); Esposito, M., 2012, (227); Alkire, L., 2020, (191); Bocken, N.M.P., 2015, (166); De Lange, D.E., 2017, (141); Stubbs, W., 2017 , (67); Becker, A., 2015, (25); Cantino, V., 2017, (12); Shrimali, G., 2011, (2); Budzianowski, W.M., 2017, (1)	Entrepreneurship and Corporate Social Responsibility	Cluster 4 Businesses are increasingly implementing sustainability measures in order to promote environmental and social responsibility while protecting and expanding profits	4	17	2016
Bocken, N.M.P., 2020, (610); Curtis, S.K., 2020, (457); Ciulli, F., 2019, (385); Short, S.W., 2014, (380); Piscicelli, L., 2018, (361); Gauthier, C., 2016, (345); Laukkanen, M., 2020, (220); Heiskala, M., 2016, (47); Wan, X., 2017, (13); Zamani, E.D., 2018, (3)	Sharing economy	Cluster 5 contributes the potential for long-term value generation of several forms of sharing economy company models	5	10	2018
Reinhardt, R., 2019, (693); Dembek, K., 2018, (544); Lüdeke-Freund, F., 2017, (541); Nosratabadi, S., 2019, (476); Matinaro, V., 2019, (469); Dentchev, N., 2018, (454); Di Vaio, A., 2020, (406); García-Muiña, F.E., 2020, (220); Ribeiro, I., 2018, (139); Di Vaio, A., 2020, (36)	Role of technologies and AI	Cluster 6 represents the connections between AI, fast advances in machine learning, and long-term development	6	10	2019

Note: We reported only the first author's name of each article, the year of documents and the association strengths in brackets due to spatial constraints. For the same reasons these authors have been not included in the references. For further information on this, you could get in touch with the corresponding author of this study.

Source: Authors elaboration, 2023

Coupling Cluster 1: The circular economy and its potential in the sustainable business models

In cluster 1 there are a total of 33 papers for which the average publication year is 2018 and consists of the most important papers on the research of sustainable business models. Publications having a shared bibliography (with the highest coupling link strength) are the ones written by Geissdoerfer et al. (2020); Ritala et al. (2018); Hofmann (2019); Yang et al. (2017); Bocken et al. (2019). The cluster majorly deals with 'the circular economy and its potential in the sustainable business models'. While the circular economy emphasizes process reform and material recycling, it may lead to more sustainable company models. According to Witjes and Lozano (2016) one of the most recent theories for tackling both environmental and socio-economic challenges is the circular economy. A circular economy strives to convert waste into resources while also bridging the gap between production and consumption. An interesting study by Fonseca (2018) looks at how the Internet of Things (IoT) might help with the transition to a circular economy (CE) by supporting circular business models and design methodologies. Some of the other versatile contributions in this cluster are: Weissbrod and Bocken (2017); França et al. (2017); Wells (2016); Scheepens et al. (2016); Lewandowski (2016).

Coupling Cluster 2: Value creation in business models and sustainable supply chains

Cluster 2 contains 30 articles and consists of evolutionary papers on the research of sustainable business models. Publications with the highest coupling link strength in the cluster are Morioka et al. (2017) and Geissdoerfer et al. (2018). The cluster majorly deals with the 'value creation in business models and sustainable supply chains'. An article by Stubbs and Cocklin (2008) aims to create a SBM, which is a model in which sustainability principles influence the firm's driving force and decision-making. Some of the papers also discusses the product-service system, especially in the fashion industry (Pal & Gander, 2018; Kozlowski et al., 2018; Todeschini et al., 2017). The apparel industry is a resource-intensive sector with several chances to decrease environmental consequences and develop new business models. Todeschini et al. (2017) looks at innovative business models in the fashion sector that include sustainability as a distinguishing feature, particularly in terms of the value proposition. The creation of sustainability-driven business models may be promoted in support of sustainable production and consumption by looking beyond the supply chain to include consumer behaviour. Some of the other versatile contributions in this cluster are: Schaltegger and Csutora (2012); Høgevold et al. (2014).

Coupling Cluster 3: Innovations in sustainable business models

Cluster 3 consists of 24 articles and consists of literature of some of the prominent authors who have contributed massively to the evolution of research related to sustainable business models. Publications with the highest coupling link strength in the cluster are: Geissdoerfer et al. (2018); Biloslavo et al.

(2018); Lüdeke-Freund (2020); Boons and Lüdeke-Freund (2013). The cluster majorly deals with the 'innovations in sustainable business models'. The article of Lüdeke-Freund (2020) introduces the 'Business models for sustainability innovation (BMfSI) framework', which is used to explore how business models significantly affect sustainability innovations and commercial reasons for sustainability. The articles in this cluster promote research on sustainable innovation via the use of a business model approach. By integrating sustainability more deeply into the core of their operations, businesses may achieve a balance of social, environmental, and economic value. Research on sustainable innovation has tended to underestimate the importance of companies combining a value proposition, the structure of the upstream and downstream value chain, and a financial model in order to bring sustainable ideas to market. Sustainable innovation highlights existing gaps and future research alternatives to address the challenges of business model innovation in the long run. Some of the other versatile contributions in this cluster are Joyce and Paquin (2016); Evans et al. (2017).

Coupling Cluster 4: Entrepreneurship and corporate social responsibility

Cluster 4 consists of 16 articles dealing with the research of sustainable business models. Articles with the highest coupling strength in the cluster are Schaltegger et al. (2016); Täuscher and Laudien (2018); Davies and Doherty (2019); Upward and Jones (2016); Kurucz et al. (2017). The cluster majorly deals with 'entrepreneurship and corporate social responsibility'. Businesses are increasingly using sustainability measures in order to promote environmental and social responsibility while preserving and growing profitability. Some of the other versatile contributions in this cluster are: Stubbs (2017); Esposito et al. (2012); De Lange (2017).

Coupling Cluster 5: Sharing economy

This cluster contains 10 articles dealing with the research of sustainable business models. Articles with the highest coupling strength in the cluster are: Bocken and Geradts (2020); Curtis and Mont (2020); Ciulli and Kolk (2019). The cluster mainly deals with the 'sharing economy'. Piscicelli et al. (2018) investigates a new and creative kind of sustainable business model built on peer-to-peer (P2P) asset sharing made possible by digital platforms. Laukkanen and Tura (2020) research investigates the potential for long-term value generation of several forms of sharing economy company models. The study presents a conceptual framework to aid in the analysis of business models' potential for long-term value development. One of the current trending topics of blockchain and Web 3.0 were discussed in Zamani and Giaglis (2018), topic which advocates the significance of blockchain, or distributed ledger technology, in the development of novel business models such as machine money, autonomous economic agents, and decentralized organizations.

Coupling Cluster 6: The role of technologies and artificial intelligence (AI)

Cluster 6 contains 10 publications dealing with the research of sustainable business models. Publications with the highest coupling strength in the cluster are Reinhardt et al. (2019) and Dembek et al. (2018). The cluster mainly deals with 'The role of technologies and artificial intelligence' in sustainable business models. Di Vaio et al. (2021) research examines the connections between AI, fast advances in machine learning, and long-term development. Recently AI has had potential growth in the business sectors proving it as a valuable asset for the future.

4 Discussion: managerial and theoretical implications

The growing body of research on SBMs provides insightful managerial implications and guides policy formulation focused on sustainability. The marked increase in scholarly publications, particularly in recent years, underscores the rising significance of SBMs in both academic and business fields. The predominant contributions from regions like Europe, the USA, and emerging economies such as China and India highlight the global relevance of SBMs.

Influential journals such as the *Journal of Cleaner Production* and *Sustainability (Switzerland)* have been at the forefront of SBM research, disseminating key findings and fostering academic debates in this area. Several publications have explored different aspects of sustainable business practices, from creating sustainable business model archetypes to advancing sustainable innovation.

The research trends identified in SBMs encompass several crucial areas: the integration of circular economy principles into business models, innovative approaches in sustainable supply chains, the intersection of entrepreneurship with corporate social responsibility, and the role of new technologies and artificial intelligence in enhancing environmental management. These trends not only inform current business practices but also offer a roadmap for future research and development in sustainable business strategies.

From a managerial perspective, these insights suggest a strategic shift towards incorporating SBMs as a core part of business operations. This transition involves a focus on value generation through sustainable practices, a thorough assessment of SBM designs across different industries, and the exploration of innovative products and processes that emerge from eco-friendly products. Additionally, the effective implementation of SBMs can significantly enhance the efficiency of the circular economy, contributing to overall sustainability goals.

Achieving the United Nations' Agenda 2030 requires a collective effort, not only from policymakers but also from businesses at the firm level. Instead of merely adding social and environmental goals to a

financially successful business model as a form of corporate social responsibility, it is more effective to design business models that are economically sustainable and aligned with the Sustainable Development Goals (SDGs) for creating shared value. This approach can lead to revenue benefits through product differentiation, enhanced brand image, effective customer communication, and increased value and productivity. Indeed, for policymakers, these findings provide a framework for developing regulation and policies that support and encourage the adoption of sustainable business practices based on the three pillars of sustainability: environmental, social, and economic. This could involve incentivizing businesses to adopt circular economy principles, where resource use is minimized, and waste is repurposed effectively. Additionally, policies could support the integration of renewable energy sources and energy-efficient practices into business operations, aligning with climate change mitigation and adaptation efforts.

The rapid growth of SBMs encountered a significant challenge with the onset of the COVID-19 crisis in early 2020, dramatically altering the landscape (Li et al., 2022). Certain SBMs, especially those emphasizing frugality or rooted in the amateur economy during lockdown periods, gained momentum and possibly positive environmental and social outcomes in the immediate term (Csutora et al., 2022). Conversely, others, such as those associated with the sharing economy in mobility (Faiyetole, 2022), faced substantial setbacks. The long-term effects of the COVID-19 crisis on sustainability practices and the viability of SBMs remain uncertain. An additional area of inquiry is the durability of any sustainability gains achieved during the crisis; specifically, the extent to which these benefits will persist or diminish once restrictions fully lift and whether SBMs will retain their appeal. One outcome of this shock was the enhancement of firms' digital capabilities and their ability to adapt by implementing resilience strategies during the COVID-19 pandemic (Khlystova et al., 2022). Furthermore, shifts in business models towards 'digitalization' and 'diversification' were observed in response to the pandemic (Kilu et al., 2023), providing alternative ways to offer products and services (see case studies proposed by Silva et al., 2023 and Xue et al., 2022). Therefore, COVID-19 pandemic has fundamentally altered how businesses operate, offering a unique window for policymakers to embed sustainability into the core of business recovery strategies. This could involve providing financial and regulatory support for businesses transitioning to more sustainable models in the post-pandemic landscape. Policies may also focus on bolstering supply chain resilience, encouraging local sourcing and sustainable procurement practices to mitigate future disruptions. The National Recovery and Resilience Plan (PNRR) is not merely a multilevel governance system for financing investments and reforms but a catalyst for fostering cohesion and innovation between the public and private sectors. Among its objectives is the regeneration of the production system through the adoption of advanced organizational models, technology, and work practices (e.g. *nearworking*) (Butera, 2022). This also includes the reconfiguration of cities and the reform and reorganization of the public sector: education, healthcare,

justice, and public administrations at large. By emphasizing comprehensive modernization and efficiency, the PNRR aims to not only support Italy's economic landscape but also to ensure that the country is better equipped to face future challenges, thereby promoting sustainable growth and societal well-being.

Although the paper primarily focuses on the production side, in general, it is important to note the increasing role that 'green brand' plays in consumer recognition and decision-making (Lopes et al., 2024). Green marketing, also known as sustainable, organic, or environmental marketing, focuses on promoting products, services, or lifestyles that are environmentally friendly. It targets consumers' readiness to spend more on products that are safe for the environment, emphasizing the sale of products that are either environmentally safe or perceived to be so. This approach to marketing concentrates on the explicit or implicit willingness of consumers to pay a premium for eco-friendly products.

Adopting environmentally friendly practices, or 'being green', helps businesses stand out and gain a competitive advantage (Arseculeratne & Yazdanifard, 2014). Consumers frequently purchase products not necessarily for their utility or actual need, but because they are associated with companies that implement circular and sustainable business models. The willingness of consumers to pay more for green products reflects the perceived additional value in these products.

Furthermore, there is an opportunity to leverage digital transformation, accelerated by the pandemic, in advancing sustainability goals. Policies that encourage digital innovation in sustainability – such as using AI for energy management or blockchain for transparent supply chains – can be crucial (Dal Mas et al., 2023). Consequently, the advanced technologies implementation has given rise to disruptions in all sectors, business models and management practices (Bagnoli et al., 2018; Bagnoli et al., 2019; Toniolo et al., 2019; Urbinati et al., 2019). In addition, AI has transformed business operations (Schneider & Leyer, 2019), reshaping trade and management across various industries. This shift has led to the development of products and services that are both more competitive and sustainable (Wirtz & Müller, 2019; Govindan et al., 2020; Sipola et al., 2023).

These initiatives must be adaptive and responsive, recognizing the diverse needs of different industries and regions. Collaborative efforts between governments, businesses, and other stakeholders are fundamental for developing and implementing effective policies. This includes engaging in dialogues to understand industry-specific challenges and opportunities in transitioning to sustainable practices, as well as monitoring and evaluating the impact of these policies to ensure they are effectively driving the desired change towards sustainability.

Considering the evolving landscape of sustainable and circular business models, this paper highlights also several theoretical implications. These might include the development of frameworks that guide firms in leveraging green technologies for innovation, models for assessing the impact of

green innovation on sustainability metrics, and strategies for overcoming barriers to the adoption of green technologies.

A significant theoretical implication emerges from the analysis of the interplay between technological advancements and SBM efficacy. The new fields of artificial intelligence and digital technologies offer a fertile ground for research into their potential to enhance the scalability and impact of SBMs, particularly in fostering circular economy practices. This intersection presents a rich domain for academic inquiry, challenging scholars to shed a light on the mechanisms through which technology can serve as a lever for sustainable transformation within business operations.

Moreover, this paper emphasises the need for empirical research that probes into the dynamics of stakeholder engagement and value creation within SBMs. It suggests a scholarly pursuit to unravel how stakeholder inclusivity and collaborative partnerships influence the design and implementation of SBMs, aiming to bridge the theoretical gap in understanding the relational complexities that underpin sustainable value co-creation.

5 Conclusions

The study on SBMs has successfully addressed the purpose of the work through descriptive and bibliometric analysis, uncovering key insights in the field. The surge in scholarly publications, particularly in the past 8 to 10 years, highlights a growing global interest in SBMs, predominantly in Europe, the USA, and developing countries like China and India.

Prominent journals like the *Journal of Cleaner Production*, *Sustainability* (Switzerland), *Business Strategy and the Environment*, and *Organization and Environment* have played a significant role in this field. Influential authors including Bocken, Boons, and Lüdeke-Freund, and most cited articles like those by Bocken et al. (2014) and Boons and Lüdeke-Freund (2013) have shaped the discourse around sustainable business models. The research identified major trends in SBMs, such as the integration of the circular economy, value creation in business models and sustainable supply chains, innovations, entrepreneurship, corporate social responsibility, the sharing economy, and the role of technology and AI in environmental management (see Dal Mas et al., 2023; Wamba-Taguimdje et al., 2020). These trends align with strategic clusters like sustainable development, sustainable entrepreneurship, and innovation.

While the study provides comprehensive insights, it acknowledges limitations such as its focus on English language publications in specific database categories. These findings offer a substantive

contribution to the understanding of SBMs, setting a foundation for future research and practical application in the business and academic communities.

As future directions, one of the forthcoming steps for the authors will be to update their analysis in a future work to collect and evaluate various publications on the topic. This will help to understand whether there has been a bibliometric difference or a sense of continuity in trends before and after the pandemic, taking into account all related consequences such as lockdowns. Additionally, a meta-regression analysis could serve as a significant endpoint to statistically quantify the information from these papers. This approach will not only deepen the understanding of SBMs in the context of global challenges but also offer a robust methodological framework for assessing their evolution and impact in the post-pandemic era.

In conclusion, the study of SBMs offers a comprehensive overview of the current state of sustainable practices in business, highlighting key areas for development and offering strategic directions for both business leaders and policymakers. The integration of these models into mainstream business practices not only addresses immediate sustainability concerns but also sets the stage for long-term economic and environmental resilience.

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