PRODUCTION & MANUFACTURING | RESEARCH ARTICLE

Green procurement implementation through supplier selection: A bibliometric review

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Abstract: The purpose of this paper is to provide a brief bibliometric review of the previous literature review in understanding the implementation of green procurement through supplier selection. Researchers contribute to the field of procurement, especially in developing environmentally friendly procurement in supplier selection. In recent years, the public and private sectors have considered environmental aspects in their purchasing policies. Consideration of environmental aspects is known as green procurement. Using green purchases makes it known to produce environmentally friendly products so that the public can more easily recognize them. The method used is a structured literature study sample for 1994–2022. A total of 220 articles with the keywords green procurement and supplier selection were collected. Authors use Publish or Perish and VOSviewer to find journals, authors, citations, keywords, and word hierarchy maps. This bibliometric review related to the implementation of green procurement is useful for researchers and practitioners in their fields, especially those related to supplier selection. Research proves that green procurement became a widely adopted method in publications from 1994. This suggests that citation and forwarder network analysis for selected publications is a topic such as a supplier selection.

Subjects: Industrial Engineering & Manufacturing; Production Engineering; Manufacturing Engineering; Operations Research

Keywords: green procurement; supplier selection; bibliometric

1. Introduction

Over the past two decades, environmental considerations have become an important issue in purchasing (Witek & Kuźniar, 2021). As a result, both the public and private sectors face increasing pressure to consider environmental aspects in purchasing policies (Ma et al., 2021). This pressure arises due to the increasing number of government, stakeholders, and NGOs regulations. This consideration of environmental aspects is known as green buying or green procurement. As a result of green purchasing, the efforts of companies and industries, which provide environmentally friendly products and services, can receive more recognition (Yang et al., 2021). Then many companies tend to be motivated to design, produce and provide environmentally friendly products and services. Thus, the green market expands, and green purchasing contributes to sustainable development.

In recent years, many researchers have studied various green procurement studies. In 1994–2002, literature related to the concept of green procurement was scarce. It can be said that this period was the initial stage in the publication of the green procurement concept because there was only one article per year with four authors, such as Min (1994), discussing supplier selection. Meanwhile, Noci (1997) discusses supplier selection’s green vendor rating system. Braglia and Petroni (2000), examined quality orientation for supplier selection.
Meanwhile, in 2012 several researchers discussed suppliers in the context of supplier selection with the concept of green procurement (Datta et al., 2012; Kuo & Lin, 2012; Setak et al., 2012) and the supplier selection method by Pani et al. (2012). In contrast, other researchers such as Goebel et al. (2012) and Reuter et al. (2012) discuss the effect of supplier selection on the company. Entering the 2014–2018 period, green procurement publications continued to experience a significant increase, around 27 article titles. This period can be said to be a stage of rapid growth, where researchers’ interest in green procurement continues to increase.

The growth of green procurement in the 2014–2018 period has been discussed by researchers, such as Dobos and Vörösmarty (2014) and Lin and Juang (2014) discussed green supplier selection specific methods. In 2015, Freeman et al. (2015) and Hu et al. (2015) discussed supplier selection in green procurement. Meanwhile, F. Yu et al. (2016) identify distances for product transportation based on supplier selection in a sustainable supply chain network. Then Qin et al. (2017) solved the green supplier selection problem using the multi-criteria method. The 2018 period was the peak of green supplier research, where this period was the peak of green procurement publications with a number of publications of around 27 article titles. Many researchers research the topic of green procurement for supplier selection, one of which is Lo et al. (2018), who create a model to solve problems in green supplier selection and order allocation.

Economic and environmental criteria were employed in the study “An integrated green supplier selection strategy with analytic network process and improved Grey relational analysis” Hashemi et al. (2015). The interdependencies between the criteria are dealt with in their paper using the analytic network process (ANP). Additionally, to weight the criterion and rank the supplier, Hashemi et al. (2015) adapted the conventional Grey relational analysis (GRA). Finally, the proposed method is used to solve a case study of the automotive industry.

Hu et al. (2015) investigated the problem of green procurement in supplier selection by considering commercial and environmental criteria using the 2-tuple linguistic assessment method for green supplier selection. Then in the research of Igarashi et al. (2015), considering the criteria for the buyer’s environment, namely there are four approaches to the problem of choosing a green supply chain, including ignoring, combining, insisting, and integrating. Decision-makers usually do not show complete rationality in decision-makers, so Qin et al. (2017) help decision-makers use the TODIM method. Further in the paper Lo et al. (2018), in its completion, proposed the TOPSIS model and fuzzy multi-objective linear programming to solve problems in green supplier selection and order allocation. Wei et al. (2020) completed the selection of green suppliers using the MABAC method. This proposed method serves to choose a suitable alternative in selecting green suppliers.

In green procurement management, one of the important activities is the selection of suppliers, especially to select green suppliers that are in line with the sustainable development strategy (Gao et al., 2021). Suppliers are upstream of the entire supply chain, and their activities are passed on to every node (Sun et al., 2021). Therefore, the role of green suppliers in cost savings and environmental protection can be passed on to all downstream nodes in the supply chain, thereby increasing the overall efficiency of the supply chain (Y. Yu et al., 2021). In this regard, the evaluation and selection of suppliers play an important role in the overall green supply chain, which will directly affect the competitiveness of enterprises and the operating results of the entire green supply chain (Dong et al., 2021). Therefore, a scientific and reliable method for selecting environmentally friendly suppliers is an important issue with real significance. Mahmoudi, Deng et al. (2021) has looked into the issue of MCDM’s Ordinal Priority Approach (OPA) being used in selecting sustainable and green suppliers on several occasions.

In their paper, “Gresilient supplier selection through Fuzzy Ordinal Priority Approach: decision-making in the post-COVID era,” Mahmoudi, Javed et al. (2021) attempted to create an innovative decision-making technology to address the supplier selection issues caused by the COVID-19 outbreak. In order to comprehend the resilient suppliers in the wake of the SC disruptions, the
study demonstrates how the green and resilience criteria might be integrated. For the purpose of resolving supplier selection issues, the researcher is applying OPA to the Fuzzy OPA (OPA-F). Price, delivery, and quality are the only factors often considered in supplier selection. Sukmawati and Setiawan (2022) propose an approach for choosing environmentally friendly suppliers in their study, including economic and environmental criteria (not just cost-related ones).

Therefore, the findings from this study related to the implementation of green procurement in supplier selection will assist in selecting green suppliers. This is useful for researchers and practitioners in the green supply chain. Thus, this paper provides a brief bibliometric review of the previous literature review on understanding green procurement in supplier selection. In addition, this paper analyzes the relationship in depth between the joint articles and the researcher’s keywords to provide information about the research field.

A few publications discussing literature reviews on green supplier selection have recently been published. To fill this gap, this paper aims to use bibliometric analysis to summarize field studies and offer a relatively complete reference for future research.

2. Method
This research literature review is a bibliometric analysis approach using Publish or Perish and Vosviewer to identify, determine, map, and evaluate literature systematically and objectively against scientific literature on implementing green procurement in supplier selection. The general objectives of quantitative analysis of bibliography include: Designing more economical building systems and information networks, improving the efficiency level of information processing, identifying and measuring efficiency in existing bibliographic services, predicting publishing trends, and discovering and eliciting empirical laws that can provide a basis for the development of a theory in information science (Tague-Suteliffe, 1992).

The methodology used in this study is similar to the method proposed by (Fahimnia et al. 2015), which applies a five-stage literature review methodology, namely defining search terms and initial search results, selecting network search results. A description of the four stages carried out in this study to achieve the research objectives is as follows:

2.1. Defining search terms
At this stage, defining terms or keywords used for data collection related to green procurement through supplier selection is carried out. The researcher collected article data from the Publish or Perish database linked to www.scholar.google.com. Before searching the database, keywords should be generated and recorded to ensure data validity. The combination of keywords in this research includes: “green procurement,” or “procurement,” or “supplier selection”.

2.2. Initial search results
In this stage, collecting and storing the data of the most relevant articles is carried out. This search was carried out in 2022 with a search of 220 articles published from 1994 to 2022, shown in Figure 1. All initial search results are exported to .xlsx format to attach all author names, citations, document title, year, source title, volume, publication, page, number of citations, source and document type, abstract, and keywords. Then the .xlsx format is processed into a spreadsheet for sorting, and the next step is to make a graph using the Minitab software.

In making a graph about the number of articles per year using the help of Publish or Perish software and Minitab. Publish or Perish software is software that is connected to the google scholar search engine. This makes it easier for researchers to find journals and articles about green procurement through supplier selection. This software has a ranking feature so researchers can find the most relevant journals. It is said to be relevant if the journal has many quotes and is in accordance with green procurement in supplier selection. Furthermore, Minitab software is used to make it easier to graph the number of articles per year from 1994 to 2022.
2.3. Article selection
The selection of articles was carried out to ensure their relevance to the research objectives. The number of articles collected was 220. Then the next selection was carried out by carefully reading the article abstracts, and the final result was 170 articles published from 1994 to 2022.

2.4. Analysis of Publish or Perish and Vosviewer results
Bibliometric analysis with Publish or Perish is carried out based on the criteria of author name, citation, document title, year, source title, volume, publication, number of citations, source and document type, abstract, and keywords. Publish or Perish processes journals or articles quickly concerning the data with the keywords the author has searched for. Meanwhile, Vosviewer focuses on authors and keywords.

3. Result and discussion
In this section, we present and discuss the main results of bibliometric analysis. As described in the method section in Figure 2, data were processed using Publish or Perish analysis software and VOSviewer and with the help of Microsoft Excel. VOSviewer was chosen because it has a visualization tool that is easy to understand, and a Spreadsheet helps make it easier for writers to sort data. Therefore, Publish or Perish, VOSviewer and Spreadsheet were chosen to perform the
bibliometric analysis in this study. Bibliometric review is used because of its scientific ability to visualize the network among sources, authors, and keywords (Mamun et al., 2021). In addition, Bibliometrics can communicate keyword findings better so that data exploration can be carried out to provide rich information to readers (Jiang et al., 2019). Besides being able to visualize data, the advantage of bibliometrics is that it can monitor knowledge in the available literature by paying attention to data quality because it can affect the analysis results (De Rezende et al., 2018).

3.1. Annual scientific production

Figure 3 shows that the number of articles published during 1994–2021 is somewhat up and down. It can be observed that an increase occurred between the 2016–2018 period in as many as six articles. On the other hand, in the 2022 period, the number of articles decreased, with the number of articles published reaching 4. From the results of this analysis, it can be concluded that the number of articles published shows that the selection of suppliers in green procurement research has not been of great interest to researchers.
From 1994–2002, literature related to the concept of green procurement was scarce. It can be said that this period was the initial stage in the publication of the green procurement concept because there was only one article per year with four authors, such as Min (1994), discussing supplier selection. Meanwhile, Noci (1997), discusses the green vendor rating system for supplier selection. Braglia and Petroni (2000) examined quality orientation for supplier selection, and Kannan (2018) tried to analyze supplier selection’s effect on a business’s sustainability. In 2003, the publication of green suppliers experienced the development of discussion topics and an increase in the number of publications by three articles, with six authors trying to develop the concept of green suppliers in supplier selection. The topics studied are supplier selection criteria, the influence of supplier selection, supplier selection integrity, and problem-solving regarding supplier selection. Among the publications in the 2003–2009 period, supplier selection issues include an article compiled by Michelsen and Boer (2009), which states that green procurement is a major contributor to supplier selection, either in supplier prequalification or determining the final decision supplier.

Meanwhile, in 2012 several researchers discussed suppliers in the context of supplier selection with the concept of green procurement (Datta et al., 2012) and the supplier selection method (Pani et al., 2012). In contrast to other researchers, Goebel et al. (2012) discuss the effect of supplier selection on the company. Entering the 2014–2018 period, green procurement publications continued to experience a significant increase, around 27 article titles. This period can be said to be a stage of rapid growth, where researchers’ interest in green procurement continues to increase.

The growth of articles on green procurement in the 2014–2018 period has been discussed by several researchers, such as Dobos and Vörösmarty (2014) and Lin and Juang (2014), which discuss green supplier selection using specific methods. In 2015, Freeman et al. (2015) and Hu et al. (2015) discussed supplier selection in green procurement. Meanwhile, F. Yu et al. (2016) identify distances for product transportation based on a sustainable supply chain network through supplier selection. Then, Qin et al. (2017) solve the green supplier selection problem using the multi-criteria method.

The 2018 period was the peak of green supplier research; this period was the peak of green procurement publications with 27 published article titles. Many researchers research the topic of green procurement for supplier selection, one of which is Lo et al. (2018), which makes a model to solve problems in green supplier selection and order allocation.

3.2. Scientific production publisher

Writing an article, of course, requires a reference that would strengthen the writing work that the researcher will publish. The references used should not use any written work, where the author needs to research whether the reference is trusted or has a good reputation. A reputable reference has a precise peer-review mechanism. Where there is a team of experts who review these references, it shows that the journal has the quality to be chosen as the reference we will use. References that can be used to strengthen scientific articles can be obtained from books, scientific articles, and written printed and electronic sources.

From the opinion above, it can be concluded that we need to research whether the source containing the reference is valid and reliable to get a reputable reference. The way to determine if the source is trustworthy is to know the number of articles published on the relevant source.

At this stage, we try to analyze the most relevant and reliable sources that produce scientific articles on green procurement on supplier selection. From 220 samples of structured literature studies from 1994–2022 on the topic of green procurement on supplier selection, we will analyze and sort according to the number of articles produced. There are 20 ranking sources or sources obtained after sorting from top to last according to the number of articles produced by these sources. The higher the ranking of the sources or sources indicates that the sources are the most
relevant, clear, and trustworthy. The distribution of the 20 most relevant sources related to green procurement for supplier selection is shown in Figure 4.

From Figure 4, it can be concluded that the source of the Journal of Cleaner Production is ranked first, with a total of 41 scientific articles published on the topic of green procurement for supplier selection. Journal of Cleaner Production is a journal published by Elsevier Ltd. Located in the United Kingdom, where this organization handles the printing and distribution of print and digital publications. Overall the Journal of Cleaner Production received a rating of 1,404. Furthermore, based on the Scimago Journal Rank (SJR) or indicators that measure the scientific influence of journals based on the number of citations and the level of interest of the journal, this source was ranked 1,937. Therefore, it can be said that the source of the Journal of Cleaner Production is the most relevant, clear, and reliable source. Thus, the articles published by this source can be used as a reference source for researchers who will research green procurement for supplier selection. Second place is the International Journal of Production Economics, with 17 published scientific articles. It was followed by the International Journal of Production Research which produced 11 scientific articles on green procurement for supplier selection.

### 3.3. Top ten authors based on keyword relevance

In this section, we analyze 220 samples of bibliography to then rank the authors according to the accuracy or relevance of the title, content, and results of the articles published by the author on the topic of green procurement and supplier selection. This ranking is done using Publish or Perish software, which shows the results in Table 1.

| Table 1 shows the author’s ranking according to the most relevant “green procurement” articles and “supplier selection”. There are 10 top rankings for authors in their research related to green procurement. The higher the author’s rating, the more relevant the article published by the author leads to the topic of green procurement for supplier selection. Then it can be seen that the number of citations or the number of articles quoted does not affect the author’s rank. As explained earlier, this ranking is based on the relevance of the author’s articles on green procurement for supplier selection. |

It can be seen from Table 1 that Hu et al. (2015) was ranked first with a scientific article entitled “Optimization decision of supplier selection in green procurement under the mode of low carbon
This study tries to solve the supplier selection problems in green procurement using optimization decisions. This author comes from China, one of the countries with the highest publication rate of scientific articles. The second place is place Igarashi et al. (2015), who published scientific articles in the same year as Hu et al. (2015) and Igarashi et al. (2015), who wrote a scientific article with the title “Investigating the anatomy of supplier selection in green public procurement”. In his research, he included environmental criteria in selecting suppliers in the Norwegian public sector by identifying environmental criteria in official tender documents related to 41 purchases and analyzing them both quantitatively and qualitatively.

The third rank of authors who publish articles most relevant to the keyword green procurement through supplier selection is Wei et al. (2020). Their article with the title “Green supplier selection with an uncertain probabilistic linguistic MABAC method” takes a case study from China trying to overcome the problem of selecting suppliers with probabilistic linguistics by using the MABAC method. In fourth place, Freeman et al. (2015), with an article entitled “Green supplier selection using an AHP-Entropy-TOPSIS framework,” was published in the same year as the authors Igarashi et al. (2015) and Hu et al. (2015) used the AHP-Entropy-TOPSIS framework method to solve supplier selection problems.

Igarashi et al. (2013) ranked fifth by publishing an article entitled “What is required for greener supplier selection? A literature review and conceptual model development,” which is a literature review on what is needed for the selection of green suppliers. There are 60 articles published in 1991–2011 with variables such as supply chain, supplier selection process, and perspective from environmental criteria. The published article aims to integrate the various dimensions of green supplier selection and identify directions for future research. Moreover, the article “An extended TODIM multi-criteria group decision-making method for green supplier selection in interval type-2 fuzzy environment” by Qin et al. (2017) was ranked sixth. The research was conducted using TODIM behavior to solve supplier selection problems. In addition, it also provides a comparison between the IT2F-TODIM and IT2F-TOPSIS methods.

The publication of the article in 2018, ranked seventh written by Lo et al. (2018), with the article title “An integrated model for solving problems in green supplier selection and order allocation”. The article solved supplier selection and order allocation problems using an integrated model. Furthermore, the article proposes a new model by integrating the best-worst method (BWM), a modified fuzzy technique for order preferences based on similarities with ideal solutions (TOPSIS), and fuzzy multi-objective linear programming (FMOLP). In the article, Lo et al. (2018) concluded that the results obtained indicate that the model used can effectively evaluate the

| Table 1. Top 10 authors |
|--------------------------|
| Authors                  | Rank | Cites |
| Hu et al. (2015)         | 1    | 49    |
| Igarashi et al. (2015)   | 2    | 76    |
| Wei et al. (2020)        | 3    | 22    |
| Freeman et al. (2015)    | 4    | 171   |
| Igarashi et al. (2013)   | 5    | 349   |
| Qin et al. (2017)        | 6    | 418   |
| Lo et al. (2018)         | 7    | 156   |
| Michelsen and Boer (2009)| 8    | 214   |
| S. P. Deshmukh and Sunnapwar (2013) | 9 | 19 |
| Yazdani et al. (2017)    | 10   | 297   |
performance of green suppliers and optimize order allocation for suppliers that meet specific requirements.

An article published in 2009 was ranked as the eighth most relevant article on green procurement through supplier selection with the title “Green procurement in Norway; a survey of practices at the municipal and county level” written by Michelsen and Boer (2009). The article focuses on surveying the city of Norway regarding green procurement to find out the importance of green procurement. Then the authors compared the information obtained from the city and information from potential suppliers to see whether suppliers and consumers agree about the importance of the environment in supplier selection.

S. P. Deshmukh and Sunnapwar (2013), with an article entitled “Validation of performance measures for green supplier selection in Indian industries” ranked ninth for the most relevant article. This article aims to identify the critical manufacturing factors considered during supplier selection in the Indian manufacturing sector. Finally, Yazdani et al. (2017) wrote the most relevant article for the tenth rank titled “Integrated QFD-MCDM framework for green supplier selection”. This article prioritizes an integrated approach to supplier selection by considering various environmental performance requirements and criteria.

4. Most cited publications in the Publish or Perish database
The most cited authors in this article are the top 10 authors calculated based on the number of citations relevant to green procurement based on the Publish or Perish database.

Table 2 shows the ten most-cited journals by some articles distributed by journal and year. For example, 1,034 articles in the Publish or Perish database are quoted from the Govindan et al. (2020) entitled “Multi-criteria decision-making approaches for green supplier evaluation and selection: a literature review”. The article is a literature review that discusses the evaluation and selection of suppliers with a multi-criteria decision method approach. Govindan et al. (2020) stated that this article would answer questions such as which selection approach is commonly applied, what environmental selection criteria are famous for green supplier management, and what limitations exist.

| Ranking | Sources                                      | Cites |
|--------|----------------------------------------------|-------|
| 1      | Journal of Cleaner Production                | 1,034 |
| 2      | Expert Systems with Applications             | 931   |
| 3      | International Journal of Production Economics| 896   |
| 4      | Journal of Supply Chain Management           | 628   |
| 5      | Journal of Materials Processing Technology   | 603   |
| 6      | International Journal of Physical Distribution & Logistics Management | 584 |
| 7      | European Journal of Purchasing & Supply Management | 546 |
| 8      | European Journal of Operational Research     | 413   |
| 9      | International Journal of Production Research | 329   |
| 10     | Journal of Manufacturing Technology Management | 296   |
The second-highest number with 931 citations is an article by Lee et al. (2009) titled “A green supplier selection methodology for the high-tech industry” has the second-highest ranking. According to Lee et al. (2009), green criteria are crucial for assessing a manufacturer’s long-term sustainability. In order to differentiate between the criteria for evaluating traditional suppliers and green suppliers, researchers used the Delphi method. The suggested approach can assess and choose the best green supplier for cooperation.

The third-highest number with 896 citations is an article from Bai and Sarkis (2010) entitled “Integrating sustainability into supplier selection with gray system and rough set methodologies”. Their article discusses integrating sustainability into supplier selection with gray system and rough set methodology. Furthermore, the fourth article related to supplier selection by Kannan and Tan (2002) with 628 quotes entitled “Supplier selection and assessment: Their impact on business performance”. This article intends to analyze the effect of supplier assessment and selection on business performance. According to Kannan and Tan (2002), selection criteria that cannot be measured, such as the strategic commitment of suppliers to buyers, significantly impact performance compared to quantitative criteria such as supplier capabilities.

Kazemi et al. (2019) believe that publication citation is important because it is a benchmark that represents how often a publication is discussed in other scientific studies and how significant its impact is in the field. In addition, citations among academics are used as a benchmark to determine how much influence they have. Therefore, if the citation index of a publication or author is high, it will be considered influential in the field (Feng et al., 2017).

4.1. Ranking of scientific article producing countries
From a sample structured literature study for the period 1994–2022, as many as 220 scientific articles on the topic of green procurement on supplier selection, there are 20 countries ranked from top to last according to the number of articles produced by that country. The distribution of the 20 countries that produce the most scientific articles related to green procurement for supplier selection is shown in Figure 3.

Figure 5 shows that China is ranked first with a number of publications of 42 articles. This is due to the demographic factor of China, which has many operating factories, so the issue of green procurement through supplier selection is interesting to discuss from China’s perspective. In addition, adding a green procurement factor to maintain the impact of pollution and pollution around the factory has attracted researchers from China to research the topic of green procurement through supplier selection. One of the researchers from China who researched the topic of green procurement through supplier selection is This researcher uses optimization decisions for supplier selection in green procurement. Therefore, the article produced by Hu et al. (2015) is also the most relevant article on green procurement for supplier selection by ranking first. Moreover, one of the researchers from China, Wei et al. (2020) is also a researcher who produces scientific articles relevant to the topic and is ranked third for the articles most relevant to the topic of green procurement through supplier selection. In addition, Hu et al. (2015) and Wei et al. (2020) use the MABAC method to solve supplier selection problems in green procurement with uncertain probabilistic linguistics in China’s manufacturing industries. From the two authors, it can be concluded that China has significantly contributed to producing scientific articles on the topic. This can be seen from the number of published articles and the quality of the scientific articles.

India is the second-ranked country with the most publications on green procurement through supplier selection, with 31 articles published. Like China, India also has several areas where many companies and factories are operating, so the issue of supplier selection is an ongoing issue to discuss. India is also very active in producing scientific papers; according to Scimago, India is ranked fifth globally. Several authors from India who have produced scientific articles on green procurement through supplier selection are (S. Deshmukh & V. Sunnapwar) Their research is related to the validation of performance measurement for the selection of green suppliers in the industry in
India. This article produced by Deshmukh and Sunnapwar (2013b) is also relevant to the topic of green procurement for supplier selection, where the article is ranked 9th for the most relevant article. Kumar et al. (2018), one of the researchers from India, tried to solve the supplier selection problem using the Fuzzy Delphi and AHP-DEMANTEL methods, where the article was ranked 25 for articles relevant to the topic of green procurement for supplier selection. After India, Iran is ranked 3rd with a total of 27 scientific articles. The United States follows it with a total of 16 articles.

4.2. Cluster and network analysis
Cluster formation and network analysis in this study use Vosviewer software to provide graphical visualization and grouping analysis related to green procurement in supplier selection. This type of analysis uses occurrence and unit analysis by involving all keywords. The first step to creating a Vosviewer cluster is to create data that contains a collection of journals from Publish or Perish with the file format (.ris). This is because Vosviewer supports RIS, Endnote, and Ref works file.
formats. The second step is to input the data into Vosviewer based on the title and abstract fields to find the keywords that appear most often. The next step is automatically forming the cluster on Vosviewer after inputting data.

The link (edge) shows the number of relationships between one item (node) with another. As shown in Figure 3.4, there are big nodes of green procurement, sustainable procurement, and green public procurement, which means these words have a high frequency. Three clusters are based on color, including purple, green, and yellow.

Figure 6 show cluster and keyword network analysis. In the first cluster, the research focuses on green procurement, sustainable procurement, case studies, and services. Green procurement research by Appolloni et al. (2014) discusses interesting findings by developing a conceptual framework for GP and suggests a number of directions for future research. Then sustainable procurement is investigated by Ghadimi et al. (2016). Aktin and Gergin (2016) also investigated the same topic and used a mathematical model in their solution. In addition, some studies apply green procurement to complete case studies, including the research of Garzon et al. (2019) with a case study of the chemical sector. Other studies by Yıldız (2019) with a case study of the automotive supply industry, and Qu et al. (2020) with a case study in a Chinese Internet company. Furthermore, green procurement research also refers to service/support, as in the research of Rhee et al. (2009). The research is about understanding the trade-offs in the supplier selection process: both from the role of flexibility, delivery, and service/support to odd value.

The second cluster focuses on environmental aspects, green procurement practices, country, and case in the second cluster. The environmental aspect was investigated by D’Souza et al. (2015) by evaluating the role of green marketing and the company’s internal practices for environmental sustainability. Furthermore, green procurement practices have been developed by several researchers by considering case studies or data collection in a country. For example, in a study by Rhee et al. (2009), empirical data for this study were collected from manufacturing organizations in Europe (Germany, France, Italy, and the UK) using a computer-based discrete choice survey of supplier selection. Moreover, Bag (2017) research develops a conceptual framework that considers institutional pressures, organizational culture, and green procurement and tests it further using primary survey data collected from South African manufacturing units.

Finally, in the third cluster, research focuses on green public procurement by Ahsan and Rahman (2017) and Igarashi et al. (2015). First, Ahsan and Rahman (2017) investigated the challenges of implementing green public procurement (GPP) in the Australian public health sector. Then develop a GPP implementation framework that combines five categories of challenges and sixteen challenges. The problem is structured as a multi-criteria analytical process-based (AHP) decision-making model. Furthermore, Igarashi et al. (2015) assessed the inclusion of environmental criteria in supplier selection in the Norwegian public sector. They identified environmental criteria in official tender documents related to 41 purchases and analyzed them quantitatively and qualitatively. The document demonstrates that buyers use different environmental criteria and can be used at different stages of the selection process.

5. Conclusion
According to literature review, one of the most significant activities in green procurement management is supplier selection, particularly green supplier selection that is in line with the sustainable development strategy. This is because suppliers are at the top of the supply chain, relaying their actions to every node. As a result, the value of green suppliers in terms of cost savings and environmental protection may be passed on to all downstream supply chain nodes, boosting the supply chain’s overall efficiency. In this regard, supplier evaluation and selection play a critical role in the overall green supply chain, affecting corporate competitiveness and the overall green supply chain’s operating performance.
This article provides an overview of research development on green procurement for supplier selection through bibliometric analysis. A bibliometric review shows that research on green procurement has experienced ups and downs over time and peaked in research in the last three years with 27 research articles. Therefore, it can be said that the topic of green procurement, especially for supplier selection, is increasingly attracting researchers’ interest.

Based on the analysis results, research on green procurement in selecting the dominant supplier in China. This is because there are many manufacturing companies in China, so supplier problems are very important to solve. Furthermore, India’s second rank is dominated by 27 published articles, followed by Iran, where the articles produced are as many as 26 articles.

Authors, journals, years of research, and keywords that contributed to the topic of green procurement for selecting suppliers in this study were extracted for analysis using a bibliometric approach. The results obtained in the analysis with this bibliometric approach can guide future researchers to gain further research insights on emerging research areas in the context of green procurement for supplier selection.

However, in this study, there are drawbacks, namely, the tools used in the search for authors, journals, years of research, and keywords are less varied. So, for further research, it is recommended to use various information search tools to collect the required data.

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