

# Mapping the Literature on Sustainability Reporting: A Bibliometric Analysis Grounded in Scopus and Web of Science Core Collection

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## Abstract

Sustainability reporting has become an increasingly common practice among companies around the globe as around 90% of the world's 250 largest companies from Fortune 500 prepare and publish its sustainability reporting. Aiming to help researchers to grasp the intellectual landscape of global research on sustainable reporting, we conducted a bibliometric analysis using CiteSpace software by applying evaluative and relational techniques to 928 articles published in 480 different journals in Scopus and 698 articles published in 374 different journals in Web of Science Core Collection from 1981 to 2020. Our findings indicate that the number of articles published in the field has increased rapidly, especially since 2009. We identified the leading countries (the United States, Australia, the United Kingdom, Germany, Spain, Canada, the Netherlands and Italy), the most prolific journals (Journal of Cleaner Production, Business Strategy and the Environment, Journal of Business Ethics), main journals categories (Business, Economics, Management and Finance, Environmental and Ecology and Science, Technology and Engineering), and the major research directions in the near future (sustainability reporting, corporate social responsibility, sustainable development, disclosure). From our findings we infer that the sustainability reporting research has just recently (2013-2019) gained traction in the literature. Moreover, our findings testify that a kind of bifurcation point has occurred is 2011 that manifests the maturity of the field of sustainability reporting. All this provides the reader with a high-view look at sustainable reporting as these quantitative findings complementing qualitative and providing valuable insights into the field.

*Keywords: Sustainability Reporting, Bibliometric, Citespace, Scopus, Web of Science Core Collection.*

## 1. Introduction

Sustainability reporting has become an increasingly common practice among companies around the globe while the latter try to match the expectations and counter the criticism and pressures from stakeholders who demand an ever greater level of companies' accountability about their social and environmental impact (Boiral, 2013). The latest available global statistical data testifies to the trend as 75% (compared to 18% in 2002) of

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N100 companies (the top 100 companies by revenue in each of the 49 countries researched) and 93% (compared to 45% in 2002) of G250 companies (the world's 250 largest companies by revenue based on the Fortune 500 ranking of 2016) prepare and publish its sustainability reporting (KPMG, 2017, p. 9).

The research in sustainability reporting is now vast area covering the preparation of the very report including among others frameworks of SR (Dumay, 2019; Hahn & Lülfes, 2014), voluntary vs. mandatory reporting (La Torre et al., 2020; Tjahjadi et al., 2020), stakeholders engagement (Bepari & Mollik, 2016; Herremans et al., 2016; Rhianon Edgley et al., 2010), materiality (Canning et al., 2019; Mio et al., 2020; Torelli et al., 2020), quality of SR (Daub, 2007; Michelon et al., 2015; van Staden & Hooks, 2007) as well as SR assurance which is manifested in such topics as accounting vs. non-accountants assurance providers (Farooq & de Villiers, 2017, 2019a, 2019b), assurance report content and quality (Hummel et al., 2019; Rossi & Tarquinio, 2017). This research areas constantly (1) produce a tangible amount of new publications and (2) gives new shoots in terms of the emergence of new branches of research and that in turn engenders the emergence of new studies that seek to capture the ever-growing field using the bibliometrics techniques into a digestible picture.

The bibliometric analysis is a very helpful utilitarian tool for researchers, journal editors and reviewers, as it assists in the transformation of qualitative information into quantitative and that in turn leads to the ability to draw conclusions pertaining “the magnitude of papers that may exist on a specific line of research or topic” (Baraibar-Diez et al., 2020). The bibliometric analysis provides a high-view look at the research areas that have attracted attention on a certain topic, paradigms or concepts, besides today “studies with data have more relevance than those subjective analyses” (Fabregat-Aibar et al., 2019, p. 2). The preceding studies employing bibliometrics have classified its techniques into three categories: review techniques, evaluative techniques, and relational techniques (Baraibar-Diez et al., 2020; Fabregat-Aibar et al., 2019). This paper utilizes the last two mentioned, namely evaluative techniques and relational techniques.

Notwithstanding the prominent position, the topic of sustainability reporting enjoins in the literature the dearth of a bibliometric approach to the subject matter is palpable in the field. We tried to find the bibliometric or systematic reviews papers devoted to the sustainability reporting per se and our search resulted in only a few of them (Dienes et al., 2016; Hahn & Kühnen, 2013) but the latest period covered was mid-2015 (Dienes et al., 2016). Even without considering the non-identical methodological and technical approaches used in those articles as contrasted to ours, the period of 5 years by the standards of the modern research world is a significant period warranting fresh research covering the subject matter up to present day. Although we came across some fresh-minted bibliometric research closely related to the topic at hand (Araújo et al., 2020; Fusco & Ricci, 2019; Gulluscio et al., 2020; Pizzi et al., 2020; Rodrigues & Mendes, 2018), at close examination all those papers targeting domain that does not fit perfectly to sustainability reporting research.

In the light of the foregoing, the paper aims to provide researchers with a quantified and visualized snapshot of the domain of sustainability reporting covering all the publication available in the leading databases Scopus and Web of Science Core Collection from 1981 up to 2020. Our main research tool is CiteSpace, freely available Java application for

visualizing and analyzing trends and patterns in the scientific literature. Our study has several specific goals enabling reaching the overall aim, namely: (1) to introduce the readers to the field and present a high-view picture on global publications related to sustainability reporting in almost last 40 years; (2) to identify the prime contributors in the domain, together with the leading countries, journals, authors, articles, topics; and (3) to identify the bursting keywords during the last 40 years and reveal based on the latest bursting topics future research directions. To the best of our knowledge, this paper is the first study using CiteSpace fully devoted to sustainability reporting and covering almost 40 years of research in the area.

The remainder of the paper is organized as follows. First, the overall method of the study, including research design, data source of analysis and research tools at use is demonstrated in the next section. The third section reveals the main finding of the paper and the paper concludes with discussions and conclusions.

## 2. Methods

The bibliometric method, utilized in this study, takes advantages of contemporary technologies in computer engineering, huge strides in database management and statistics achieved in the last decade. The method of bibliometric analysis is to make statistics of numerous scientific publications in a certain research field, and reveal the history, current situation and trend of the research field through statistical tables and statistical images. At the same time, this method can also mark the evolution of the research field and provide references for researchers in this field. Eugene Garfield who stood behind Science Citation Index in the 1950s (now morphed to be a part of WoS CC) was one of the first who understood the importance of citations and went on to established database of it (C. Chen, 2018). At the time citation were employed with the goal similar to ours in this study to “help for researchers to search the literature more effectively” (Mingers & Leydesdorff, 2015, p. 2) and “also enabled unfamiliar authors to be discovered” (Mingers & Leydesdorff, 2015, p. 2). After it was confirmed that Garfield's statistical analysis keywords predicted suggested the future science directions (Barton et al., 1990), bibliometric analysis by keywords to analyze research trends has proved to be effective in recent years (D. Chen et al., 2016).

### 2.1 Research Design

The method of this research can be summarized into 5 steps (figure 1). The first step was planning through reading related references, analyze which items are meant to measure, and initially determine the items that need bibliometrics. The second step was a preliminary search. This step aimed at determining according to research needs, the search keywords through search and also to explore feasible data presentation methods and discover possible problems among them. At this stage very important task was pre-searching, selecting appropriate software and measurement methods, determine how to present the results of bibliometric analysis.

After the first two stages prepared the ground, we initiate the main search - our third step. The main activity at this stage was to perform a search, select documents that meet the requirements, and download the corresponding bibliographic information. The fourth step

is data preprocessing. At this stage, the downloaded bibliographic information is converted into a usable format, and appropriate sorting and inspection are performed to eliminate occasional format errors in format conversion and downloading. The fifth step is to reveal and to present the results and analysis, display the results of bibliometrics, and select suitable parameters through repeated attempts to display the results.

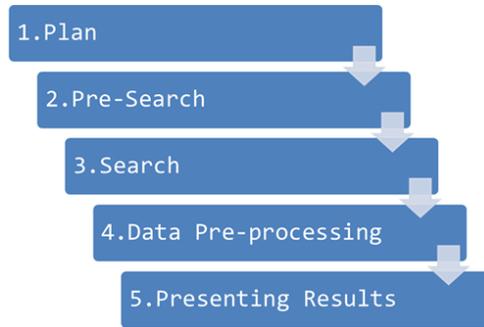


Figure 1. Schematic diagram of the research method

## 2.2 Data collection

The gathering of bibliometric data implies the selection of the database(s), to clarify and purify the bibliographic data and at least to refine it. We decided to make use of two world-leading research databases that adhere to rigorous standards in content selection and maintenance – Scopus (run by Elsevier) and Web of Science Core Collection (run by Clarivate) (Gusenbauer, 2019; Rousseau et al., 2018). Although Google Scholar according to some studies is believed to be the largest database (Gusenbauer, 2019) its approach to data curation is in our opinion is questionable and hardly make it a reliable source for analysis.

Sustainability reporting is a multi-disciplinary research subject of economy, management, environment, science and technology. To make the data sources more comprehensive, Scopus and Web of Science Core Collection (hereinafter referred to as WoS) are selected for the research data of this article. Scopus is currently the world's largest research abstract and citation database, containing 24,600 journals from 5000 publishers (Elsevier, 2020). WoS is a reliable, high-quality authoritative database generally recognized by scientific researchers. Its core collection is an index of high-quality scientific research articles selected by editors. To make the search results more concentrated, after pre-searching, we chose to use "sustainab\* report\*" in the title as the search condition and finally got 928 effective search records in Scopus and 698 effective search records in WoS. After exporting the search results into text format and Excel format respectively, CiteSpace and Excel are used to analyze, make tables and draw knowledge graphs.

The data retrieval time is October 8, 2020. The exact string used to search in Scopus is "TITLE (sustainab\* AND report\*) AND DOCTYPE (ar) AND PUBYEAR > 1959 AND PUBYEAR < 2020", and the search results are 931 (Table 1). A total of 3 data formats have problems and were deleted. The final search formula for WoS database is "TI= sustainab\* and TI=report\* Refined by: DOCUMENT TYPES: (ARTICLE) Databases= WOS Timespan=1950-2019 Search language=Auto", and the search results are 698.

**Table 1. The search formula used**

	Scopus	Web of Science Core Collection
search formula	"TITLE (sustainab* AND report*) AND DOCTYPE (ar) AND PUBYEAR > 1959 AND PUBYEAR < 2020"	"TI= sustainab* and TI=report* Refined by: DOCUMENT TYPES: (ARTICLE) Databases=WOS Timespan=1950-2019 Search language=Auto"
The data of retrieval	October 8, 2020	October 8, 2020
Results of the search	931 articles	698 articles

Some articles lacking DOI and publication year were supplemented after the source was retrieved.

### 2.3 Research tools

The tools used in this article include CiteSpace 5.7.R1 (64bit), which was devised by C.M. Chen at Drexel University in 2004 (Chen, 2004) and since then is widely used. As the axillary tools, we also use MS Excel 2010, and Stata 16.0. CiteSpace is a popular bibliometric tool that can draw knowledge graphs through bibliometric methods to show the relationship network between the various attributes of the literature (de Bellis, 2014; Gao et al., 2020). It can also output statistical tables corresponding to the graphs. Excel is used to filter and count data, and to make tables. We resort to Stata's pvenn software package to draw a Venn diagram to show the number and proportion of documents in the two databases. So in a nutshell, the Venn diagram was drawn using Stata 16.0 and the software package pvenn, the histogram was drawn using MS Excel 2010, the co-occurrence maps are drawn using CiteSpace 5.7.R1. The data in the table comes from the statistical results of CiteSpace. Some of the data in the tables are collected manually and are indicated below the tables. To make our research more replicable we adduce the search string in CiteSpace we used for specific data throughout the paper from here on.

## 3. Results

### 3.1 Databases distribution

The fact that we make use of two databases gives us a much larger sample compared to the hypothetical situation when we stopped our choice on only one of the databases (Figure 2).

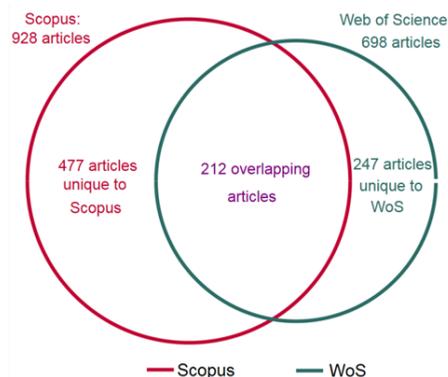


Figure 2. Database distribution of relevant articles

Figure 2 shows the number of articles in the Scopus and WoS databases with "sustainability report" in the title, and the number of overlapping articles. The number of articles in Scopus (n=928) is greater than that in WoS (n=698). There are a total of 1,626 articles in the search results, of which 451 are repeated in the Scopus and WoS databases. Although there are many crossovers, many articles are in only one database: Scopus has 477 of those articles and WoS - 105 articles. Therefore, using both Scopus and WoS databases can make our research results more comprehensive. Compared with using two databases at the same time, if the Scopus database is not used, the parameters of the research would have been reduced by 29.3%, and if the WoS database is not used - by 15.2%.

### 3.2 Output overview

It is worth noting three significant years: the first appearance of the publication related to the subject matter, the year when the number of publications exceeded 10, and the year when the number of annual publications exceeded 100. In the search results of this article, the sustainability report-related articles included in the Scopus and WoS databases first appeared in 1981. Since 2004, the number of related articles published per year has exceeded 10, and since then, every year the number of publications has increased steadily. Beginning in 2015, the number of articles per year has exceeded 100.

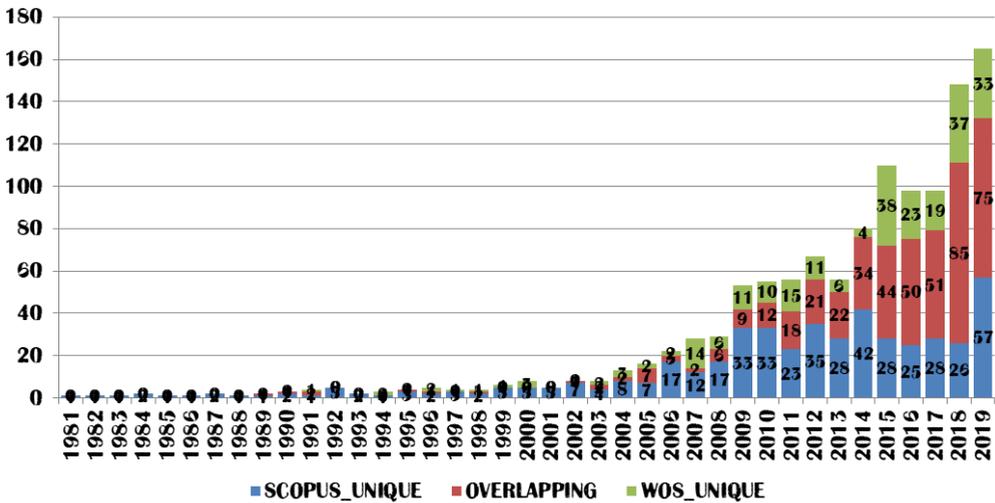


Figure 3. Number of publications

In bibliometrics the networks connection are analysed through citations, therefore it is imperative to overview citation count (Figure 3). The number of citations can be divided into three stages based on 2000 and 2015. Before 2000, only articles published in 1991, 1995, and 1997 had a large number of citations. Important documents appeared in these three years. From 2001 to 2015, the number of citations increased rapidly and reached a peak in 2015. The number of citations of articles published after 2015 has gradually decreased. We want to issue a warning at this point for you to take those data with caution because the reason for it is that these articles were published later, and it takes longer to reach more citations.

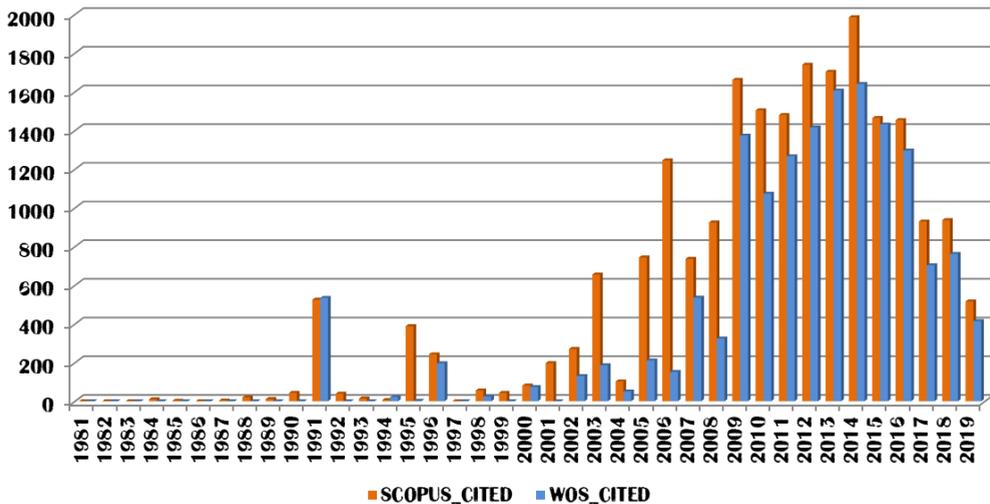


Figure 4: Number of citations

### 3.3 Country distribution

Scopus and WoS include different journals and articles. Statistics on the countries where the authors are located can be used to understand which countries scholars have made more contributions to the sustainability report research. To make our research more replicable we adduce the search string we used. We made the following input parameters in CiteSpace: (1) 1 years per interval from 1981 to 2019; (2) term source = title/abstract/author/keywords/keywords plus; (3) node type = country; (4) pruning = none; (5) selection criteria is g-index scale factor  $k = 25$ ; (6) look back years = 8; (7) link retaining factor = 3.

Figures 5 and 6 are schematic diagrams of statistics by country in the Scopus and WoS databases, respectively. The UK data in the Web of Science database is divided into England, Scotland, Wales, Northern Ireland, etc., and we merge them into the United Kingdom. For easy viewing, we adjusted the positions of nodes representing each country according to the size of the area. The larger the area of the node, the more the number of articles published in the country. The outer circle of the node represents betweenness centrality. The thicker the outer circle, the stronger the importance of the relevant literature published in the country.

In Figure 5 and Figure 6, we can see that in the Scopus database, the United States, Australia, the United Kingdom, Germany, and Spain are the top five countries with the most publications. In the WoS database, the United States, the United Kingdom, Australia, Spain and Germany are the countries with the most publications.

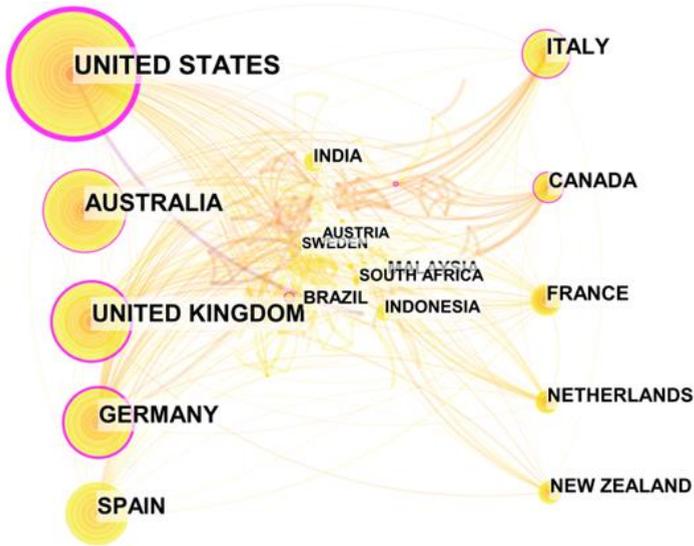


Figure 5. Top 10 countries with the most articles (Scopus)

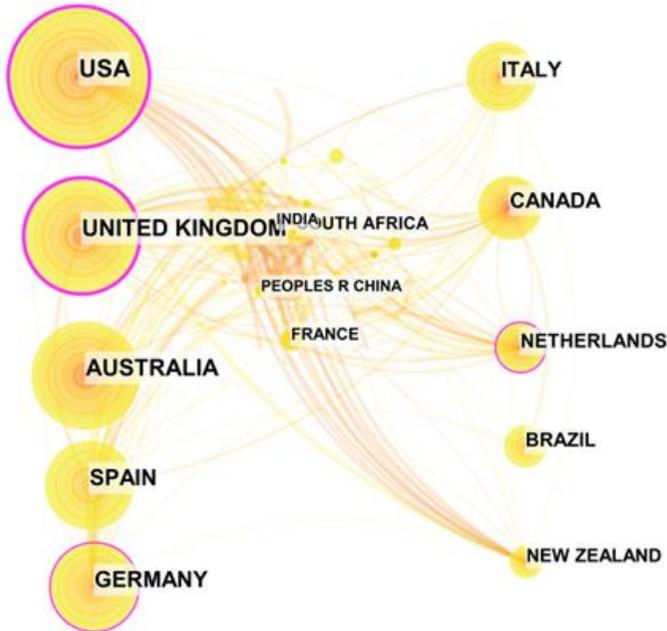


Figure 6. Top 10 countries with the most articles (Web of Science Core Collection)

Table 2 shows the betweenness centrality and ranking of the top 5 countries in Figure 5 and Figure 6. It can be seen that in the Scopus database, the top five betweenness centrality rankings are the United States, Germany, the United Kingdom, Canada, and Australia. In the WoS database, the top 5 are the United Kingdom, the United States, Germany, the Netherlands and Italy.

**Table 1. Top 10 countries with the most articles**

Scopus					Web of Science Core Collection				
#	Freq	Country	Centrality	Rank (Centrality)	#	Freq	Country	Centrality	Rank (Centrality)
1	151	United States	0.75	1	1	103	USA	0.28	2
2	99	Australia	0.13	5	2	80	United Kingdom	0.34	1
3	96	United Kingdom	0.32	3	3	78	Australia	0.02	8
4	80	Germany	0.38	2	4	64	Spain	0.02	8
5	76	Spain	0.07	7	5	63	Germany	0.14	3
6	62	Italy	0.1	6	6	53	Italy	0.06	5
7	48	Canada	0.15	4	7	51	Canada	0.05	7
8	44	France	0.05	8	8	38	Netherlands	0.13	4
9	38	Netherlands	0.04	9	9	35	Brazil	0	10
10	34	New Zealand	0.01	10	10	29	New Zealand	0.06	5

### 3.4 Periodicals

Table 3 lists the 10 most cited journals in the relevant literature of the "Sustainability Report". Because some references may overlap, the number of references from the two databases is not merged. Table 2 shows the citations of Scopus and WoS databases respectively sorted separately as well as the JCR and SJR indicators. It can be seen that the sustainability report research has been published in journals with greater influence.

**Table 3. The most cited journals and their impact factors**

Scopus						
#	Journal title	ISSN	CiteScore 2019	SJR 2019	Articles	Citations
1	Journal of Cleaner Production	0959-6526	10.9	1.89	44	2457
2	Business Strategy and the Environment	0964-4733	8.4	1.83	33	2699
3	Sustainability (Switzerland)	2071-1050	3.2	0.58	33	426
4	Journal of Business Ethics	0167-4544	7.0	1.97	26	1630
5	International Journal of Sustainability in Higher Education	1467-6370	3.2	0.64	24	244
6	Corporate Social Responsibility and Environmental Management	1535-3958	5.9	0.97	23	1071
7	Accounting, Auditing and Accountability Journal	0951-3574	4.9	1.46	16	1419
8	Social Responsibility Journal	1747-1117	2.5	0.43	14	199
9	Sustainability Accounting, Management and Policy Journal	2040-8021	3.8	0.67	12	362
10	Sustainable Development	0968-0802	4.9	1	10	196
Web of Science Core Collection						
#	Journal title	ISSN	CiteScore 2019	SJR 2019	Articles	Citations
1	Journal of Cleaner Production	0959-6526	10.9	1.89	47	2681
2	Sustainability	2071-1050	3.2	0.58	36	307
3	Journal of Business Ethics	0167-4544	7.0	1.97	28	1775
4	Business Strategy and the Environment	0964-4733	8.4	1.83	26	1269
5	Corporate Social Responsibility and Environmental Management	1535-3958	5.9	0.97	24	840
6	Accounting, Auditing & Accountability Journal	0951-3574	4.9	1.46	14	589
7	International Journal of Sustainability in Higher Education	1467-6370	3.2	0.64	13	283
8	Sustainable Development	0968-0802	4.9	1	10	168
9	Social Responsibility Journal	1747-1117	2.5	0.43	9	76
10	Meditari Accountancy Research	2049-372X	5.0	0.95	7	72

In the Scopus database, 928 articles were published in 480 different journals. In the WoS database, 698 articles were published in 374 different journals.

The most cited journal (in absolute terms) in the study is the Journal of Cleaner Production, and the number of articles published in it is also the largest one. But if you count the citation per article, it (Journal of Cleaner Production) is inferior to Business Strategy and the Environment and Journal of Business Ethics. On average, each article in Journal of Cleaner Production is cited about 56 times in the Scopus database and about 57 times in the WoS database, whereas in "Business Strategy and the Environment", each article is cited about 82 times in the Scopus database and about 63 times in the WoS database and for Journal of Business Ethics the numbers are 63 in both databases.

**3.5 Authors**

Counting the search results, we can find that 393 authors are participating in 928 articles in the Scopus database, and 460 authors participating in 698 articles in the WoS database. Table 4 shows the top 10 authors with the largest number of articles, the organizations and countries they represent, the articles published and cited, and the H-index of these authors. Interestingly enough, in two databases, only 3 of the top 10 authors have overlapped (Fernandez-Feijoo B. from Universidade de Vigo, Uyar A. from La Rochelle Business School, Boiral O. affiliated with Université Laval).

**Table 4. Top 10 authors with the most published articles**

#	Author	Organization	Country	Articles		Citations		H-index
				SR*	total	SR*	total	
<b>Scopus</b>								
1	Amran A.	Universiti Sains Malaysia	Malaysia	7	87	334	1384	21
2	James M.L.	California State University	United States	6	20	28	46	4
3	Uyar A.	La Rochelle Business School	France	6	53	93	709	14
4	Romero S.	Montclair State University	United States	5	16	281	416	10
5	Boiral O.	Université Laval	Canada	5	91	376	4117	34
6	Adams C.A.	La Trobe University	Australia	5	50	677	3555	25
7	Fernandez-Feijoo B.	Universidade de Vigo	Spain	5	20	270	439	9
8	Kaur A.	University of South Australia Business School	Australia	5	9	53	61	4
9	Ruiz S.	University of Vigo	Spain	4	10	194	304	7
10	Patten D.M.	Illinois State University	United States	4	65	225	5944	32
<b>Web of Science Core Collection</b>								
1	Fernandez-Feijoo B.	Universidade de Vigo	Spain	7	20	272	439	9
2	Boiral O.	Université Laval	Canada	7	91	349	4117	34
3	Rezaee Zabihollah	Univ Memphis	United States	6	87	0	1527	21
4	Del Mar Alonso-Almeida M.	Universidad Autónoma de Madrid	Spain	6	70	228	1851	23
5	Uyar A.	La Rochelle Business School	France	5	53	72	709	14
6	Searcy C.	Ryerson University	Canada	5	83	368	3658	29
7	Skouloudis A.	University of the Aegean	Greece	4	42	21	589	16
8	Dittrick P	University of Texas at Austin	United States	3	364	5	71	3
9	Karaman Abdullah S.	American University of the Middle East	Kuwait	3	17	16	75	5
10	Kaur Amanpreet	University of South Africa	South Africa	3	9	20	61	4

\* - Sustainability reporting related.

Data source: scopus.com. Visit time: October 25th, 2020.

### 3.6 Articles

According to the data of Scopus and WoS, Table 5 lists the basic information of the top 10 articles ranked by the number of citations. The histogram shows the amount of usage each year. Because of the overlap between Scopus and WoS citation data, data from Google Scholar (searched at 2020.10.25) is used. Table 4 lists the article title, author(s), journal name, DOI, and the number of citations (Scopus, WoS, Google Scholar). Among the top 10 articles cited, Scopus contains all 10 articles, and only 4 articles are included in the WoS.

**Table 5. Top 10 most cited articles**

#	Title	Author(s)	Journal	DOI	Cited in Scopus	Cited in WoS	Cited in Google Scholar
1	The Sustainable Biosphere Initiative: an ecological research agenda. A report from the Ecological Society of America	(Lubchenco et al., 1991) Lubchenco J.	Ecology	10.2307/2937183	497	534	1151
2	Assurance on sustainability reports: An international comparison	(Simnett et al., 2009) Simnett R., Vanstraelen A., Chua W.F.	Accounting Review	10.2308/accr.2009.84.3.937	472	434	977
3	Environmental indicators: a systematic approach to measuring and reporting on environmental policy performance in the context of sustainable development	Hammond A., Adriaanse A., Rodenburg E., Bryant D., Woodward R.	Fuel and Energy Abstracts	10.1016/0140-6701(95)98081-2	383	-	1207
4	W(h)ither Ecology? The Triple Bottom Line, the Global Reporting Initiative, and Corporate Sustainability Reporting	(Milne & Gray, 2013) Milne M.J., Gray R.	Journal of Business Ethics	10.1007/s10551-012-1543-8	358	326	825
5	Determinants of sustainability reporting: a review of results, trends, theory, and opportunities in an expanding field of research	(Hahn & Kühnen, 2013) Hahn, R; Kuhnen, M	Journal of cleaner production	10.1016/j.jclepro.2013.07.005	349	-	963
6	Sustainability, accountability and corporate governance: Exploring multinationals' reporting practices	(Kolk, 2008) Kolk A.	Business Strategy and the Environment	10.1002/bse.511	329	-	816
7	Trends in sustainability reporting by the fortune global 250	(Kolk, 2003) Kolk A.	Business Strategy and the Environment	10.1002/bse.370	293	-	811
8	Social, environmental and sustainability reporting and organisational value creation?: Whose value? Whose creation?	(Gray, 2006) Gray R.	Accounting, Auditing and Accountability Journal	10.1108/09513570610709872	291	-	765
9	Assurance statement practice in environmental, social and sustainability reporting: A critical evaluation	(O'Dwyer & Owen, 2005) O'Dwyer B., Owen D.L.	British Accounting Review	10.1016/j.bar.2005.01.005	273	-	622
10	Sustainability accounting and reporting: Fad or trend?	(Burritt & Schaltegger, 2010) Burritt R.L., Schaltegger S.	Accountin, Auditing & Accountability Journal	10.1108/09513571011080144	266	228	615

Figure 7 shows the document co-citation network generated by CiteSpace, showing the co-citation connection between these documents and the weight of the article. In order to generate Figure 7, we using the following parameters: (1) 8 years per interval from 1989 to 2019; (2) term source = title/abstract/author/keywords/keywords plus; (3) node type = reference; (4) pruning = pathfinder / pruning sliced networks; (5) select criteria is g-index factor k=25; (6) look back years = 8; (7) link retaining factor = 3. To improve readability, the label of the threshold is set to 20. The frequency of citations determines the size of tags and nodes. The larger the label of a node, the more times it is referenced. The colour of the node indicates the age of the cited document.

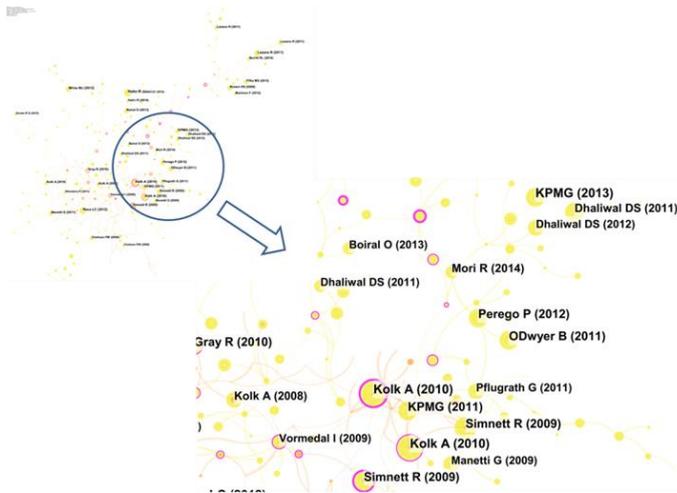


Figure 7. Co-citation network (1989-2019)

Table 6 present the detailed information of the co-citing literature network. We can see that the network has a total of 465 nodes and 556 links, of which 957 are located in 2013-2019. At the same time, we also found that the vast majority of links (13,462) were in 2013-2019. This shows that the sustainability report research has just recently received more and more attention.

Table 6. Cited references network

Year	Nodes	Exposed Links	Total Links
1989-1996	27	81	129
1997-2004	26	42	42
2005-2012	116	348	1,222
2013-2019	319	957	13,462

### 3.7 Subject areas / Categories

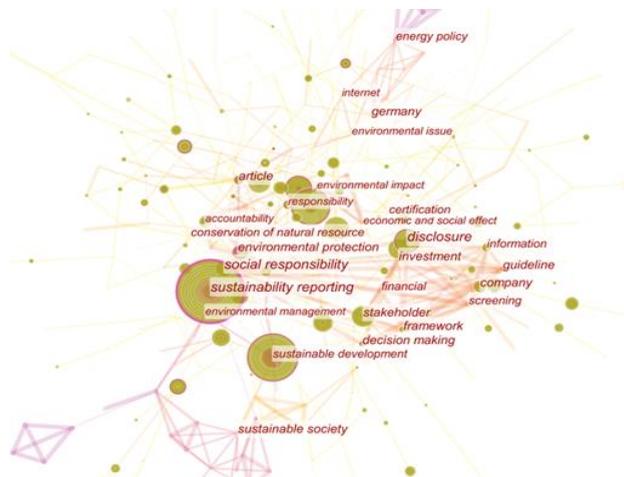
All journals are marked in databases as belonging to one or several subject areas (Scopus) or categories (WoS). This section analyzes subject areas/categories of the sustainability report research. The subject of the survey article can enable us to understand which areas of research are related to the sustainability report research. The parameters set

in CiteSpace are: (1) 1 years per interval from 1989 to 2019; (2) node type=category. Table 7 shows the top 10 topics with the largest number of documents.

**Table 6. Main categories of sustainability reporting**

<i>Rank</i>	<i>Category</i>	<i>Freq</i>
1	Business & Economics	342
2	Environmental Sciences & Ecology	217
3	Management	155
4	Business	150
5	Science & Technology - Other Topics	144
6	Green & Sustainable Science & Technology	136
7	Environmental Studies	134
8	Environmental Sciences	120
9	Business, Finance	103
10	Engineering	82

If similar categories are combined, we can find that Business, Economics, Management and Finance (Freq=750) is ranked first, and Environmental and Ecology (freq=607) is ranked second, and Science, Technology and Engineering closes the top three (freq=226). Investigating keywords can give us a complete overview of the research hotspots in this research field. We set the parameters in CiteSpace as: (1) 8 years per interval from 1989 to 2019; (2) term source = title/abstract/author/keywords/keywords plus; (3) node type = term/keyword; (4) pruning = pathfinder / pruning sliced networks / pruning the merged network; (5) select criteria is g-index factor k=15; (6) look back years = 8; (7) link retaining factor = 3. Set label threshold=8, font size= in the control panel 6, node size=60. Adjust the position of the node appropriately, we get the keyword clustering graph (Figure 8).



*Figure 8. Keyword co-occurrence diagram*

Based on Figure 8, keyword clustering is performed in CiteSpace to obtain the keyword clustering map shown in the figure below (Figure 9).



Figure 9. Keyword cluster map (1981-2019)

### 3.8 Analysis of bursting keywords

The burst keyword analysis reveals the research hotspots that have suddenly appeared in a research field for a while, show the appearance and duration of hot topics, and grasp the development path. We set the parameters in CiteSpace as follows: (1) 1 years per interval from 1989 to 2019; (2) term source = title/abstract/author/keywords/keywords plus; (3) node type = term/keyword; (4) pruning = pathfinder / pruning sliced networks; (5) select criteria is g-index factor k=25; (6) look back years = 8; (7) link retaining factor = 3. After running the analysis, pushing in the CiteSpace control panel "Burstness" we got the burst keyword map shown in Table 7:

Table 7. Top 21 Keywords with the Strongest Citation Bursts

Keywords	Year	Strength	Begin	End	1981 - 2019
Environmental Impact	1981	4.211	1995	2010	[Timeline bar with red burst from 1995 to 2010]
Health	1981	4.0076	1995	2011	[Timeline bar with red burst from 1995 to 2011]
Article	1981	9.9098	1996	2012	[Timeline bar with red burst from 1996 to 2012]
Sustainable Development	1981	15.9099	2000	2011	[Timeline bar with red burst from 2000 to 2011]
Eurasia	1981	5.5138	2005	2009	[Timeline bar with red burst from 2005 to 2009]
North America	1981	5.2265	2005	2007	[Timeline bar with red burst from 2005 to 2007]
Europe	1981	6.3395	2005	2009	[Timeline bar with red burst from 2005 to 2009]
Financial Reporting	1981	4.7369	2007	2013	[Timeline bar with red burst from 2007 to 2013]
Corporate Sustainability	1981	5.9793	2009	2016	[Timeline bar with red burst from 2009 to 2016]
Human	1981	5.7595	2010	2012	[Timeline bar with red burst from 2010 to 2012]
Industry	1981	5.5295	2010	2013	[Timeline bar with red burst from 2010 to 2013]
Institutional Theory	1981	4.91	2010	2012	[Timeline bar with red burst from 2010 to 2012]
Report	1981	5.0256	2010	2014	[Timeline bar with red burst from 2010 to 2014]
Sustainability Indicator	1981	4.1684	2011	2015	[Timeline bar with red burst from 2011 to 2015]
Communication	1981	3.7948	2012	2014	[Timeline bar with red burst from 2012 to 2014]
Stakeholder	1981	4.9566	2013	2014	[Timeline bar with red burst from 2013 to 2014]
Sustainability Assessment	1981	4.5157	2014	2016	[Timeline bar with red burst from 2014 to 2016]
Standard	1981	4.1585	2015	2016	[Timeline bar with red burst from 2015 to 2016]
Stakeholder Theory	1981	5.1846	2015	2017	[Timeline bar with red burst from 2015 to 2017]
Quality	1981	4.0916	2016	2019	[Timeline bar with red burst from 2016 to 2019]
CSR	1981	4.8793	2017	2019	[Timeline bar with red burst from 2017 to 2019]

From 1995 to 2012, three keywords are lasting more than 15 years, namely environmental impact, health and article. From 2000 to 2011, the burst keyword "sustainable

development" was the keyword with the highest burst intensity. These 4 keywords are the most popular research topics in the first 10 years of the 21st century. It should also be noted how research priorities have changed. From 2005 to 2009, keywords based on region, Eurasia, North America, and Europe have become hot spots. Beginning in 2007, the burst of research has shifted from macro to the mesolevel as more and more studies began to appear occupied with companies as opposed to regions. A notable feature of that period is also that burst keywords began to be related to financial reports, companies, and industries, and this trend has continued to the present.

What happened from 2011 is remarkable as it manifests the reaching of maturity of the field of sustainability reporting. Notable feature since 2011 is that at least one new burst keyword has appeared every year, which shows that the research of sustainability report has been carried out in multiple sub-fields coexisting and developing in parallel.

### 3.9 Future research directions

It is our perception that any research based on past data cannot be complete if it does not allow us to glimpse into the future. When looking for future research directions, we summarized the articles published in 2019 to identify innovative research opportunities. We generated a keyword co-occurrence map based on the keywords of articles published in 2019 and then generated a cluster map on this basis. We used the following parameters: (1) 1 years per slice in 2019; (2) term source = title/abstract/author/keywords/keywords plus; (3) node type = keyword; (4) pruning = pathfinder, pruning sliced networks; (5) select criteria is g-index factor  $k=25$ ; (6) look back years = 8; (7) link retaining factor = 3. After running CiteSpace, we got 159 nodes, 203 links, after finding the clusters, we got 10 clusters with modularity  $Q=0.8117$ , Mean Silhouette= $0.7686$ . The scores of modularity  $Q$  and mean silhouette range from 0 to 1. The larger the modularity  $Q$  value, the more structured the network. Reasonable, the larger the value of mean silhouette, the higher the credibility of the classification. To make the network clear, we use the "Filter out small clusters" function to hide the smaller clusters.

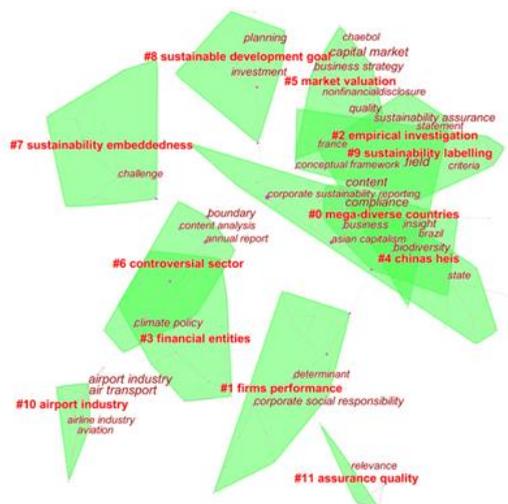


Figure 10. Sustainability report research keyword cluster map in 2019

Table 9 shows the keywords that appear most frequently, that is, the top 10 most relevant clusters. The marking technique is the log-likelihood ratio (LLR) (Chen et.al, 2010). The cluster numbers are arranged in descending order of frequency.

**Table 9. Future research directions**

#	Freq	keyword
1	127	Sustainability Reporting
2	44	Corporate Social Responsibility
3	35	Sustainable Development
4	31	Disclosure
5	22	Performance
6	21	Governance
7	21	Management
8	19	Global Reporting Initiative
9	18	GRI
10	17	Determinant

Based on the bibliometric analysis we assume that the keywords listed in Table 9 are the 10 keywords with the highest frequency in articles published in 2019, and they likely will also be the main research directions in the near future.

#### 4. Discussions and Conclusions

This paper aims to map the literature on sustainability reporting by refining its research fields and detecting trends. To reach our aim we conducted a bibliometric analysis using CiteSpace software by applying evaluative and relational techniques (Baraibar-Diez et al., 2020; Fabregat-Aibar et al., 2019). We strive to provide researchers with a quantified and visualized snapshot of the domain of sustainability reporting covering all the publication available in the leading databases Scopus and Web of Science Core Collection from 1981 up to 2020. The scope of our study is 928 articles published in 480 different journals in Scopus and 698 articles published in 374 different journals in Web of Science Core Collection.

The number of articles related to sustainability reporting in Scopus (n=928) is greater than that in WoS (n=698). There are a total of 1,626 articles in the search results, of which 451 are repeated in the Scopus and WoS databases. Although there are many crossovers, many articles are in only one database: Scopus has 477 of those articles and WoS - 105 articles. In terms of publications output, we marked three significant years: (1) 1981 - the first appearance of the publication related to the subject matter; (2) 2004 – since when the number of related articles published per year has exceeded 10 and (3) 2015 - when the number of articles per year has exceeded 100 and continued to hover around this number since after it.

In terms of a citation we have marked 2000 and 2015 as watershed years: before 2000, only articles published in 1991, 1995, and 1997 had a large number of citations; from 2001 to 2015, the number of citations increased rapidly, and reached a peak in 2015; the number of citations of articles published after 2015 has gradually decreased (what is a natural

process as to accrue citation some time should past).

Assessed only after publications the United States, Australia, the United Kingdom, Germany, and Spain are the top five countries with the most publications in the Scopus, whereas, in the WoS database, the United States, the United Kingdom, Australia, Spain and Germany are the countries with the most publications. But when we add betweenness centrality to the equation in the top five countries in Scopus Canada replaces Spain. Consideration of betweenness centrality shakes the top five countries in WoS as only the United Kingdom, the United States and Germany hold its places while Australia, Spain vacate their places for the Netherlands and Italy respectively.

The most prolific journals in the study and also the most-cited journal (in absolute terms as well as on per article basis) are Journal of Cleaner Production, Business Strategy and the Environment, Journal of Business Ethics.

We found that 393 authors are participating in 928 articles in the Scopus database, and 460 authors participating in 698 articles in the WoS database. The top three authors in Scopus are Amran A. (Universiti Sains Malaysia), James M.L. (California State University), Uyar A. (La Rochelle Business School) in WoS - Fernandez-Feijoo B. (Universidade de Vigo), Boiral O. (Université Laval) and Rezaee Zabihollah (Univ Memphis). In two databases, only 3 of the top 10 authors have overlapped (Fernandez-Feijoo B. from Universidade de Vigo, Uyar A. from La Rochelle Business School, Boiral O. affiliated with Université Laval). Our study has also identified the top 10 articles cited, therefrom Scopus contains all 10 articles, and only 4 articles are included in the WoS.

Co-citation connection between these documents allowed us to identify the network of a total of 465 nodes and 556 links, of which 957 are located in 2013-2019. From these findings, we infer that sustainability reporting research has just recently received more and more attention and gained traction in the literature.

All journals are marked in databases as belonging to one or several subject areas (Scopus) or categories (WoS). The conducted analysis revealed (if similar categories in two databases are combined) that Business, Economics, Management and Finance is ranked first (Freq=750), Environmental and Ecology - second (freq=607), and closes the top three Science, Technology and Engineering (freq=226).

The burst keyword analysis revealed how research priorities have changed with the lapse of time. From 2005 to 2009, keywords based on regions, like Eurasia, North America, and Europe dominated, whereas starting in 2007, the burst of research has shifted from macro to the mesolevel as more and more studies began to appear occupied with companies as opposed to regions.

Another key watershed moment (kind of a bifurcation point) we identified is 2011 as it, we believe manifests the reaching of maturity by the field of sustainability reporting. Since 2011 there are at least one new bursting keyword has appeared every year, which shows that the research of sustainability report has been carried out in multiple sub-fields coexisting and developing in parallel.

A keyword co-occurrence map based on the keywords of articles published in 2019 and log-likelihood ratio marking technique allowed us to identify the keywords listed with the highest frequency and they likely will also be the main research directions shortly (in descending order of frequency): sustainability reporting, corporate social responsibility, sustainable development, disclosure.

The main limitations of this paper must be mentioned. Those limitations have its roots in the methodological choices made by authors. First, we analyze articles in English only. This choice is obvious, as the majority of contemporary articles are written in this language, but articles in other languages are also becoming increasingly popular, especially in the WoS, which has indexes in Chinese, Russian and Spanish. We believe that research into these articles may open up some new perspectives. The second limitation may be linked to the bibliometric analysis which could contain deeply rooted bias as it heavily focuses on the most cited works. In practice though, this could have another conflicting explanation because as a rule “the most cited references tend to be the oldest ones, thereby generating a temporal bias” (Lopes & de Carvalho, 2018, p. 296).

This shortcoming can be mitigated in future research which would also include research papers written in a language other than English. Besides, other types of publications (book chapters and proceedings papers) and other high-quality studies in these two databases capable to deliver additional valuable information that opens up an additional view of the field. It would also be useful to contrast the findings of such studies with those presented in this paper.

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