



A Bibliometric Analysis for Stakeholder Management Focused on Energy and Sustainability

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Abstract: The study of sustainability in scientific literature represents a subject of interest for many authors, institutions, and countries, being considered as a complex subject given the multiple interactions among internal and stakeholders. In that matter, this research presents a bibliometric analysis in relation to stakeholder management focused on the subjects related to energy and sustainability to understand the state of the art in the field using data from Scopus database of published papers including a period considering the years 1994 to 2021. Thus, the first stage presents an analysis of general productivity by year, country, source, author, and affiliation, using descriptive measures related to the number of research units published, concentration indexes, and descriptive comparisons at different levels. Then, the work includes the analysis of the most influential articles in terms of citation levels for countries, affiliations, and authors, ending with a comparative analysis that considers proportional data. As a matter of conclusion, the present research shows that the state of the art in relation to stakeholder management focused on energy and sustainability is guided by subjects such as sustainable development, decision making, environmental management, climate change, environmental impact, economic and social effects.

1 INTRODUCTION


Stakeholder management represents a multidimensional process in any organization, since usually involves stakeholders and decision makers, considering a variety set of preferences and opinions that form a complex process of decision making (Ren, 2020); is in that sense that such managerial approach is relevant for the environment of the contemporary organizations, facing challenges such as pandemics, historic recession, armed conflict, and difficulties related to energy and sustainability.


Following this idea, it is important to point out that embodied energy has part of the sustainability debate, including a focus on regulations on in-use energy and carbon, the state of the legislation in the


matter, and even the assessment of appropriate impacts on the public and industry stakeholders (Hakansson, A., Höjer, M., Howlett, R. J., & Jain, L. C., 2013).


Thus, the focus on stakeholder engagement for this complex subject is based on promoting the enrolment of actors such as policymakers, technocrats and innovators, is considered a basis to explore complex relationships of multiple actors in the energy system, since to apply an integrative analysis in this manner is necessary to use the theoretical framework of Stakeholder Theory, contributing to the debate on energy transitions and potential interest of relevant interest groups (Nora, Alberton, & Ayala, 2021).

Given the intricacy of multiple interactions, that could be in a simultaneous or successive fashion, the

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major objective of stakeholder engagement and involvement address the complexity, uncertainty, multiplicity of values and perceptions on sustainability issues such as energy transition, where considering essential knowledge from all relevant disciplines and actor groups related to the problem is highly effective (Mielke, Vermaßen, Ellenbeck, Milan, & Jaeger, 2016).

In order to address this theoretical need for creating knowledge directed in the state of the art in the field, the present research work presents a bibliometric analysis considering a deductive and multilayer analysis, guided by the following research questions and independent variables.

1.1 Research Questions and Independent Variables

The main contribution of our study is to fill the knowledge gap relative to the research on extant stakeholder management in general production, research approaches, and influence structure by identifying, synthesizing, and evaluating existing literature to analyze the evolution of the research field, considering the following general and specific research questions.

What multilevel trends help to explain the state of the art in relation to stakeholder management focused on energy and sustainability?

In order to answer the general question, the following specific research questions will be the main guidelines of the study, including a multilevel trends analysis in relation to general productivity, keywords associated and influential authors and papers, as follows:

How is the general productivity in stakeholder management on energy and sustainability in terms of countries, institutions, and journals since the first mention of the concept in literature?

What are the most relevant keywords associates with the stakeholder management on energy and sustainability approach in the consulted literature that represent the principal research approach in the field?

Who are the most influential authors and papers in stakeholder management on energy and sustainability?

In that sense, the study performs a comprehensive bibliometric analysis in terms of the following variables:

General Productivity: *Including an analysis of the growth of researching papers, concentration indexes, and indicators related to the most productive institutions, journals, and countries.*

Research Approaches: *Considering an analysis of the approaches to the field by identifying the most related topics present in the literature.*

Influence Structure: *Presenting an analysis of the most influential papers in the subject and the leading authors in terms of the number of citations and average citation per year indexes.*

Considering the research questions and the stated variables, the research method will be done through a bibliometric review study that leads to a comprehensive view of the general productivity, research approaches, and influence structure of the research field related to stakeholder management on energy and sustainability to provide a comprehensive answer to the research questions that guides the research.

1.2 A Bibliometric Review to Understand the Evolution of Stakeholder Management on Energy and Sustainability

Considering bibliometrics as a form of study of quantitative nature that made the analysis of published or bibliographic units possible, including quantitative measures or analyses applied to indicators such as number of volumes in a collection, number of titles, numbers of articles published in a given field over a certain length of time, numbers of articles in journals, chapters in collected works published by a given number of persons (Broadus, 1987), this represent an useful approach to understand relevant trends and overall situation of quantitative nature regarding scientific activity.

In that sense, measurement of scholarly impact is considered one of the strongest currencies in the Academy (traditionally been equated with number of citations—be it for individuals, articles, departments, universities, journals, or entire fields), given its scholarly impact of multidimensional nature construct on members of the academia (Aguinis, Suárez-González, Lannelongue, & Joo, 2012) by including a diversity of relevant measurements including studies regarding most productive and influential countries, leading journals in the field, authors, affiliations (Merigó, Cancino, Coronado, & Urbano, 2016); universities and research scholars who have had the greatest impact on the field (Podsakoff, MacKenzie, Podsakoff, & Bachrach, 2008); frequency of terms extracted from publication titles (Pritchard, A., 1969); and even visualization techniques using specialized software such as VOSviewer and NVivo to perform complexity reduction in large bodies of literature and theorizing

graphically (Sinkovics, 2016); in the sense of understanding stakeholder management on energy and sustainability for the present work, the methods used are including in the following section.

2 METHODS

The analysis made in the present work will take into consideration bibliometric indicators proposed by Macan & Petrak (2014), that can be classified into three categories: quantitative indicators, used to measure the productivity of relevant researchers; performance indicators, that measure the quality of journals or researchers; and structural indicators, useful to establish a link between publication, authors and research fields.

Also, recommendations from Zupic and Čater (2015) in terms of main bibliometric methods that considers the use of citation data to to construct measures of influence and similarity, and co-word analysis to find connections among concepts that co-occur in document titles, keywords and abstracts.

To achieve that, the process we applied follow a procedure that explains how we collected the data, the use of keywords, the type of documents considered, the most important indicators and the specific analysis for bibliometric review, ending with the discussion regarding the findings and research proposal for future interest.

Following the recommendations of the AMSTAR protocol (Shea et al., 2007), as a measurement tool to assess the methodological quality of systematic reviews, for this research paper the data was collected from Scopus database, which is a source-neutral abstract and citation database, curated by independent subject matter experts, with tools that generates precise citation search results and automatically updated researcher profiles, that includes more than 75 million records, with 68 million post-1970 records.

In the research questions we focused on descriptive analysis to understand the development of the research field of the stakeholder management theory at country, institution and journal level from the first mentions of those combines set of topics in the literature, establishing an inclusion criterion limited to “Articles” in the Final (or published) stages, as the selected document type from all type of sources, affiliation, sponsors, countries, and source types, in English language; all other type of documents such as Conference Papers, Book Chapter, Books, Editorials, Conference papers and Letters were excluded, since in recent years the research paper represents the most used form of

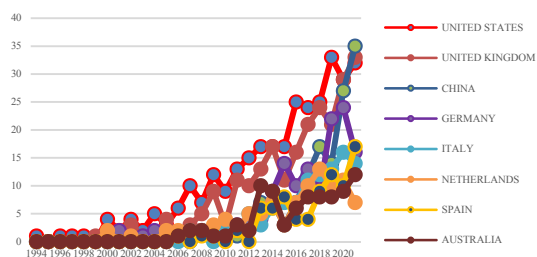
communication of science and this was made in order to ensure an objective and equivalent comparison among study subjects.

In those terms, we present the most relevant and influential articles regarding the subject between 1969 and 2021 using Scopus database, considering 23,841 document results including the keywords: “Stakeholder”, “Management”, “Energy” and a diversity of concepts related to sustainability; besides, the selection was limited to “Social Sciences, Business and Economic” as subject areas, using the option “show all abstracts”, and a sorting option on: “Cited by highest”; in that sense, there were no conflict of interest that could affect the rigorous method of selection for the analysis.

3 RESULTS

To understand how the production of papers have increase in time as an introduction to the descriptive statistical analysis, first we present the productivity tendency since the first paper where the concept was mentioned.

The results show the country of origin of the leading research being mainly in eight countries which accounts for the 50% of the total publications: United States (13%), United Kingdom (10%), China (6%), Germany (6%), Italy (4%), Netherlands (4%), Spain (4%) and Australia (3%); the literature about the significance of stakeholder management on energy and sustainability subjects shows a positive trend in the last year, with a clear positive tendency in the number of documents published each year considering the period between 1994 and 2021, beginning with the works of Hirst (1994) focused on conducting planning to assess demand and supply resources to meet customer energy-service needs; and Jelacic (1994), focused on method related to geothermal wells; in comparison to the year 2021 that covers a wide array of subjects, including papers that mentions keywords related to subjects such as sustainable development (59), climate change (36), energy management (33), decision making (31), waste management (13), alternative energy (23), economic and social effects (22), water management (19), energy efficiency (18), environmental management (18), and investments (18), among others. In what refers to total productivity of each country, is possible to notice the relevance of the United States in the overall productivity, being the global leader in studies related to stakeholder management focused in energy and sustainability, as figure 1 shows.



Source: Own elaboration based in Scopus (2022).

Figure 1: Tendencies of productivity in the most productive countries.

Figure 1 shows that all the countries have a positive tendency, and that China is making an important leap in the final trace of the period considered, since in 2021 showed the largest productivity considering the tier 3 countries on the list.

3.1 Concentration Index of Productivity of Countries in Stakeholder’S Management Research

To better understand the level of concentration of productivity in terms of documents published at country, institution and journal level, we used the Ck concentration index, which is an index that presents a sum of the shares in publication given a K largest institution, journals or countries in this scientific field, calculated as expressed in formula 1 (Valencia, 2020):

Formula 1: Ck concentration index

$$C_k = \frac{\sum_{i=1}^k Documents}{\sum_{i=1}^N Documents} \quad (1)$$

Source: Own elaboration based in Valencia (2020).

Where K represents the quantity of documents published in a journal, country or institution related to the scientific field. Using this index, is possible to understand if there is any relevant concentration in the production and citation in a specific subject in terms of regions, institutions, and journals.

The way to interpret the index is as follows: Ck < 33% = low concentration; 34% < Ck < 67% = moderate concentration; Ck > 68% = high concentration. Now, a list of the most productive countries using an analysis with concentration index by the total productivity of each country.

Table 1: Most productive countries and Ck concentration index.

CK	Country	Documents	%
4	United States	342	12.8%
	United Kingdom	266	9.9%
	China	166	6.2%
	Germany	153	5.7%
10	Italy	115	4.3%
	Netherlands	102	3.8%
	Spain	95	3.5%
	Australia	88	3.3%
	Canada	87	3.2%
	Sweden	67	2.5%
	18	France	66
Denmark		56	2.1%
Greece		49	1.8%
India		48	1.8%
Finland		46	1.7%
Austria		45	1.7%
Switzerland		45	1.7%
Portugal		44	1.6%
Rest of countries		802	29.9%

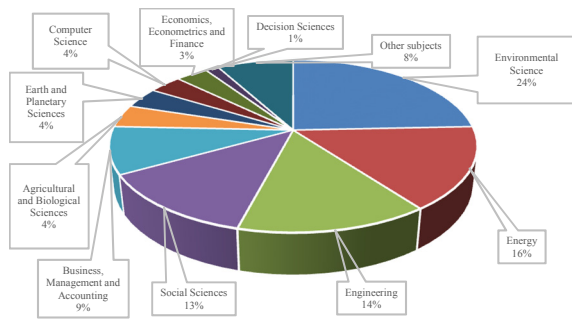
Source: Own elaboration using data from Scopus (2022).

As we can see in table 3, there is a moderate level of concentration in the countries that have a production of documents in the subject of stakeholder management focused in energy and sustainability subjects, mainly in ten countries: United States, United Kingdom, China, Germany, Italy, Netherlands, Spain, Australia, Canada, and Sweden.

3.2 Most Related Subject Areas and Keywords

Stakeholder management represents an approach to organizational management used in a diverse framework, where topics such as most common subject area and specific keywords found in the database of Scopus can provide a better view of the studies that are made related to this specific topic.

First, when analyzing the distribution by subject area, most articles written about the subjects relate to Social Sciences and Business Management and Accounting, leaving other subjects to a lesser percentage of participation.

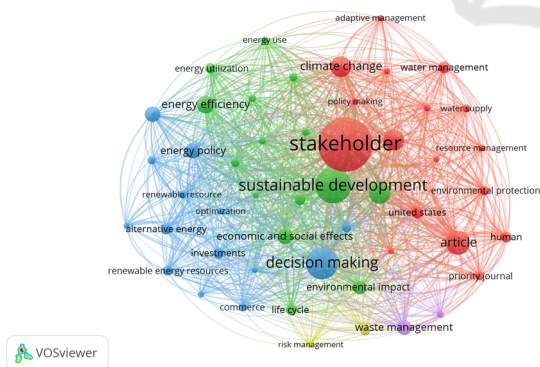


Source: Own elaboration using data from Scopus (2022).

Figure 2: Documents by subject areas.

As we can see in figure 2, the most present representative areas are Environmental Science, Energy and Engineering which represents the 54.07% of the total publications; up to 2022, those are the dominant fields of the stakeholder's approach related to energy and sustainability present in the research works founded in the Scopus database.

Following the analysis, we proceed to use the VOSviewer software to perform a graphic analysis of the database, since this specialized software is useful to construct networks of scientific publications, journals, researchers, organizations, countries, keywords, or terms (van Eck and Waltman, 2017); figure 4 show the relationship of the publications in terms of bibliometric by keywords, in terms of the multiple relations found in keywords related to stakeholder management, giving a better idea of how researchers are using the topic to study and explain related issues.



Source: Own elaboration using VOSviewer (2022).

Figure 3: Bibliometric network by keywords.

To better understand the data present in figure 3, the software presents the main keywords related to stakeholder's management research, considering a minimum number of 25 occurrences of each keyword (a custom attribute that indicates the number of documents in which a keyword occurs), in which 76

meet the threshold; also, we eliminate keywords directly related to the meaning of the subject and regions (such as the term stakeholders, stakeholder management or names of countries, among others) to avoid repetition of concepts.

A general overview of the most influential papers considered in this research shows that the subjects can be summarized in specific keywords, which are represented in the next figure 5:



Source: Own elaboration using data from Scopus (2022).

Figure 4: network analysis of index keywords presents in the most influential papers by citation.

As figure 4 shows, the index keywords that have the highest number of occurrences are 13, presenting a varying level of link strength with the rest of keywords in the most influential papers by citations that goes from 7 to 13, which include climate change, competition, decision making, economic and social effects, innovation, risk assessment, supply chain management, sustainability, sustainable development and United States.

3.3 Most Influential Authors

Next, for the analysis related to the most productive and influential authors, the table 8 presents data in terms of TP = Total Papers; TC = Total Cites, CPP = citations per paper and H index for the authors regarding the papers published related to stakeholder's management.

Table 2 shows that the most productive authors in terms of cites are not necessarily the most influential, as we can see with the relationship among citation level and productivity: Holthus (0), Mbohwa (2.5), Wright (0.25), Abram (4) and Bernnat (4).

In terms of the most cited papers in stakeholder's management on energy and sustainability, the following table includes information related to the respective papers in terms of journal (J), total citations (TC), title, authors, year of publication and the average citation per year (C/Y).

Table 2: Top 10 authors by average citations per paper (CPP).

#	Author	Total papers	Total Cites	CPP (Citations per paper)
1	Dale, V.	6	330	55
2	Junginger, M.	5	63	12.6
3	Kline, K.	5	300	60
4	Holthus, P.	4	0	0
5	Lombardi, P.	4	49	12.25
6	Mbohwa, C.	4	10	2.5
7	Wright, N.	4	1	0.25
8	Abram, T.	3	12	4
9	Bernnat, W.	3	12	4
10	Brouwer, F.	3	37	12.33

Source: Own elaboration using data from Scopus (2022).

4 DISCUSSIONS

This study presented a general overview of the most productive sources in the subject of stakeholder's management on energy and sustainability, which show a comprehensive view of the research field in those subjects. The main advantage of this approach is that it identifies the most productive and influential authors, journals, institutions and countries are presenting the major productivity in a focused research field of study, so any person interested in the subject can clearly identify where is the leading research taking place since 1994 to 2021.

The productivity observed in the considered period (between 1994 and 2021), shows a clear positive slope in the number of publications each year; also, the most present related subjects are climate change, competition, decision making, economic and social effects, innovation, risk assessment, supply chain management, sustainability and sustainable development, with a peak of productivity in the year 2021.

Using the concentration indexes is possible to understand if there is any relevant concentration in the production and citation in a specific subject in terms of regions, institutions, and journals; the results show that there is an important concentration of productivity mainly in eight countries: United States, United Kingdom, China, Germany, Italy, Netherlands, Spain and Australia, with a

predominance of United Kingdom and United States, followed by a recent increase in the scientific production of China. The global leading institutions in the subject are Delft University of Technology and Wageningen University & Research (Netherlands), Imperial College London, The University of Manchester and University of Leeds (United Kingdom), Chinese Academy of Sciences and Hong Kong Polytechnic University (China), and finally, Rutgers University–New Brunswick (United States).

This work reveals the following insights, firstly, in what it comes to the main keywords related to stakeholder's management on energy and sustainability are: sustainable development, decision making, environmental management, climate change, environmental impact, economic and social effects, energy efficiency, energy policy, waste management, environmental protection, economics, alternative energy, energy resource, energy management, life cycle, energy utilization, investments, water management, greenhouse gases, renewable energy resources, water supply, risk assessment, energy conservation, emission control, renewable resource, energy planning, carbon dioxide, recycling, energy use, environmental policy, commerce, resource management, policy making, public policy, renewable energies, optimization, carbon, participatory approach, adaptive management, governance approach, biomass, risk management, project management; also, there is a strong presence of keywords referring to United States and China.

This relation show that stakeholder's management on energy and sustainability are subjects close to investment, utilization, waste management and risk management and assessment. The most influential authors are Dale, V.H. and Kline, K.L., who are the authors with the highest level of citation in the considered period of time; meanwhile, the authors of the most influential papers are from countries such as United States (3), China (2), United Kingdom (1), Spain (1), Netherlands (1), Norway (1), United Arab Emirates (1), Greece (1), Germany (1) and France (1); it is also relevant to highlight that the most influential work is related to climate change impacts and adaptation in cities, being a systematic literature review by Hunt & Watkiss, in 2011.

5 CONCLUSIONS

Given that Bibliometrics are useful tools for document and justify the role of the research work in terms of understanding the evolution of a given scientific fields, the contributions of the present paper

are substantial to better understand the behavior of scientific activities in what comes to energy and sustainability considering stakeholder management as a basis.

With this information, the scientific community can have a clear overview of the most significant trends in relation to productivity (at country and subject levels) and influence (at related subjects expressed by keywords and authors level) in a practical and useful manner; that is one of the reasons that support the structure of the descriptive argumentation included in this research.

As a group of researchers that are specialized in the subject, the authors consider that the information included is relevant to identify key aspects that shows the main contributors in the field, useful to trace relationships amongst indicators such as most productive countries, subjects and even authors, which can be used to show an actual trend in the study of a subject, given space to discussion that can be present in multidisciplinary studies; in a sense, this information could be used to identify a given predilection of a country in the subject that guides the interest of such nation in developing goals towards energy and sustainability taking into consideration stakeholder management as the main managerial practice to achieve those, considering that bibliometric methods are frequently used in the field of library and information science.

In the other hand, in what comes to the citation analysis (based on constructing a citation graph in a descriptive manner), this is useful for any research fields to explore connections between keywords or even authors, the impact of a particular paper, with the possibility for the development of thesauri, and evaluation of reader usage.

Given the findings, it is important to understand the changes that recent events brought to the subject; in that sense, in future research is necessary to develop further analysis in terms of specialized subjects related to a during and post war environment in relation to the current conflict in Russia and Ukraine; that could provide a major understanding of the intellectual structure of stakeholder management on energy and sustainability by applying methods such as bibliographical coupling, co-citation, co-author analysis, and possible correlations with conflicts of geopolitics nature.

Thus, the main contribution of this paper is not just descriptive for the results, but also a procedure to obtain, process, analyze and show the overall behavior of scientific productivity, influence and trend of any given field, being these aspects as relevant for the research community.

Also, it represents a practical way to use the bibliometric information to understand where the scientific activity is heading, what countries are more interested in a particular topic, what kind of keywords or specialized subjects are more relevant to the field and who are the most influential actors, so any researcher can have the possibility of using this methodology to create their own analysis.

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