

# Open innovation in SMEs a bibliometric literature review using VOSviewer

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## Abstract

**Purpose** – The focus of this study is to evaluate the features of open innovation using data accessed from the Scopus online database. We are looking at two keywords: open innovation and SMEs.

**Design/methodology/approach** – The study measured a bibliometric analysis of 1,214 articles from 157 journals during 2007-2020.

**Findings:** The findings showed that the publication trend on open innovation kept increasing. The most cited article was *Open Innovation in SMEs: Trends, Motives, and Management Challenges* by Van de Vrande with 1,107 citations, followed by Lee et al. with 699 citations. The publication journal with the highest citation was Technovation and Research Policy. The United Kingdom and Italy were in the top-ranking countries for publications on this topic. The document citation category showed that Belgium ranked the highest with 1,990, followed by the Netherland with 1,212.

**Research limitation/implications:** This study provides a literature search on open innovation and has several limitations that require future study recognition. These limitations include that databases are limited to sources originating from one database only in data collection and data synthesis.

**Practical implications:** The practical implications provide benefits about open innovation, which can help SMEs understand open innovation and apply it as their preferred strategy in developing business. This study also allows SMEs owners and managers to understand open innovation as a strategic choice to consider as the concept is a part of the strategic intervention for their business.

**Originality/value:** This study provides the most influential contribution and impact on the research interest of open innovation that develops from various fields, including leading researchers and their home countries. Second, a co-citation analysis addressed the second question in this research study.

**Keywords:** SCOPUS, VOSviewer, bibliometric review, open innovation, SMEs

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## Introduction

Studies about open innovation that exert influence on competitive advantage and performance are still an interesting debate for researchers in recent years (Inauen et al., 2011; Shin et al., 2018; Srisathan et al., 2020; Valdez-Juárez & Castillo-Vergara, 2020). Several researchers preferred to conduct research studies on open innovation in a study scope that focuses on SMEs (Ali et al.,

2020; Avalos-Quispe & Hernández-Simón, 2019). However, other researchers chose to focus on the scope of the study with research samples on manufacturing companies (Burcharth et al., 2017). Within marketing studies scope, (Zhang et al., 2017) tested open innovation emerging markets and focused on the company's international market coverage compared to companies with the domestic market.

Innovation is a broad term widely explored and adopted beyond geographical borders. Due to the advancement of technologies, development of better infrastructure, and revolution of industries, innovation has become a vital ingredient of these changes. According to (Marques, 2014), innovation and invention are different terms. Innovation refers to introducing a new product or system to the market, while invention involves discovering it.

In recent times, Small-Medium Enterprises are continuously interested in adopting innovation as a strategic move to improve their competitive edge. Generally, SMEs refer to businesses with a relatively small number of employees. According to (Schaper, 2020), SMEs do not have an international standardized definition. Usually, they have a limited number of employees or revenue. For instance, Malaysia defines an SME as an enterprise with less than 200 employees or 11.7 million USD, whereas Singapore SMEs generates less than 72 million USD. To create new successful products, a growing number of SMEs require knowledge about adopting open innovation to create value and improve their performance (Carrasco-Carvajal & Garcíá-Pérez-De-Lema, 2021)

The company's open innovation is considered a result of the availability of complementary resources and transformative capacities providing essential supports (Huang et al., 2015). Several researches in the course of the last 14 years have highlighted the open innovation concept of SMEs (Agostini et al., 2017; Ali et al., 2020; Avalos-Quispe & Hernández-Simón, 2019; Stanislawski, 2020), executive and top management levels (Najar & Dhaouadi, 2020; Naqshbandi, 2016; Tahir et al., 2021), global business service industry (Wei et al., 2018), manufacturing companies (Cabrilo et al., 2018; Hameed et al., 2018; Jeong et al., 2020), technology (Cabrilo et al., 2020; Wu et al., 2019), exporting firm (Meidute-Kavaliauskiene et al., 2021), smartphone industry (Han et al., 2020) and several other sectors. As a result of this concept's study interest being high, there is a need for sufficient understanding of its development, progression and advancement and its capacity for further application in other diverse disciplines. Therefore, it is indeed critical to investigate the open innovation phenomenon to develop understanding and knowledge whose benefits cut across the industry sector and academia field. It is where the current study is heading.

Various researchers have previously reviewed and conceptualized open innovation theoretically and empirically (Ali et al., 2020; Avalos-Quispe & Hernández-Simón, 2019; Bogers, 2019; Gupta et al., 2016; Lo et al., 2020; Valdez-Juárez & Castillo-Vergara, 2020). Considering that the open innovation topic is becoming increasingly important in theoretical and empirical studies, it is therefore evident that this concept is a strategy chosen by companies in maintaining a sustainable edge in their competitive advantage amidst the uncertainty of the business environment and rapid changes in information technology (Valdez-Juárez & Castillo-Vergara, 2020). Systematic and in-depth analysis, therefore, is a component required to incorporate a holistic picture related to the open innovation concept. This analysis describes in-depth the idea of open innovation from various previous literature. Therefore, a wide background research on the bibliometric analysis is needed to explore the dimensions of open innovation for 14 years since popularized in 2007.

This study is the first bibliometric research of open innovation covering sources up to 2020. Previous bibliometric studies like (Thi et al., 2019) analyzed open innovation from 2007 to 2017 using the Web of Science database, whereas (Odriozola-fernández & Berbegal-mirabent, 2019) covered the research area from 2003 to 2017 using Social Science Citation Index database. Therefore, this bibliometric research will be one of its kind to cover publications running up to 2020 and using the Scopus Engine. The year 2007 is selected as a starting period as most of the publications were growing by this timeline.

This study also draws on several topics regarding critical open innovation studies for practitioners and academics. However, given the significant growth recently in the literature review on open innovation and limitations in the methodological approach adopted, this study does not

measure recent developments in the discussion of the concept of open innovation. The authors pin-point a gap to be filled in the literature to closely analyze developments around the open innovation concept and explain the extent to which many previous researchers have studied this concept. This study objective is to fill this space by conducting a systematically detailed and organized bibliometric analysis than previous studies.

This study was conducted using a bibliometric approach. The bibliometric analysis uses a meta-analytic method summarizing a group of bibliographic publications to show the relationship between articles with several parameters by analyzing quotations using a quantitative design, and in the process revealing the main research themes related to specific topics (Dohale et al., 2020; Kim & McMillan, 2008; Özdemir & Selçuk, 2021). The bibliometric approach assumes that publications have been made on the topic being researched and published in scientific journals. Researchers have considered these journals on the basis of similar articles published in them (Fetscherin & Usunier, 2012). Using an approach through bibliometric studies, the most prominent works that provide contributors in a particular field will be easy to find out. A bibliometric approach can also showcase the top influential articles and journals whereas describe the evolution of specific fields.

The aim of this research is to systematically analyze the features of the study about open innovation in the SME scope using data accessed from the SCOPUS online database by looking at two keywords: open innovation and SMEs. The bibliometric analysis helped to understand the subject's general descriptions in question and identify emerging research paths. The VOS viewer software was utilized to accomplish the proposed objectives. This tool allows the development of bibliometric citations, co-citation, and co-word maps, allowing the researcher to envision the current state of the matter and observe new research paths.

The paper is structured according to the sections as follows: the first is a literature review which categorizes the selected articles in a chronological manner of different periods; the next section describes the methodology used in the literature review, including data collection techniques and sampling methods; the third part covers the research and evaluation of the resulting bibliometric maps, and the final section provides a discussion of the findings and conclusions.

## Literature Review

Open innovation is a concept that has been widely researched, especially in large technology multinational companies, which are oriented towards global markets and sufficient financial facts (Hameed et al., 2018; Jeong et al., 2020; Wei et al., 2018). This study focuses on the concept of open investigation in the SME scope. Open innovation practices are also applied to SMEs as in several previous researchers (Avalos-Quispe & Hernández-Simón, 2019; Najar & Dhaouadi, 2020; Stanislawski, 2020). The practice of open innovation strategies for SMEs is still a concern since the business scope has various limitations in the capital, access to market information, labor, skills and competencies, and the number of resources that support their operations.

Open innovation applies diverse ideas in an organizational context combining resources in firm processes (Rauter et al., 2019). According to (Baregheh et al., 2009), the research highlights different definition approaches of open innovation. For instance, the concept of open innovation is defined broadly by (Kimberly & Evanisko, 1981) as taking three various forms; a discrete item like goods, a process, and a firm's attribute. Other researchers define open innovation from a newness perspective (Damanpour, 1996), technological perspective (Editor et al., 1989), and knowledge management perspective (du Plessis, 2007).

The study developed by Lee et al., (2010) put the open innovation concept in small medium-enterprises there by providing solid support through innovation in achieving the success of SMEs. He further explained that the strength of the SMEs network determines the potential for open innovation for SMEs as a unit and an effective strategy in facilitating open innovation among SMEs.

Open innovation focusing on bountiful external pools of knowledge can shift into innovation. According to Chesbrough (2003), open innovation accumulates both internal knowledge and external knowledge in developing as well as commercializing company products or

services. Open innovation is the opposite of a company innovation system that is managed closely. This innovation emphasizes the creation of benefits from the accelerated use of new knowledge. Chesbrough (2003) distinguishes between open and closed innovation in the scope of Research and Development. As closed Research and Development is seen as a competitive advantage, open R&D mostly deals with the search of new external information that are collaboratively required to speed the development of innovations.

Valdez-Juárez & Castillo-Vergara (2020) expounds that open innovation is critical in achieving goals. Achieving the goal of technology capability is an essential factor in increasing open innovation and affecting company performance. Open innovation also affects the performance. Although the concept of open innovation is primarily at the company level, in practice, this concept can also be applied at all levels in the organization. The limits on the open innovation concept can be tested on the supply chain (Thi et al., 2019), human capital at the managerial level (Najar & Dhaouadi, 2020), and the R&D scope (Najar & Dhaouadi, 2020).

Open innovation is a company practice supporting strategic choices for company to access business networks at a relatively low cost. It also minimizes barriers such as finance, technology, and human resources, which can hinder growth-oriented perspectives from accessing new markets and improve performance (Shin et al., 2018). Open innovation also explains that companies can obtain external pools of knowledge derived from contrasting market-based partners (Santoro et al., 2018). This open innovation can form integration in the form of knowledge capabilities through practice to support innovative capacities.

The open innovation concept in the scope business should emphasize the choice of non-closed R&D processes chosen by company in managing innovation to describe innovation (Santoro et al., 2018). Company with capability resources and competencies and technology can develop open innovation. For example, in the marketing scope, the concept of open innovation can be practiced with external marketing agencies built by SMEs to reach the commercialization stage. Open innovation can also occur when SMEs can collaborate with their networks, particularly in R&D (Hameed et al., 2018), which are actively involved in partnership, contributing largely to the process of innovation by market exploitation, market testing, or absorption capacity (Wu et al., 2019).

Open innovation and closed innovation contrast depending on organizations' approaches to innovation. (Marques, 2014) explains the differences between these concepts and highlights the work of (Chesbrough et al., 2007), who provides a basic differentiation model of open innovation as illustrated in the following table.

**Table 1.** Comparative between open innovation and closed innovation

Open Innovation	Closed Innovation
Not all clever people work in a firm	All intelligent people work in a firm
External R&D provides value to the firm	To capitalize on R&D, we need to create and supply everything
Internal R&D is necessary to create value	If we keep discovering, we will enter the market first
We should participate in basic research, but the discovery does not have to be us	We will be winners if the company commercializes fast innovation as the first player
We will win if we unify the knowledge internally and externally	We will win if we create the most and best ideas in the industry
We should optimize the firm's outcomes by licensing our innovations and buying external innovation processes	If we fully control pools of innovation, our competitors will not profit from our innovative ideas

Source: (Chesbrough et al., 2007)

Open innovation is an ingredient that spurs technological advancements and is a more efficient choice for organizations than closed innovations. Due to rising product development costs and shorter product life cycles, many companies engage in open innovation to leverage their market standing and increase profits (Gassmann et al., 2020). There are many examples of such companies globally that divide their innovation work with other firms. Initially, Qualcomm produced cell phones and base stations but later on ceased, allowing other firms to make the products under

Qualcomm's license. Similarly, The Procter & Gamble Co. has an open innovation model whereby product development arises from collaborative efforts contributed by different companies.

Smaller companies should also consider open innovation to leverage costs, improve their profitability and steer growth. Alibaba is an example of an SME that grew into a large profitable company due to adopting an open innovation-friendly environment (Yun et al., 2020). The Open Innovation concept is considered highly relevant for the success of technology-intensive companies (Yun et al., 2018). Some of the advantages accrued to implementing open innovation include fostering technological innovations, reduced financial expenditure, and lessened cost of losses.

## Methods

This study aims to determine the latest study trends and identify a conceptual work to provide future research designs using bibliometric indicators which conceptualize data with open innovation topic. The search engine on the Scopus database filtered to 2007-2020 publications to identify the broad literature on the open innovation concept.

The researcher selected the collection period of publications from 2007 as there was a consistent growth of the number of publications during this time compared to earlier periods. The popularity of the open innovation topic rose at the end of the first decade (2001-2010), leading to a growth of the publications.

Scopus is one of the most extensive citations to include a database of abstracts that undergo a thorough review from peers (Zahra et al., 2021). Although several publications discuss open innovation, this study focuses only on international journals extracted using the search engine from the Scopus database accessed through a non-free document subscription. In practice, there exists a proportion of studies on the open innovation topic that has a reasonably large cross-index in Scopus and on the web of sciences. This study does not include all of these databases because it allows a realistic representation of research topics related to open innovation in various journals. Furthermore, the search for strings is limited to getting the maximum number of records that correspond to open innovation depending on the period of publication (year). The authors compiled the articles published from 2007-2020 with the highest number of publications.

The researcher considered collecting data from the Scopus engine as it is a highly peer-reviewed database consisting of quality publications with a higher impact factor than other databases. In addition, many similar previous researchers already utilized other databases like the Web of Sciences and Social Science Citation Index. Therefore, there is a gap in research to be conducted and collected from the Scopus engine. Authors compiled articles with the highest number of publications, most influential journals and authors, top publishing countries, and top-cited documents. The collection of data enables analysis of the trends of publications to reveal the body of open innovation literature in the period from 2007-2020.

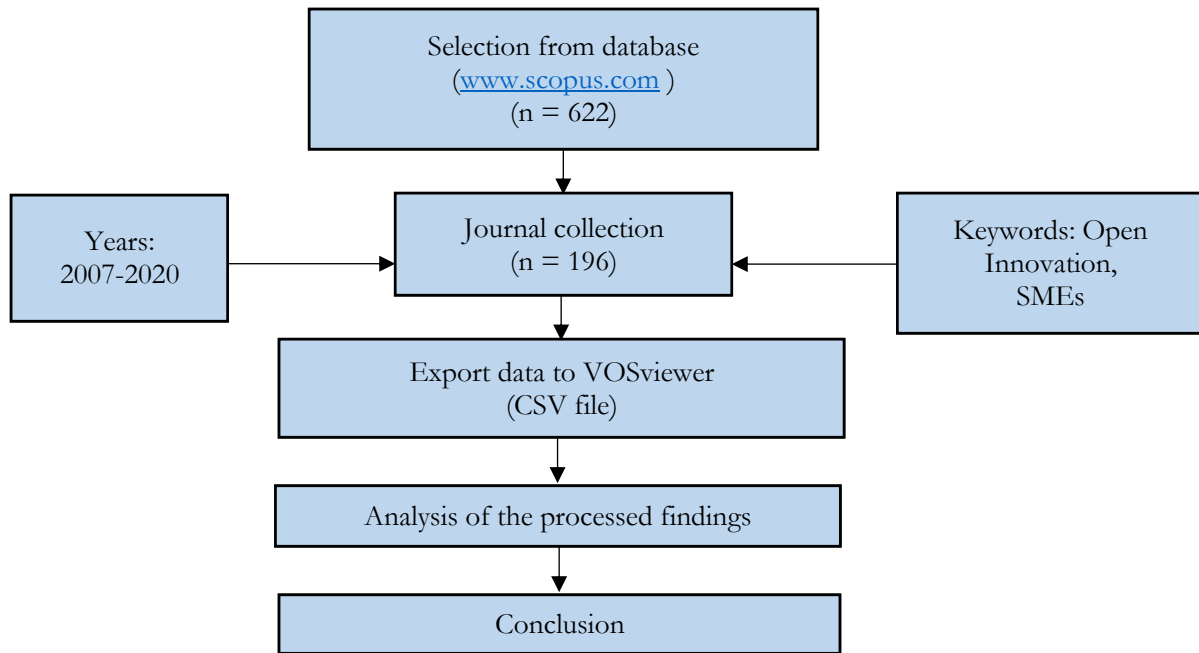
### Scopus Filtering

The Scopus search engine filtered 2007-2020 publications to identify the extensive literature on specific open innovation. Scopus is one of the most extensive citations and abstract literature databases, such as scientific journals, books, and conference proceedings. The initial search identified 622 journals which were later reduced to 196 after deleting documents that were not classified as articles, reviews, letters, or notes. Thus, the final number of analysis papers was 196. This research study aims to extract and analyze data from published scientific articles from well-known journals.

**Scopus Filtering** Thus, the final number of analysis papers was 196. This research study aims to extract and analyze data from published scientific articles obtained from the scopus engine.

### VOSviewer Analysis

By using the VOSviewer software and as a complement to the analysis, this study also presents graphic images of bibliographic materials (Van Eck & Waltman, 2010). The software retrieves saved excel (CSV) format data and generates maps based on combining bibliographies, co-authoring, quotations, co-quotes, and shared keywords (Merigo et al., 2016).



**Figure 1.** Research Methods

**Data Analysis**

The research data about this topic was collected from the Scopus database. The Scopus website from Elsevier provides the largest scientific literature database based on abstracts and citations that are peer-reviewed. The authors selected this database because the highest number of topic-related data are generated. Further inclusion and exclusion procedures applied regarding the publication period (2007 - 2020 publications), keywords (open innovation, SMEs, Small Medium Enterprises keywords), sources (articles, reviews, book chapters, and conference papers), and subject area (business, management and accounting areas).

The reasons for selecting the diverse inclusion and exclusion criteria are based on their relevance to this study. However, the specific period between 2007 - 2020 was chosen because this study topic was gaining popularity during this period, similar to research done by (Saha, Mani, & Goyal, 2020). Based on the research questions, proper analysis of the data was derived and conducted using VOSviewer 1.66 software and interpretation of data from the Scopus analysis engine. For data to be exported for further research in the VOSviewer app, it was saved in CSV format. The bibliographic information like abstract and keywords, bibliographic information, citation information, and other relevant information was extracted for exportation purposes.

Regarding the first research question: "1) How many articles are currently covering Research Trends in SMEs Open Innovation?", the authors conducted a Scopus engine search that generated 196 publications from 622 general publications. These data were further analyzed using the Scopus analysis tool that developed a map for the publication trends between the years 2007-2020. Furthermore, this data could also be more widely mapped out by the VOSviewer software tool after exporting the whole data under CSV format to produce three information constructs: Co-authorship of authors, organization and country, and co-citations and keywords.

The authors sought the answers to the question by analyzing the data derived from the Scopus engine through the VOSviewer application to develop network linkages and density overlays for keyword occurrences. Therefore, the various themes originating from the keywords are visible and connected to different accessible paper titles forming other clusters.

**Result**

This section describes the data analysis using VOSviewer. VOSviewer is assistive software used in the accurate technique of bibliometric analysis. The bibliometric analysis consists of the first stage,

which will present the citation results. Then, it will add joint citation analysis and co-author using their respective keywords.

### Citation Analysis

In this category, evaluation describes the results in the following format: general findings and statistics relating to the study; the amount of papers produced annually; the papers with the highest citations; the most influential author; the top influential journals; the top influential institution; and the most influential country.

Citation Analysis ensures an assessment of papers' impact quality and frequency of publications, thereby providing an in-depth understanding of the topic. According to (Odriozola-fernández & Berbegal-mirabent, 2019), citation analysis as part of the bibliometric analysis is vital for capturing an overview of a topic's state of the art. Moreover, information derived from the study is crucial for newcomers and policymakers requiring knowledge on creating reforms linked to open innovation and SMEs.

### Result

This area considers 1,214 articles originating 119 paper, produced by 471 authors attached to 371 institutions in a total of 57 nations, garnering a wide total reference citation of 5,234 (see Table 2). In full non-specific results, snippets of all the articles under review of the open innovation concept are shown.

### Publications Per Year

The evolution of research about open innovation from 2007 to 2020 reveals an exciting description of the data. First, early studies about open innovation from 2007 to 2008 are still limited. Even in 2008, no data describes the open innovation study. However, from 2009 - 2016, discussion on the concept gradually increases steadily. The study illustrates a closely consistent growth in publications achieved in those vulnerable years. In 2017 and 2020, it reaches the highest publications at 14 years. In 2018, there is a drastic decline (see Figure 1). However, in 2018, there has been a significant increase from 2018 - 2019. The year 2020 has received more publications compared to previous years.

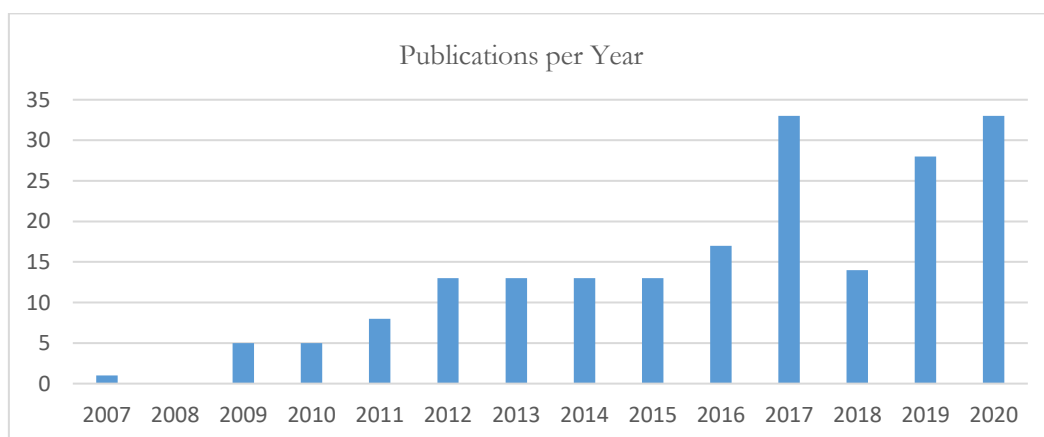


Figure 2. Publications Per year

Table 2. General results

Criteria	Quantity
Countries	57
Authors	471
Institutions	371
Journals	119
Publications	196
Cited references	5,234

### The Most Cited Document(s)

This section displays the 21 most cited paper from publications. The research papers are ranked in citation volume from top citations volume to the lowest citation of the 21 documents.

**Table 3.** Top 21 Document Cited

No.	Publication Title	Year	Authors	Citations
1	Open innovation in SMEs: Trends, motives and management challenges	2009	Vareskavan de Vrandea, Jeroen P.J.de Jong, WimVanhaverbeke, Mauricede Rochemont	1,107
2	Open innovation in SMEs—An intermediated network models	2010	SungjooLee, Gwangman Park, Byungun Yoon, Jinwoo Park	699
3	Building absorptive capacity to organize inbound open innovation in traditional industries	2010	André Spithoven, Bart Clarysse, Mirjam Knockaert	238
4	Open innovation practices in SMEs and large enterprises	2013	André Spithoven, Wim Vanhaverbeke & Nadine Roijakkers	237
5	Building absorptive capacity to organise inbound open innovation in traditional industries	2011	André Spithoven, Bart Clarysse, Mirjam Knockaert	215
6	On the path towards open innovation: assessing the role of knowledge management capability and environmental dynamism in SMEs	2017	Martinez-Conesa, Isabel Soto-Acosta, Pedro Carayannis, Elias George	129
7	Antecedents, moderators, and outcomes of innovation climate and open innovation: An empirical study in SMEs	2017	Popa, Simona Soto-Acosta, Pedro Martinez-Conesa, Isabel	122
8	The role of absorptive capacity in facilitating "open innovation" outcomes: a study of Australian smes in the manufacturing sector	2009	Fang Huang and John Rice	101
9	Research collaboration and R&D outsourcing: Different R&D personnel requirements in SMEs	2013	Peter Teirlinck, André Spithoven	91
10	Open Innovation in Practice: Goal Complementarity and Closed NPD Networks to Explain Differences in Innovation Performance for SMEs in the Medical Devices Sector	2012	Annemien J. J. Pullen, Petra C. de Weerd-Nederhof, Aard J. Groen, Olaf A. M. Fisscher	82
11	Open innovation in small and medium-sized enterprises: An overview	2013	Pooran Wynarczyk, Panagiotis Piperopoulos and Maura McAdam	75
12	Open innovation in SMEs: a systematic literature review	2016	Mokter Hossain , Ilkka Kauranen	75
13	Innovation intermediaries: a process view on open innovation coordination	2013	Bernhard Katzy a , Ebru Turgut a , Thomas Holzmann b & Klaus Sailer b	68
14	Which factors hinder the adoption of open innovation in SMEs?	2016	Bigliardi, B., & Galati, F	67
15	Connecting local entrepreneurial ecosystems to global innovation networks: open innovation, double networks and knowledge integration	2011	Edward J. Malecki	67
16	Roadmapping for technology push and partnership: A contribution for open innovation environments	2011	Mauro Caetano, Daniel C.Amaral	65



No.	Publication Title	Year	Authors	Citations
17	The effects of open innovation activity on performance of SMEs: the case of Korea	2010	Hyukjoon Kim, Yongtae Park	64
18	Open innovation and within-industry diversification in small and medium enterprises: The case of open source software firms	2014	Massimo G.Colombo, EvilaPiva, CristinaRossi-Lamastra	61
19	How to foster shared innovation within SMEs' networks: Social capital and the role of intermediaries	2015	CristinaIturrioz, CristinaAragón, LoreaNarvaiza	56
20	Open innovation in SMEs: A dynamic approach to modern entrepreneurship in the twenty-first century	2013	Pooran Wynarczyk	55
21	How start-ups successfully organize and manage open innovation with large companies	2017	Muhammad Usman, Wim Vanhaverbeke	50

Based on Table 3, the top cited article on open innovation is the *Open innovation in SMEs: Trends, Motives, and Management Challenges* (Van de Vrande et al., 2009). In this article, the authors conceptualized open innovation around the scope of SMEs, which previously was primarily done in high-tech companies. This study dealt with the rationale and obstacles in the process of Small and Medium Enterprises adoption of open innovation practices. The next most cited article is *Open Innovation in SMEs - an Intermediated Network Model* (Lee et al., 2010). In this article, the researchers discussed the concept of open innovation, its application capability and potential in the SME sector. The focus of the discussion in the article tried to put open innovation in the context of SMEs. Findings show that there is an untapped opportunity of open innovation for Small and Medium Enterprise. In addition, it highlights networking as accelerator for open innovation.

### The Most Influential Authors

This area showcases highly influential authors on open innovation topic. Authors' influence is evaluated by the amount of publications related to the topic. According to the citations received, Van de Vrande et al. (2009) were the most influential authors with 1,107 and Lee et al. (2010) 699 citations (see Table 3).

**Table 4.** Top Authors by Citations

Authors	Publications	Citations
Vanhaverbeke W.	3	1394
Spithoven A.	4	781
Yoon B.	2	704
Clarysse b.	2	453
Knockaert M.	2	453
Martinez-Conesa i.	2	251
Soto-Acosta p.	2	251
Huang f.	2	131
Rice J.	2	131
Wynarczyk P.	2	130

### The Most Influential Journals

This section shows the most influential journal with a narrative around open innovation. Based on the analysis, the International Journal of Innovation Management and Technological Forecasting and Social Change ranks the highest with nine (9) articles published, followed by the European Journal of Innovation Management and Technovation journals with six (6) published articles. For

citations received, the most influential journals are Technovation, with 1,731 citations, followed by Technological Forecasting and Social Change, with 243 citations each (see Table 5).

**Table 5.** Top Journals by publications

Journals	Publications	Citations
International Journal of Innovation Management	9	168
Technological Forecasting and Social Change	9	243
European Journal of Innovation Management	6	88
Technovation	6	1,731
International Journal of Business Innovation and Research	5	32
International Journal of Technology Management	5	152
Business Process Management Journal	4	37
International Journal of Entrepreneurship and Innovation Management	4	77
Strategic Direction	4	0
Technology Analysis and Strategic Management	4	171

**Table 6.** Top Journals by citations

Journals	Publications	Citations
Technovation	6	1,731
Research policy	3	764
Small business economics	2	251
Technological forecasting and social change	9	243
Technology analysis and strategic management	4	171
International Journal of Innovation Management	9	168
International Journal of Technology Management	5	152
Journal of product innovation management	2	131
Journal of knowledge management	2	129
Journal of small business and enterprise development	3	105

**The Most Influential Countries**

In this area, a description of the highly influential countries that have provided contributions to the research field of open innovation has been made. Countries are mapped to published authors and cited during their association with the countries. The United Kingdom and Italy are in the top ranks. From the parameters for documents in the two countries, United Kingdom has 29 documents, and Italy with 26 documents. Meanwhile, in document citation, the total citation received shows that Belgium ranks the highest with 1,990, followed by the Netherlands with 1,212 (see Table 8).

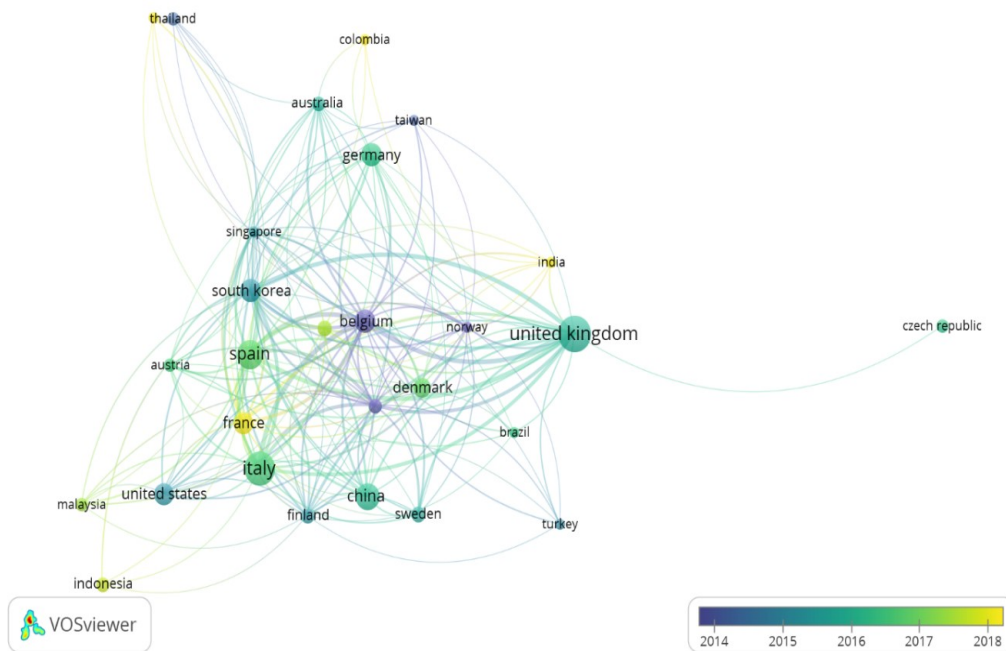
**Table 7.** Top Publishing Countries by documents

Rank	Country	Documents	Citations
1	United Kingdom	29	830
2	Italy	26	379
3	Spain	20	751
4	China	16	127
5	Belgium	12	1990
6	Germany	12	215
7	South Korea	12	868
8	France	11	55
9	United States	11	329
10	Denmark	9	193

**Table 8.** Top Publishing Countries by Citations

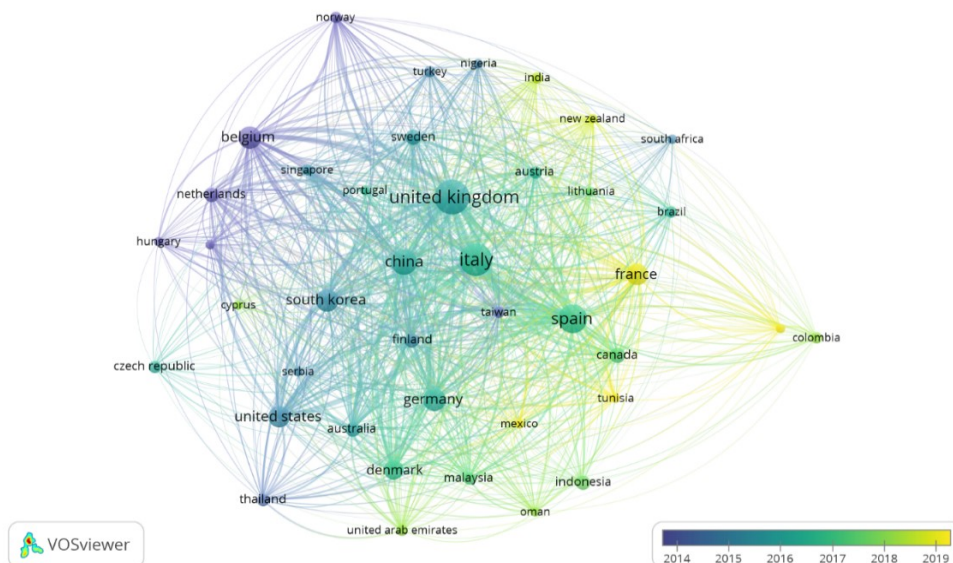
Rank	Country	Documents	Citations
1	Belgium	12	1,990
2	Netherlands	5	1,212
3	Switzerland	2	1,107
4	South Korea	12	868
5	United Kingdom	29	830
6	Spain	20	751
7	Norway	3	471
8	Italy	26	379
9	United States	11	329
10	Singapore	3	302

**Citation by Country**



**Figure 3.** Citation by country

**Bibliographic Coupling of Countries**



**Figure 4.** Bibliographic coupling of countries

### Co-citation Analysis

In this category, evaluation describes the results in the following format: general findings and statistics relating to the study; the amount of papers produced annually; the papers with the highest citations; the most influential author; the top influential journals; the top influential institution; and the most influential country. Co-citation analysis assesses the citation relationships of documents, and it's helpful to map publications of high credibility and reputation in a particular field. The researcher uses co-citation analysis to measure citation relationships of 196 papers retrieved from the Scopus engine into Voss Viewer.

Co-citation form of analysis describes the profiles of among them: the first being the authors most cited and the journals that have the highest citations. This segment displays the findings of co-author-author-author citation examination cited (Saha et al., 2020). The results of the analysis of the references came from the 1,214 articles. For a comprehensive analysis, the authors set up a total of 157 research publications. Citation analysis conducted derived the highest frequently cited author names displayed by the larger nodes (see Figure 2). The authors commanding the highest citation volume include Van de Vrande et al. (1,394 citations) and Spithoven A (781 citations). Chronologically, following authors are Yoon B. (704 citations), Clarysse b (453 citations), Knockaert M (453 citations), Martinez-Conesa I (251 citations), Soto-Acosta p (251 citations), Huang f (131 citations) ), Rice J (131 citations) and Wynarczyk P (130 citations). This list shows the overwhelming contribution of authors on the open innovation topic.

### Co-occurrence of Keywords

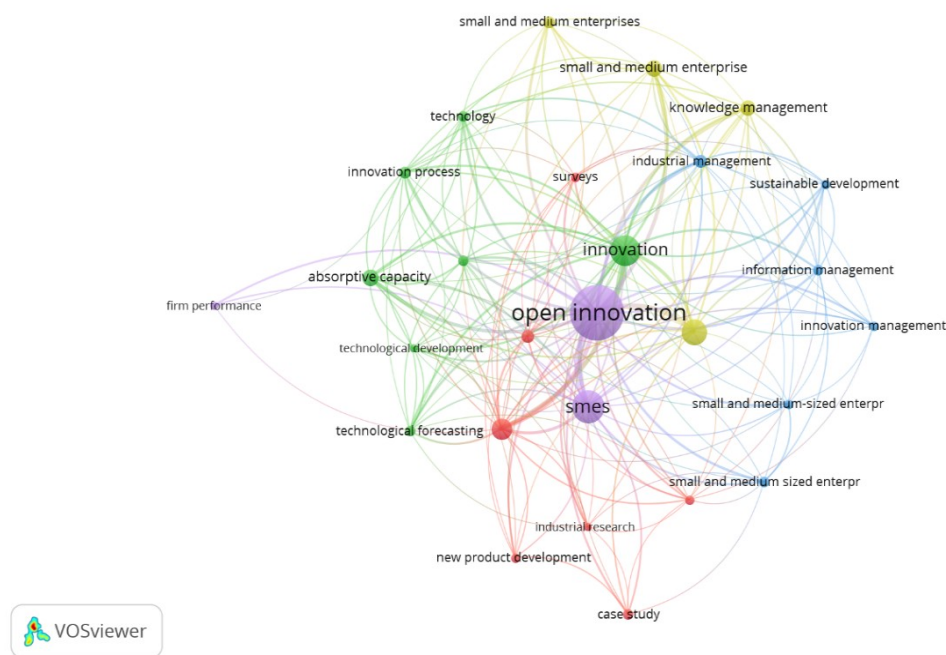
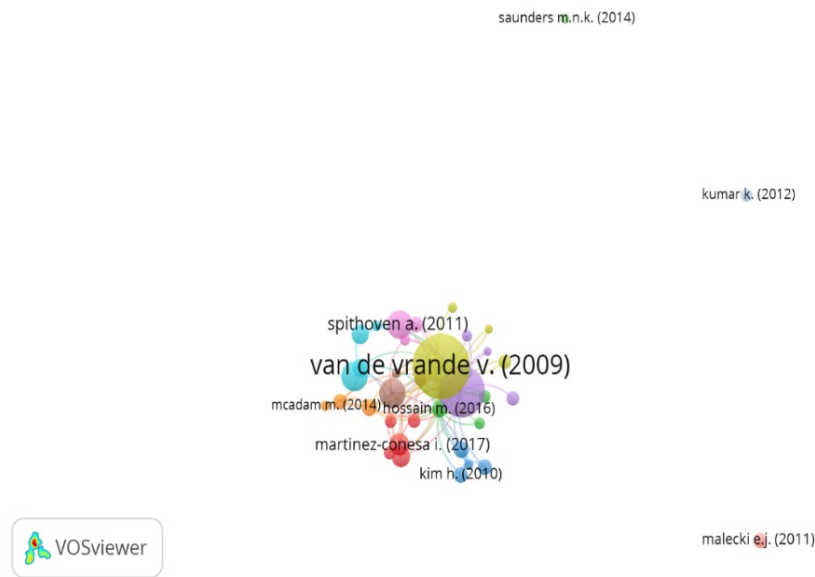


Figure 5. Co-occurrence of keywords

### Co-occurrence of Author Keywords

Figure 4 displays a map showcasing the keywords selected and entered by the author. The results found that names such as open innovation, "innovation," "SMEs," "technological forecasting," technological development, absorptive capacity, and information management are the most popular keywords found in this body of literature that discusses open innovation during the last 14 years. Plenty of other keywords have possible extensions to mould future roadmaps on open innovation, such as knowledge management, innovation process, new product development, innovation management. These keywords develop crucial knowledge on how the literature on open innovation has relied heavily on the concepts or keywords researched in recent years.



**Figure 6.** Co-occurrence of author keywords

## Discussion and Conclusion

This study seeks to assess the area of open innovation and map developments of this topic over the past decade. Bibliometric studies involving citation analysis techniques, co-citation analysis, and co-author keywords were to answer the predetermined research questions of this study. This research also measures developments of open innovation through conducting thorough bibliometric analysis of 1,214 articles from 157 journals between 2007 and 2020.

This study answers two critical questions in this research. First, a bibliometric analysis was used to answer research questions about how many articles currently cover Research Trends in SMEs Open Innovation. This question arouses a descriptive statistic approach to map out the evolution of research on broad aspects like influential journals, authors, countries, and co-occurrence networks (Gao et al., 2020). In addition, it enables the study to have an overview and future directions of the topic.

The publications related to open innovation have continued to increase for a decade. The trends in this publication can be categorized into two steps. The first step (2007-2009) was still limited. The second step, 2009 - 2016, increased continuously. In 2017 and 2020, the publication reached the highest number for 14 years. The most cited article was *Open innovation in SMEs: Trends, Motives, and Management Challenges* by Van de Vrande et al. (2009), with 1,107 citations. The most influential authors, Van de Vrande et al. (2009), were the most influential with 1,107 and followed by Lee et al. (2010) with 699 citations. The highest publications related to open innovation were *Technovation and Research policy*.

The United Kingdom and Italy were in the top ranks. From the parameters for documents in the two countries, United Kingdom had 29 documents, and Italy had 26 documents. Meanwhile, in the category of citation documents, the total citation received showed that Belgium ranked the highest with 1,990, followed by the Netherland with 1,212.

This study provides the most influential contribution and impact on the research interest of open innovation that develops from various fields, including leading researchers and their home countries. Second, a co-citation analysis addressed the second question in this research study. This study provides the most influential contribution and impact on the research interest of open innovation that develops from various fields, including leading researchers and their home countries. Second, a co-citation analysis addressed the second question in this research study which is similar to the research by (Odriozola-fernández et al., 2019). The co-citation analysis enables the

researcher to retrieve and analyze frequently occurring keywords that are garnering high interest in the field and co-occurrence of authors to show collaboration patterns.

The journals cited included the Journal of the Marketing Science Academy, Marketing Journal, Business Research Journal, Service Research Journal, and Management Industry Marketing. These results suggest that the top marketing journals played a big role by being the top contributors for value co-creation.

This research provides valuable practical and academic implications, including making several important contributions to open innovation and studies related to the topic, such as high impact factor journals and influential authors who have shaped this field. This finding is comparable with the results of previous studies obtained (de las Heras-Rosas & Herrera, 2021) on such a similar aspect. This research also identifies the gradual development of research on open innovation over a decade. Further, it contributes to the theory by describing the main research themes emerging from the literature on open innovation. The theme of this study is also in line with some of the key findings derived from the study (Van de Vrande et al., 2009).

The practical implications provide benefits about open innovation, which can help SMEs understand open innovation and apply it as their preferred strategy in developing business. This study also allows SMEs owners and managers to understand open innovation as a strategic choice to consider as the concept is a part of the strategic intervention for their business.

### Limitations and Recommendations

This study provides a literature search on open innovation and has several limitations that require future study recognition. These limitations include that databases are limited to sources originating from one database only in data collection and data synthesis. Several bibliometric studies generally select a particular database for evaluation to avoid creating duplicate data, for example, those originating from other databases (like web of science or google scholar). A single database made it easier for researchers in this study.

Another challenge this research poses is the lack of sufficient grasping of the contextualization of the article's citation structure. Another study clearly illustrated the nature of the citation structure for the literature on open innovation. Still, the context and intent of the citation structure could not be measured. For developing a future research roadmap, an extensive literature review using bibliometric techniques indicates some of the main directions of future research, such as a study focusing on open innovation related to management and business disciplines only. Besides, a literature review using bibliometric analysis can have several more techniques. Meanwhile, this study used three analytical methods in bibliometrics. Future studies will hopefully adopt other different bibliometric techniques to add more valuable insights.

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