PROBLEMY EKOROZWOJU/ PROBLEMS OF SUSTAINABLE DEVELOPMENT
SUBMITTED: 28.03.2024, ACCEPTED: 27.04.2024, PUBLISHED ON-LINE: 1.07.2024
2024, 19(2): 153-165
DOI: https://doi.org/10.35784/preko.6049

The Contribution of the Business, Management and Accounting Literature to the UN Sustainable Development Goals

Wkład literatury biznesowej, zarządczej i księgowej w realizację Celów zrównoważonego rozwoju ONZ

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Abstract

Businesses and academia as two stakeholders of the sustainable development goals are important to under-stand the recent status quo of research. This paper examines 851 papers in the field of business dealing with the sustainable development goals. For bibliometric analysis, concept-based search, manual coding and biblio-metrix was used. The results showed that the research in the marketing area is lagging behind. Accounting and finance, management and organization and production management have almost the same ratio. Most re-search have been done in line with the 9th, 12th and 8th goal. The fewest research has been done in line with the 3rd,4th, 10th, 14th,15th and 17th goal.

Key words: bibliometric analysis, Sustainable development goals, business literature

Streszczenie

Aby odnieść się do najnowszych badań w zakresie zrównoważonego rozwoju, niezbędne jest uwzględnienie przedsiębiorstw i środowisk akademickich, jako dwóch stron zainteresowanych celami zrównoważonego rozwoju. W artykule poddano analizie 851 publikacji z zakresu biznesu zajmujących się celami zrównoważone-go rozwoju. W analizie bibliometrycznej wykorzystano wyszukiwania oparte na pojęciach, kodowanie ręczne i bibliometrix. Wyniki pokazały, że badania w obszarze marketingu pozostają w tyle za innymi dziedzinami. Rachunkowość i finanse, zarządzanie i organizacja oraz zarządzanie produkcją pozostają mniej więcej na takim samym poziomie. Większość analizowanych badań przeprowadzono odnośnie celu 9., 12. i 8. Najmniej badań przeprowadzono w nawiązaniu do celów 3., 4., 10., 14., 15. i 17.

Słowa kluczowe: analiza bibliometryczna, Cele zrównoważonego rozwoju, literatura biznesowa

1. Introduction

In 2022, the world hit the overshoot day on the 1st of August (Earth Overshoot Day, n.d.). That means that the world used all the resources that can regenerate itself in one year on that day. Everyone has their contributions to this date and all stakeholders should do their part to not overuse the resources and meet with the Agenda 2030. The Agenda 2030 and the Sustainable Development Goals of the UN were announced in 2015, before this the Millenium goals were the ones to be achieved but with no success.
The Millenium goals addressed in first line governments, but the SDGs are addressed to all stakeholders, like governments, policy makers, private sector, academicians e.g. (Drastichová, 2022; Williams and Blasberg, 2022).

So, the contribution of the business literature as a mix of both stakeholders; private sector and academicians, is important to investigate the status quo of SDG research. With their research scholars can provide both theoretical and practical determinations by literature research and case studies. In line with case studies, they can reveal the contribution of the firms to the Goals (Calabrese, Costa, Ghiron, Tiburzi, and Pedersen, 2021). Due to Mio et al. (2020) research is still leaking to understand how businesses contribute to achieving the SDGs. Therefore, this study examines the business literature in line with the SDGs, especially with clustering into the subfields of business research.
This paper is structured as follows. The first section is a literature review, where the research questions were developed. Then the methodology section follows, where it is explained how the data was gathered and which methods were used. Descriptive and further analysis were shown under the fourth section named findings. And at last, the findings were discussed, the limitations of this study were shown in the discussion and conclusion section.

2. Literature Review

Sustainability is a research area that is gaining increasing attention. For over 50 years, more than 200.000 papers have been published in different subject areas. Much research has also been done in the business, management and accounting literature. Many articles in this area connected with bibliometric analysis are mainly related to the tourism industry (dos Santos, Méxas, and Meiriño, 2017; Molina-Collado, Santos-Vijande, Gómez-Rico, and Madera, 2022; Santos-Rojo, Llopis-Amorós, and García-García, 2023; Séraphin and Chaney, 2023; Singhania, Singh, and Aggrawal, 2023) and supply chain management (Ayan, Güner, and Son-Turan, 2022; Chen et al., 2017; Muñoz-Villamizar, Solano, Quintero-Araujo, and Santos, 2019; Soledispa-Cañarte et al., 2023). There are other biblometric analysis related to sustainable issues like the perspective of investment (Kapil and Rawal, 2023) or the role of corporate sustainability (Lespinasse-Camargo et al., 2023).
Some papers have addressed the relationship between the sustainable development goals and business literature. Pizzi, Caputo, Corvino, and Venturelli (2020) analyzed 266 articles to understand the connection between SDGs and business entities. As a result, they classified the research in the business area into four groups: technological innovation, contributions of companies in developing countries, non-financial reporting, and SDG education. The article also clusters the analyzed papers into six sub-topics related to SDGs; jurisdiction, organizational focus, geographical location, focus on SDG literature, research methods, and frameworks and models. This article gives no information about which subfield has done the most research in line with de SDGs or which SDG is the most entreated in the business literature.
Asatani, Takeda, Yamano, and Sakata (2020) analyzed 312,584 papers in the context of sustainability and clustered them into the 17 SDGs and general academic clusters. This cluster does not correspond with academic fields exactly but is related to them, e.g. some articles in the area of the clusters corporate, CSR, and entrepreneurship could be a part of the business research. Agrawal, Majumdar, Majumdar, Raut, and Narkhede (2022) analyzed 144 articles in the context of the SDGs, supply chain practices, and business strategies. Besides answering the research questions like the research trends, emerging themes, and future research propositions in this field, they clustered all the analyzed articles into the 17 SDGs. The findings show the readers and future researchers which fields of the SDGs are lacking behind in the supply chain research area. Nevertheless, these papers have either a too general scope or are limited to the research area of supply chain and give no information about the business literature trends is still a deficiency.
Novais, João, and Serralvo (2012) did a bibliometric analysis in the business and management research area within the sustainability topic. They analyzed 3,009 articles by topic lists as keywords, main institutions, language, and leading journals. At that moment, the SDGs were not published yet, so there is no information about the SDGs in the article. However, the article also fails the information about the subfields of business research either.
The most recent research in this area was conducted by Vinayavekhin, Li, Banerjee, and Caputo (2023). They have analyzed papers in the field of sustainability within the business and management literature. They answered the questions of main research streams, the sustainability research interdisciplinarity, and the link to the SDGs. Yet there is no clustering within the main subfields of business: accounting and finance, management and organization, marketing and production management. Therefore, we have developed the following research questions:

RQ1: *How have the sustainable development goals studies developed within the business literature?*
RQ2: *Which journal is leading in publishing sustainable development goals studies?*
RQ3: *On which sustainable development goal has the business literature focused?*
RQ4: *Which field of business is more dominant in line with the sustainable development goals in the literature?*
RQ5: *Which researchers and affiliations contribute the most to the literature?*

3. Methodology

The data used for this study was obtained from the Scopus database on 14th April 2023. To get the necessary data, a search query was set up. The search query was generated so that sustainable development goals should appear in the English-written article's title, abstract, or keywords, published by the end of 2022 in a journal in the business subject area. The search query is as follows:
TITLE-ABS-KEY (*sustainable development goal*) AND (LIMIT-TO (SRCTYPE, *j*)) AND (LIMIT-TO (PUBSTAGE, *final*)) AND (LIMIT-TO (DOCTYPE, *ar*)) AND (LIMIT-TO (SUBJAREA, *BUSI*)) AND (EXCLUDE (PUBYEAR, 2023)) AND (LIMIT-TO (LANGUAGE, *English*))
As a result of this query, 1797 articles were obtained. In 8 articles, the abstract was missing. Therefore, these articles were excluded, and 1789 articles remained for the analysis. Then we categorized every article within the 17 sustainable development goals. Therefore, we used a list of phrases created based on the targets of every goal. We associated every article with at least one SDG. After this, we found that 564 articles are not directly related to at least one of these goals. Hence, we took these out.
After that, we categorized every article within the subfields of business, like accounting andfinance, management and organization, production management, and management. Therefore, we created a list of words that may apply under these subfields. After concept-based search, whether these phrases appeared in the title, abstract or key-words, there were some articles with no match. So, we looked up the articles that do not contain any of these phrases manually and categorized them if possible. The ones that were too general for categorizing within the subfields were extracted. After these steps we obtained 851 articles. The steps of the data gathering process were shown in Figure 1.

1. Preliminary Search

Searching on SCOPUS for *sustainable development goal* with the result of 1797 articles

2. First Round Elimination

Excluding articles with missing data, 1789 articles remaining

3. Creating SDG Concept List

Creating a concept list based on the UN's 17 sustainable development goals and targets

4. Second Round Elimination

Just the articles related to at least one SDG according to the concept list were retained, the others were eliminated because they were considered as to general
1225 articles remaining

5. Creating Business Subfield Concept List

Creating a concept list to relate the articles with the subfields of business, e.g. management &organization, accounting& finance etc.

6. Third Round Elimination

Just the articles related to at least one business subfield according to the concept list were retained
The others were read and coded manually to categorize them to a subfield or to decide wheter to general and eliminate
851 articles remaining

Figure 1. Data collection procedure

After cleaning the data, clustering by SDGs and subfields with the help of Excel and manual coding, we used bibliometrix to make further analysis with R. Bibliometrix is a tool created by Aria and Cuccurullo (2017) for R to science mapping analysis. With the help of this tool many analysis in different levels can be conducted. First in 4 different levels of analysis can be conducted in source, author, document and clustering levels. Then further analysis can be made in 3 structures of knowledge conceptual structure, intellectual structure, and social structure. This tool is therefore useful and provides much information for the users.

4. Findings

Before a detailed bibliometric analysis, some descriptive data will be presented. The analyzed 851 articles were published between 2011 and 2022; a cluster over the years is shown in Figure 2.

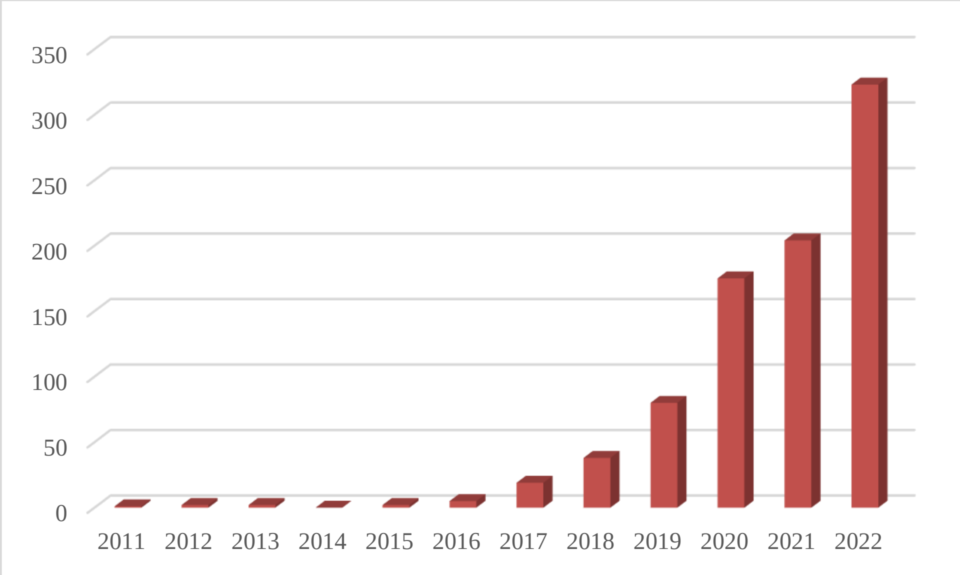

Figure 2. Annual number of publications

The number of articles published started to increase after the sustainable development goals were launched in 2015, which can be considered the start of the main research period. Also, it is worth mentioning that there is no fluctuation but a constantly increasing trend. Besides, in the business literature, the sustainable development goals have entered a significant growth stage after 2019. Though there has been significant growth after 2019, all other findings could be investigated in three parts, first the period until the launch (2011-2015), second the first years after the launch (2016-2019), and third, the years with the increased research time spectrum (2020-2022).
In line with the research questions, seeing a general distribution of the articles within the sustainable development goals will be informative. Therefore Figure 3 was created. Significantly, most of the papers published within the business literature were dealing with the 9th goal (Industry, innovation, and infrastructure) and the least papers were dealing with the 3rd goal, good health, and well-being.

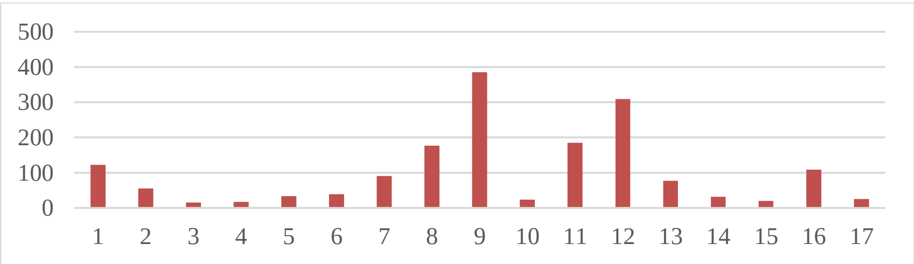

Figure 3. Number of articles dealing with each SDG

To answer the research questions, we have to make further analysis. The first research question was:

RQ1: *How have the sustainable development goals studies developed within the business literature?*

Figure 4 shows us the clustering of the articles in subfields of business research by years. It is seen that in 2014 there weren't published any papers. Also, it is seen that the research in the field of accounting and finance was leading except for 2019 and 2022. In these years research in management and organization and production management gained the upper hand, respectively. If the two articles published in 2011 and 2012 were overlooked, it can be stated that the research started slowly in 2018 in the marketing field.

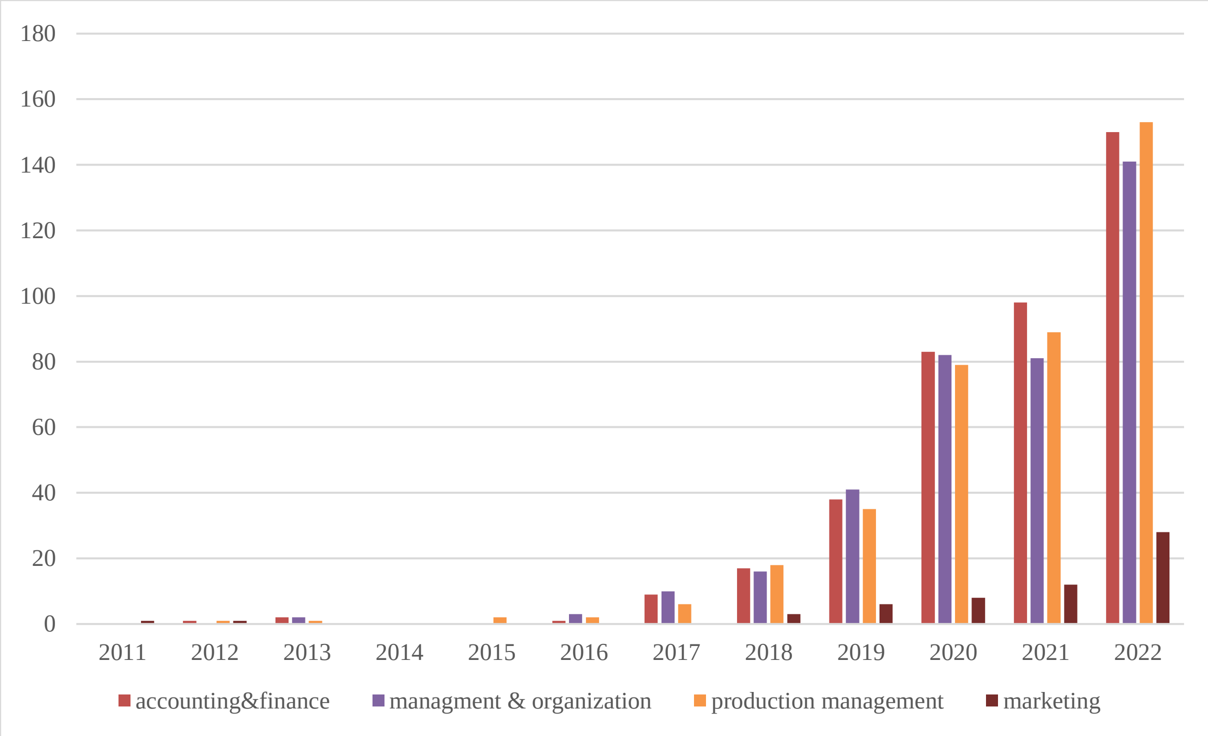

Figure 4. Clustering the articles by subfield by years

Afterwards we have to have a deeper look into the subfields and their trend shifting. Figure 5 shows the trend topics in the field of accounting and finance over a time period. The research was shifting into greenhouse gas emissions, environmental economics, planning and economic analysis after 2020. Themes like sustainability reporting and corporate social responsibility research have lost their popularity after 2021.

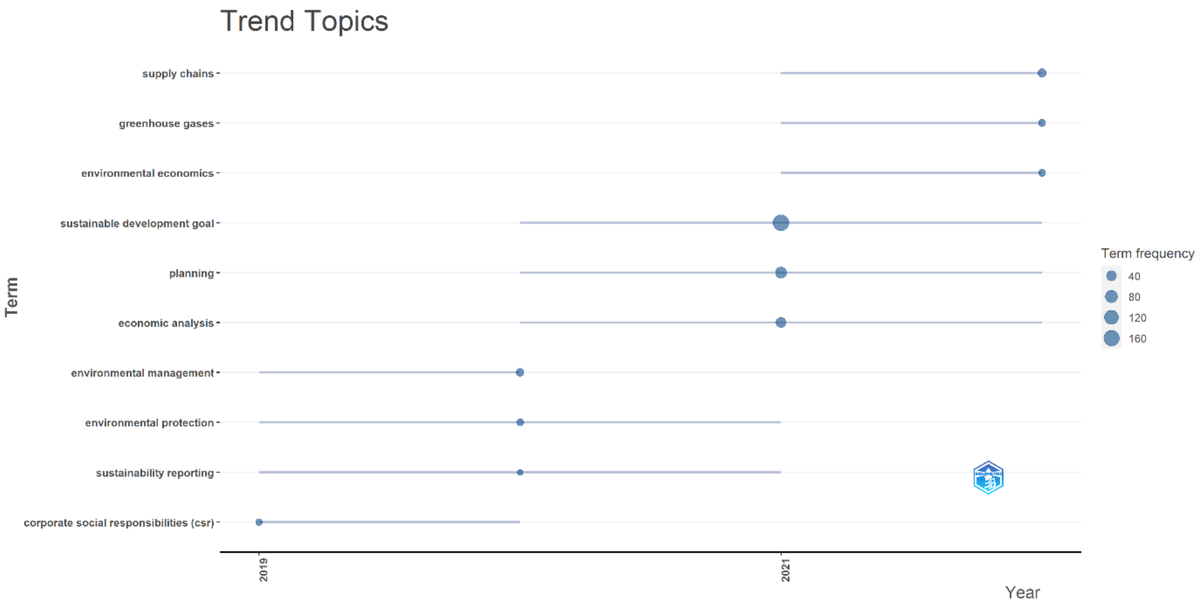

Figure 5. Trend Topics in Accounting and Finance Literature

Figure 6 shows the trends for management and organization literature. Ecoturism and digital storage are very new trends in this field, circular economy, environmental management are also trending themes in the past few years. It is interesting that research in corporate social responsibility has lost his popularity in accounting and finance research but gained it in management and organization research.

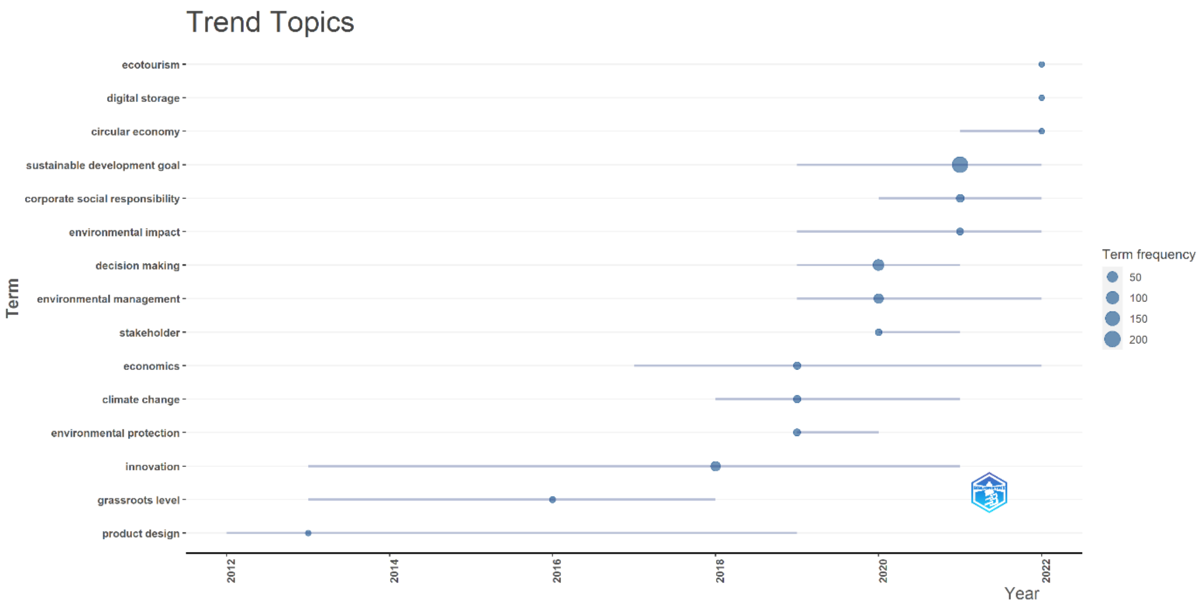

Figure 6. Trend Topics in Management and Organization Literature

It is clearly seen in Figure 7 that environmental protection and environmental management are the themes that sustain their trend in production management literature. For a short period life cycle assessments were crowd-pleasing after it gave its place to economic analysis, cleaner production, environmental technology and circular economy.

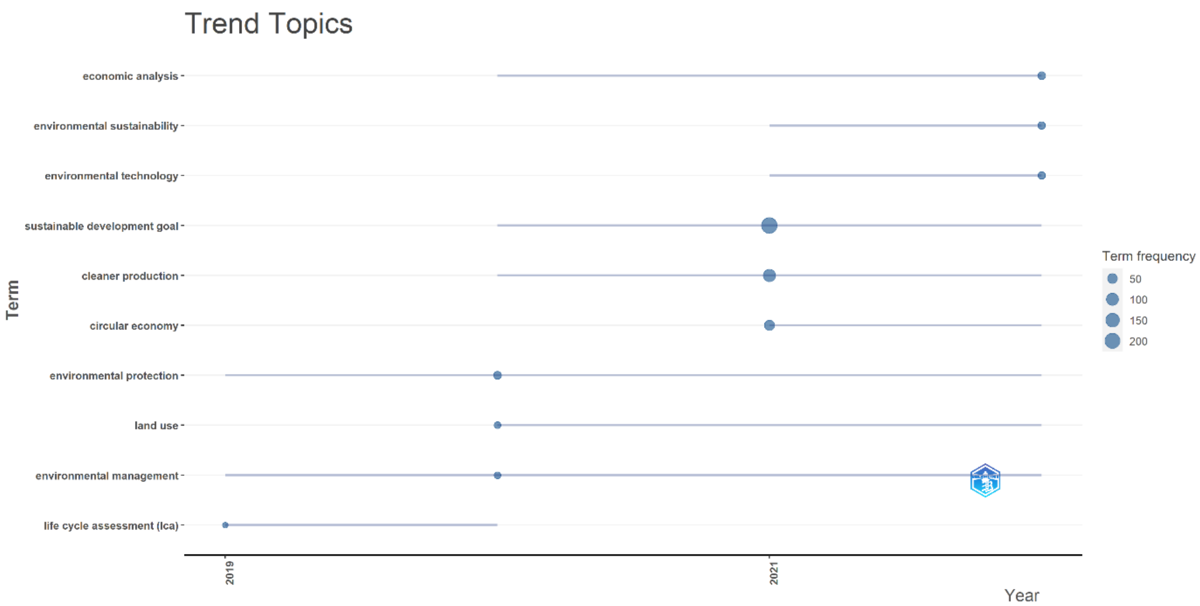

Figure 7. Trend Topics in Production Management Literature

Because there are so few articles in the field of marketing Figure 8 is not very explanative. But to have a comparison it is shown as follows. As it is expected consumption behavior is one of the trending topics in the field of marketing. Planning is the topic which is the most constant one.

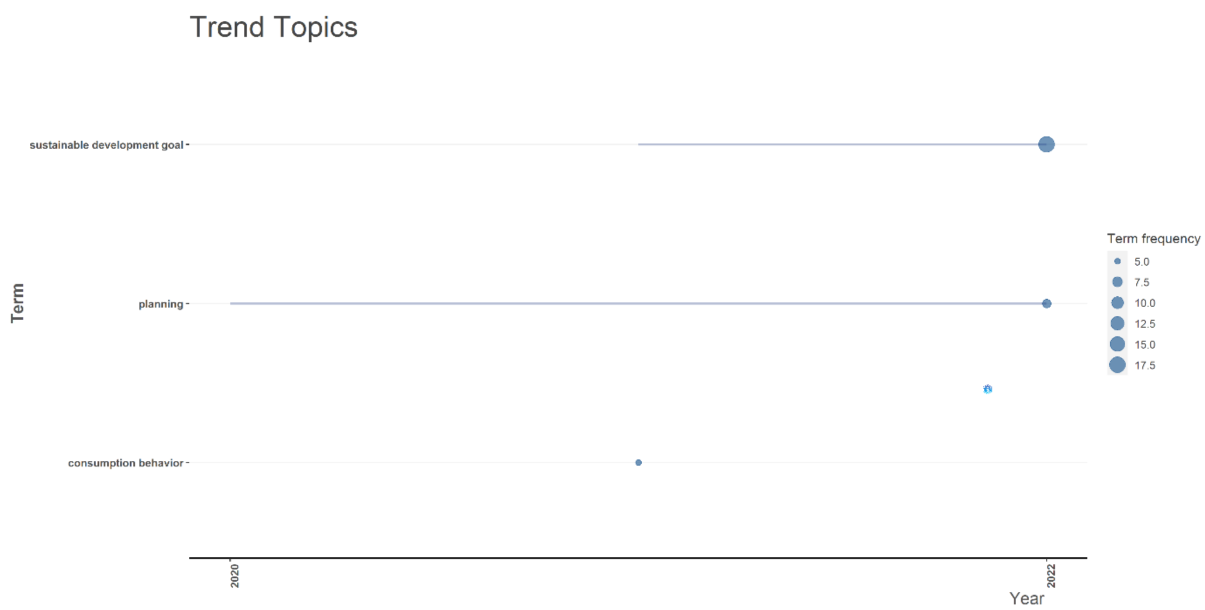

Figure 8. Trend Topics in Production Management Literature

***RQ2:** Which journal is leading in publishing sustainable development goals studies?*

For researchers it is important to find a suitable journal for their research. This could be a time-consuming activity. Therefore, it is helpful to them to know which journal is leading in their research field for publishing sustainable development goals studies. Table 1 shows the number of articles published in each journal for every subfield of business research.

Table 1. Leading journals list clustered by subfields

Accounting and Finance	
Journal of Cleaner Production	105
Business Strategy and the Environment	16
Corporate Social Responsibility and Environmental Management	15
Technological Forecasting and Social Change	10
Sustainability Accounting, Management and Policy Journal	7
Australasian Accounting, Business and Finance Journal	7
Production management	
Journal of Cleaner Production	153
Technological Forecasting and Social Change	16
Production and Operations Management	10
Business Strategy and the Environment	9
Journal of Business Research	6
Cities	6
Management and organization	
Journal of Cleaner Production	57
Corporate Social Responsibility and Environmental Management	15
Business Strategy and the Environment	14
Journal of Sustainable Tourism	13
Worldwide Hospitality and Tourism Themes	10
International Journal of Management Education	10
Journal of Business Ethics	10

Marketing	
Journal of Cleaner Production	8
Australasian Marketing Journal	5
Marketing Intelligence and Planning	4
Business Strategy and Development	3
Emerald Emerging Markets Case Studies	3

It is clearly seen that Journal of Cleaner Production mostly publishes papers in the subfield of production management and accounting and finance, less in management and organization and marketing, but it is the only common one for all subfields. It is followed by Business Strategy and the Environment which is one of the leading journals in three subfields. Researchers working in the subfield accounting and finance can consider Business Strategy and the Environment, Corporate Social Responsibility and Environmental Management, Technological Forecasting and Social Change, Sustainability Accounting, Management and Policy Journal, and Australasian Accounting, Business and Finance Journal for their work related to the SDGs.

For their work on the SDGs, researchers in the discipline of production management should take Technological Forecasting and Social Change, Production and Operations Management, Business Strategy and the Environment, Journal of Business Research, and Cities into consideration. Corporate Social Responsibility and Environmental Management, Business Strategy and the Environment, Journal of Sustainable Tourism, Worldwide Hospitality and Tourism Themes, International Journal of Management Education, and Journal of Business Ethics are options for researchers in the subfield of management and organization. Lastly marketing related SDG manuscripts can be submitted to Australasian Marketing Journal, Marketing Intelligence and Planning, Business Strategy and Development, and Emerald Emerging Markets Case Studies.

RQ3: *On which sustainable development goal has the business literature focused?*

To have an overview of the status Figure 3 is showing that the most research were made in accordance with the 9th (industry, innovation, and infrastructure), 12th (sustainable consumption and production), 11th (sustainable cities and communities) and 8th (decent work and economic growth) SDGs. Hence, it is useful for researchers to know on which SDGs their subfield is focusing on. Therefore, a clustering into subfields were made and shown in Figure 9.

It is seen that although, in general, the 9th SDG is leading, in the field of accounting and finance, the 12th SDG (sustainable consumption and production) is leading. Besides this, the most papers were published in the field of accounting regarding to the SDGs 8 (decent work and economic growth) and 1 (no poverty). The field of production management is leading in the 9th SDG (industry, innovation, and infrastructure), 11th (sustainable cities and communities), 7th (affordable and clean energy), 13th climate action, 2nd (zero hunger), 6th (clean water and sanitation), 14th (life below water) and 15th (life on land). Though production management is the research field of business doing the most research and contribution in line with the SDGs. In line with the 16th (peace, justice, and strong institutions), 5th (gender equality), 17th (partnership for the goals), 10th (reduced inequalities), 4th (quality education) and 3rd (good health and well-being) most research were made in the field of management and organization. It is clearly seen that the research field of marketing isn't leading anywhere. When the marketing research is considered in itself, the most articles were dealing with the 12th, 9th, 13th and 1st SDGs.

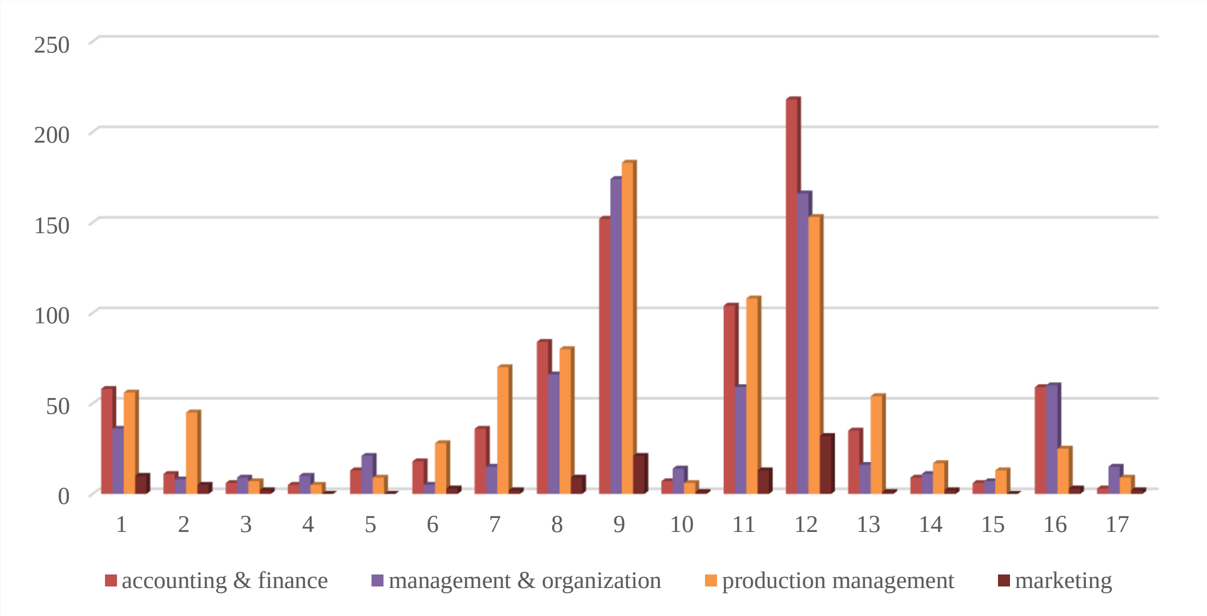

Figure 9. Clustering the articles by subfield by SDGs

***RQ4:** Which field of business is more dominant in line with the sustainable development goals in the literature?*

It is also essential to see the clustering within the business literature. Figure 10 shows the distribution between the subfields of business research. It is clearly seen that the research distribution between accounting and finance, management and organization, and production management is quite similar. However, research in the subfield of marketing needs to catch up.

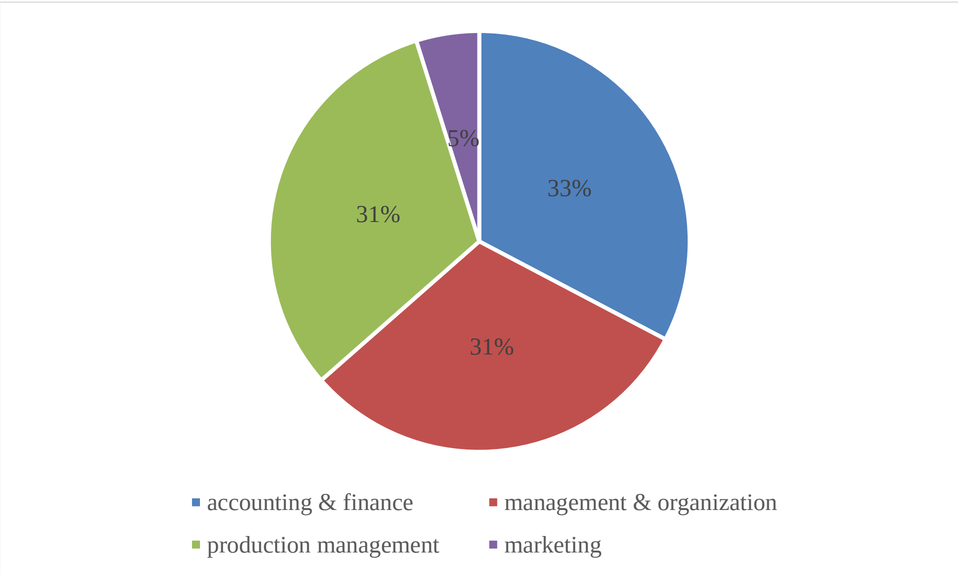

Figure 10. Articles clustered by the fields of business research

***RQ5:** Which researchers and affiliations contribute the most to the literature?*

For researchers it is important to be up to date with the literature and to follow the most influential authors. Therefore, it might be helpful to them to see which researchers are leading in their subfield working in the sustainable development area. Also, it is important to know which affiliations contribute the most to this topic. Therefore, a subfield-based clustering of the leading authors was obtained and shown in Table 2.
It is interesting to see that Sachin Kumar Mangla is a leading author in both accounting and finance and production management. So, he is the most influential author in the field of business and SDGs. It is also a point to mention that the fields of accounting and finance and production management are more likely to have leading authors than management and organization although the total published article numbers are very similar. Besides these, because there are few articles in the field of marketing, a leading author in this field did not shine out strictly.

Table 2. Leading authors list clustered by subfields

Accounting and Finance		***Production Management***	
Authors	**N. of Articles**	**Authors**	**N. of Articles**
MANGLA SK	5	MANGLA SK	8
KUMAR A	4	LIU Y	5
RAUT RD	4	ZHANG X	5
CAPUTO F	3	ALOLA AA	4
CHEN L	3	GOVINDAN K	4
DE VILLIERS C	3	KUMAR A	4
HOPPER T	3	SINHA A	4
LAI FW	3	CHEN X	3
LIU Y	3	KAZANCOGLU Y	3
PIZZI S	3	RAUT RD	3
Management and Organization		***Marketing***	
Authors	**N. of Articles**	**Authors**	**N. of Articles**
ALBAREDA L	3	AMOAKO GK	2
DI VAIO A	3	DZOGBENUKU RK	2
FEOLA G	3	ABRAR M	1
MOYA-CLEMENTE I	3	ABREU M	1
NA NA	3	ADJAISON GK	1
RIBES-GINER G	3	AGGARWAL N	1
RITALA P	3	AHMAD BAIG S	1
SEYFANG G	3	AHMED A	1
TURA N	3	AHMED JU	1
VAN TULDER R	3	ALMANSOUR M	1

Although there are not strictly leading authors in accordance with the publication number in the field of management and organization, there are leading affiliations, like the Seoul National University, Lappeernranta University of Technology and University Utara Malaysia. It is also interesting that University Utara Malaysia and Universitat Politècnica de València are leading affiliations in both accounting and finance and management and organization, although they do not share any common leading authors.

Table 3. Leading affiliations list clustered by subfields

Accounting and Finance		
Affiliation	**N. of Articles**	**Country**
UNIVERSITY UTARA MALAYSIA	11	MALAYSIA
UNIVERSITAT POLITÈCNICA DE VALÈNCIA	10	SPAIN
QUEENSLAND UNIVERSITY OF TECHNOLOGY	6	AUSTRALIA
THE UNIVERSITY OF AUCKLAND	6	NEW ZEALAND
UNIVERSITY OF WOLLONGONG	6	AUSTRALIA
UNIVERSITI TEKNOLOGI PETRONAS	5	MALAYSIA
UNIVERSITY OF ZARAGOZA	5	SPAIN
AMITY UNIVERSITY	4	INDIA
BABSON COLLEGE	4	UNITED STATES OF AMERICA
NATIONAL INSTITUTE OF INDUSTRIAL ENGINEERING (NITIE)	4	INDIA

Production Management		
Affiliation	**N. of Articles**	**Country**
UNIVERSITY OF SOUTHERN DENMARK	8	DENMARK
UNIVERSITY OF PLYMOUTH	7	UNITED KINGDOM
BEIJING NORMAL UNIVERSITY	6	CHINA
HANKEN SCHOOL OF ECONOMICS	6	FINLAND
ISTANBUL GELISIM UNIVERSITY	6	TURKEY
AUSTRALIAN NATIONAL UNIVERSITY	5	AUSTRALIA
GOA INSTITUTE OF MANAGEMENT	5	INDIA
INDIAN INSTITUTE OF TECHNOLOGY	5	INDIA
SOUTH URAL STATE UNIVERSITY	5	RUSSIA
SUN YAT-SEN UNIVERSITY	5	CHINA
Management and Organization		
Affiliation	**N. of Articles**	**Country**
SEOUL NATIONAL UNIVERSITY	9	SOUTH KOREA
LAPPEENRANTA UNIVERSITY OF TECHNOLOGY	7	FINLAND
ESUNIVERSITY UTARA MALAYSIA	6	MALAYSIA
AUSTRALIAN NATIONAL UNIVERSITY	5	AUSTRALIA
DEAKIN UNIVERSITY	5	AUSTRALIA
THE UNIVERSITY OF TOKYO	5	JAPAN
UNIVERSITAT POLITÈCNICA DE VALÈNCIA	5	SPAIN
UNIVERSITY OF SOUTHERN DENMARK	5	DENMARK
UNIVERSITY OF SUSSEX	5	UNITED KINGDOM
UNIVERSITY OF ZARAGOZA	5	SPAIN
Marketing		
Affiliation	**N. of Articles**	**Country**
CENTRAL UNIVERSITY	3	INDIA
DALHOUSIE UNIVERSITY	3	CANADA
NORTH SOUTH UNIVERSITY	3	BANGLADESH
UNIVERSITY OF ZARAGOZA	3	SPAIN
FU JEN CATHOLIC UNIVERSITY	2	TAIWAN
NATIONAL UNIVERSITY OF IRELAND	2	IRELAND
RUSSIAN ACADEMY OF NATIONAL ECONOMY AND PUBLIC ADMINISTRATION UNDER THE PRESIDENT OF THE RUSSIAN FEDERATION	2	RUSSIA
SWINBURNE UNIVERSITY OF TECHNOLOGY	2	AUSTRALIA
THE AMERICAN UNIVERSITY IN CAIRO	2	EGYPT
TRINITY COLLEGE DUBLIN	2	IRELAND

5. Conclusions

To investigate the contributions and interrelations between the SDGs and subfields of business research in business literature, we examined 851 articles. The SDG, that gained the most attention from the business literature is the

9th, which is in line with the findings of Vinayavekhin et al. (2023). Our findings show that the 8th ,11th and 12th goals are following, but 13 is lacking behind. Also, we differ from this work with our findings that the 10th SDG is also one of the neglected goals as it is clearly seen in Figure 3.

Rao and Shukla (2022) found that Journal of Cleaner Production and Technological Forecasting and Social Change are the leading journals in publishing management and organization studies. Same results show in our research too for the Journal of Cleaner Production, but Technological Forecasting and Social Change is a leading journal in the production management area due to our findings. Instead, journals like Corporate Social Responsibility and Environmental Management and Business Strategy and the Environment are the leading ones further.

This paper shows researchers, editors, scholars and policy makers the current situation and opportunities in current business research. First, this paper shows clearly that the research in the marketing literature came up short in line with the SDGs. Therefore, editors of marketing journals may open a call for special issues in contribution with de SDGs in marketing research. Also, researchers and scholars in the marketing discipline can direct their focus on SDGs.

Besides, the trend topics in every subfield shown in figures 5,6,7 and 8 can lead the researchers to conduct their work in more recent themes. Like it is interesting to see, that the theme of corporate social responsibility has ended its popularity in 2020 in accounting it has gained attention in management and organization discipline. For scholars and researchers this kind of information could be helpful to make research in popular areas.

To achieve the sustainable development goals due to Agenda 30 the contributions of all stakeholders is essential(Cristina Ferreira Caldana et al., 2022; Nicolò et al., 2023). The policymakers can identify the most influential academicians in this field to corporate with them. In this way academicians, policymakers and mediately the private sector could help to find policies that lead to achieve the SDGs.

Cernev and Fenner (2020) found that the SDGs 1,3,14 and 15 are the most critical ones in order to achieve all goals. In our research we found that the research in line with the 3rd, 14th and 15th goal are very low, and the research in line with the 1st goal is average. Therefore, business scholars should be encouraged to do more research in line with these goals to do their part for the Agenda 2030.

Like every research this article has also its own limitations. First, we used the Scopus database, because it is the most covering database (Mushtaq et al., 2023; Mongeon and Paul-Hus, 2016), but there are a lot of articles that are not in this database. Second, we used the subject area filtration of Scopus, which may lead that we have lost some articles that could be related to business literature but classified otherwise. Third we just analyzed articles that clearly deal with first at least one of the SDGs and second at least can be categorized in one subfield of business research. Hence, these limitations could be new themes for new research in this field.

Acknowledgments

A former version of this paper was presented in the Eurasian Conference on Economics, Finance and Entrepreneurship held in 20-21 May 2023. The authors especially thank Oğuzhan Ari for his assistance with concept-based search and coding.

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