



# **Bibliometric Analysis: An Overview and Guidelines**

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## الآية

قال تعالى:

(وَقُلْ اَعْمَلُوا فَسَيَرَى اللّٰهُ عَمَلَكُمْ وَرَسُولُهُ وَالْمُؤْمِنُونَ)  
صدق الله العظيم.

## الإهداء

من قال أنا لها نالها... ونحن لها وإن أبت رغما عنها اتينا بها  
نلناها وعانقنا اليوم مجدا عظيما فعلناها بعد أن كانت دروباً صعبة وقاسية  
الحمد لله حباً وشكراً وامتناناً على البلاغ ثم الحمد لله على التمام الحمد لله الذي بفضلته أدركنا أسمى  
الغايات ما كنا لنفعل ذلك لولا أن الله مكننا فالحمد لله عند البدء وحين الختام الحمد لله جل جلاله  
إلى من بلغ الرسالة وأدى الأمانة ونصح الأمة إلى نبي الله نور العالمين سيدنا محمد صلى الله عليه  
وسلم  
إلى أمي وأبي سر النجاح ومعنى الحب والحنان والتقاني ومصدر الدعم والدعوات التي تلازم خطانا  
إلى خيرة أيماننا وصفوتها إخواننا وأخواتنا، الذين مُدت لنا أياديهم وقت ضعفنا وآمنوا بقدرتنا، إلى  
ضلعنا الثابت وأمان أيماننا  
إلى موطننا ودارنا وأمننا وأماننا إلى السودان الحبيب وأهله اعداك الله لنا سالماً منعماً مصدراً للأمن  
والحب والسلام كما كنت.  
إلى منارة العلم والعلماء إلى الصرح الشامخ.. جامعة الخرطوم  
إلى الذين حملوا أقدس رسالة في الحياة الذين مهدوا لنا طريق العلم والمعرفة وكافحوا بجِدِّ واجتهاد  
لإنهاء ما وُكِّل إليهم إلى أساتذتنا الأفاضل حفظهم الله  
إلى أصدقاء الطرق جميعاً الوعرة والسهلة أصدقاء الدرب والرحلة لقد تم الختام بحمد الله ونقول لكم  
سنين الجهد وإن طالست ستطوى لها أمد وللأمد انقضاء  
لكل من يبهجهم نجاحنا وكل من كان عوناً وسنداً في هذا الطريق  
**نهديكم هذا الإنجاز الذي لولاكم لم يكن**  
وأخيرا الشكر موصول لأنفسنا على الصبر والعزيمة والإصرار، اليوم نختم كل ما مررنا به بفخر  
ونجاح فالحمد لله من قبل ومن بعد، راجين من الله تعالى أن ينفعنا بما علمنا وأن يعلمنا ما جهلنا  
ويجعله حجة لنا لا علينا.

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### **Abstract:**

Bibliometric analysis is a popular and rigorous method for exploring and analyzing large amounts of scientific data. It enables us to untangle the evolutionary nuances of a particular field. However, its application in business research is relatively new and, in many cases, underdeveloped. Accordingly, we strive to provide an overview of bibliometric analysis methodology, focusing on its various techniques, while providing reliable step-by-step instructions for conducting bibliometric analysis accurately and confidently. Overall, this research should be useful for gaining insights into the techniques and procedures available for conducting studies using bibliometric analysis.

## **Chapter One:**

### **Introduction:**

Indicators of scientific activity, previously absent from the interests of most politicians, are now in full swing, revolving around the links between advances in science and technology, as well as economic and social progress, hence the growing awareness of the advantages of basing opinions and subsequent choices on criteria more suitable for quantitative evaluation. It is now inconceivable to conduct reviews of science policies without resorting to existing indicators. After a long focus on measures of inputs, attention has increasingly shifted to outputs, especially those related to technology. For example, patents and trade in advanced technologies, as well as the balance of technological payments.) Also, assessing an individual or group of published works and their impact on a particular field or discipline is time-consuming, labor-intensive, and expensive. As a result, bibliometrics has gained popularity in academia, governments, and research institutions, which means the quantitative analysis of books and articles. The appeal of bibliometrics lies in their being a data-based measure of productivity, impact, and trends, as well as mitigating some of the subjective factors such as bias surrounding this type of analysis. Therefore, when it comes to science, bibliometric indicators are essential.

Bibliometric indicators are tools that enable monitoring the state of science and technology through the total production of scientific literature at a given level of specialization. There are many terms used for metrics that apply to research, including scientific metrics, information metrics, web metrics, network metrics, and internet metrics, which can be used interchangeably. Bibliometric indicators are a means of determining the position of a country in the world, an institution around a country, and individual scientists. These scientific indicators are equally appropriate. However, the usual precautions are taken for any analysis, for example, the share of a particular country in the global output of scientific literature over a given period or the role of a specific institute in producing research papers. For this reason, bibliometric indicators are a tool that helps in decision-making. Of course, research management cannot justify a decision on its own or replace experts, but bibliometric indicators are practical tools that can be used in conjunction with other indicators.

We will begin our research with a historical overview of bibliometric indicators, to find out their origins and define their role in evaluating science. We will also present a variety of bibliometric indicators with respect to their uses and limitations. In addition to some practical examples, this study aims to explain how to conduct bibliometric analysis and give an overview of how to conduct it and guidelines for its use.

## Literature review:

Bibliometric analysis is one of the important tools used to evaluate relationships between authors, research trends, scientific publications. It relies on bibliographic data such as citations, collaboration between authors, and occurrences of keywords to provide strong insights into the academic impact of papers. Bibliometric analysis has witnessed significant development over the past decades thanks to scientific development in tools and databases that allow examining relationships between papers and exploring research networks. In this literature review, we will provide a comprehensive overview of the development of bibliometric analysis, the tools used, the most important studies, and the challenges faced by this analysis.

### 1. The development of bibliometric analysis:

The first evidence of bibliometrics dates back to **1873** when de Candolle described changes in the scientific strength of nations according to membership of scientific societies, with this study he aimed to identify factors that might influence the scientific success of a nation (van Raan, 2004).

**1926:** Lotka analyzed the distribution of scientific productivity, leading to the development of "Lotka's Law," one of the most widely used laws in Bibliometrics, assesses patterns in author productivity.(Lotka,1926)

**1927:** Gross and Gross took up citation analysis to determine the most influential journals in chemistry, this work has had enormous consequences, since citation analysis is now one of the main areas in bibliometrics.

**1934:** Bradford focused on the distribution of scientific papers among journals, leading to the development of "Bradford's Law." Which is now widely used in bibliometrics to study journal productivity.

**Paul Otlet (1934):** Otlet is considered one of the first to propose the idea of organizing knowledge systematically and indexing it in a book he called the "Universal Book" he is the first one used the term "bibliometrie" and defined it as "the measurement of all aspects related to the publication and reading of books and documents". Although his idea was not fully implemented, it laid the foundations for what is now known as bibliometric analysis.

**1935-1949:** Zipf studied word frequency in texts, generalizing two previous laws.

**Real breakthrough in bibliometrics arrived some years later through the work of Garfield (1955) and Price (1963).**

**Eugene Garfield (1955):** Garfield introduced the concept of the Science Citation Index (SCI), and this concept revolutionized the field of bibliometric analysis by making it

possible to track citations between scientific papers. This allowed researchers to quantitatively evaluate the scientific impact of research.

**Pritchard (1969):** He was the first to use the term bibliometric when he called for the use of this term instead of the term statistical bibliography

In an article published in December 1969 in the “Documentation Magazine” entitled “Statistical Bibliography or bibliometrics.”

Pritchard was coined the term “bibliometrics” and defined it as “all the studies which seek to quantify the processes of written communication”. He described bibliometrics as an application

Mathematical and statistical methods include books and other media that carry information. His work was a cornerstone in establishing the field and providing a framework for citation analysis.

At almost the same time, Nalimov and Mulchenko (1969) expanded the scope of bibliometric analysis to include what is now known as scientometrics to refer to ‘the application of quantitative methods which are dealing with the analysis of science viewed as an information process.

## 2. Expansion of tools and methodologies:

**Henry Small (1973):** Small introduced the concept of co-citation analysis, in which the number of times two scientific papers are cited together is measured. This approach helped reveal intellectual structures within scientific disciplines by analyzing how ideas in research are connected.

CiteSpace development allowed for dynamic analysis of citations, which helped visualize scholarly networks, reveal interconnections between articles, and analyze emerging research trends and patterns and the scientific literature. The research of **Leydesdorf and Rafols (2011)** focused on interdisciplinary studies, and used bibliometric analysis to measure research diversity and analyze citation patterns across different disciplines.

**Lutz Bornmann<sup>1</sup> and Rüdiger Mutz (2015)** examined the relationship between the number of citations and the quality of research, analyzing how citations are used as a measure of influence. The study found that citations are often used as an indicator of impact, but they do not always reflect the true quality of research. It pointed out the need to use additional measures to more accurately evaluate the quality of research (Bornmann& Mutz ,2015)

**Ullah, Asghar, & Griffiths (2023)** focused on developing a new methodology for bibliometric analysis by integrating data from multiple databases, such as Google



Scholar, Scopus, And Web of Science. It has been shown that integrating data from multiple sources improves the accuracy of bibliometric analysis and increases the representativeness of research and Combining databases provides better representation of research.

**Donthu, Kumar, Mukherjee, Pandey & Lim (2023)** provided insight on how to improve the accuracy of bibliometric analysis using Modern tools like VOSviewer and Gephi. The study found that integrating data from multiple sources leads to improving the accuracy of bibliometric analysis and increasing the coverage of research studies. And the study indicated that tools such as VOSviewer and Gephi provide powerful visualizations that help understand complex relationships between authors, topics, and citations(Donthu et al.2023).

**Montazeri, Mohammadi, Hesari, Ghaemi, Riazi, & Sheikhi-Mobarakeh (2023)** provided initial guidance for bibliometric reporting (BIBLIO), which was developed through a comprehensive review of the scientific literature related to conducting bibliometric reporting. Databases such as PubMed, Scopus, and Web of Science were searched. They identified 20 essential elements that bibliometric analysis reports should include, from title and abstract to discussion and conclusion. These guidelines aim to enhance transparency and accuracy in the provision of bibliometric analysis (Montazeri et al.,2023).

Bibliometric analysis has evolved thanks to advanced and sophisticated tools that have helped provide more accurate visualizations of relationships between authors, keywords, and citations. Some of these tools are:

**VOSviewer:** It is a tool widely used to visualize scientific collaboration networks between researchers, term density, citation patterns, and keyword occurrences. This software provides easy-to-understand visualizations of complex bibliographic data and is widely used in mapping scientific knowledge.

**SciMat:** An open source software tool (GPL v3) developed to perform science mapping analysis in a longitudinal setting. SciMAT provides different modules that help the analyst perform scientific mapping workflow steps. This tool is used to analyze and visualize the development of scientific topics. It is a valuable tool for analyzing the evolution of concepts in different research fields, and has been used in particular in tracking progress towards achieving the Sustainable Development Goals (SDGs).

### 3.Limitations:

Tools limitations: for example, VoSviewer is limited in its ability to analyze full texts and focuses mainly on quantitative relationships between words and citations, which limits its ability to analyze the actual content of papers. Likewise, Scimat relies heavily on the quality of data from sources such as Scopus, which can lead to biased or

incomplete results if the data is not comprehensive or up-to-date.

Data diversity: Databases such as Scopus and Web of Science may vary in their coverage, leading to gaps in data for citations and publications.

Quality versus quantity: Bibliometric analysis often relies on citation counts as an indicator of academic impact, but this may inflate the value of papers with high citations but limited actual impact.

Geographic and linguistic bias: Large databases tend to marginalize research published in languages other than English, which affects the comprehensiveness of the analysis.

With increasing interest in bibliometric studies, dedicated publications have emerged, such as the journal *Scientometrics* founded by Tibor Braun (1978).

Despite challenges facing researchers in the 1980s, such as a lack of documentation and the difficulty of collecting data manually, technological developments in the 1990s brought significant progress, as electronic databases replaced traditional systems.

Today, there are many multidisciplinary databases that provide indexing information for thousands of journals, articles, and books. The technological era has contributed to tremendous progress in the field of bibliometric analysis.

In conclusion, bibliometric analysis has become an indispensable tool in evaluating research and understanding research relationships. Thanks to modern tools such as VOSviewer and SciMat, it has become possible to better visualize research networks and track the development of knowledge. Despite challenges related to data diversity and geographic biases, bibliometric analysis remains a powerful way to understand the dynamics of scientific research.

## **Chapter Two:**

### **Methodology of bibliometric analysis:**

This chapter explains the four stages to conduct the bibliometric analysis and the steps for each stage in detail. All stages and their steps are summarized in Table 3.

#### **Stage 1: Aim of the research**

As is the case at the beginning of any research, we must begin by stating the goal of that research. We must continue this until we provide a comprehensive justification for all the objectives of the study and the reasons for using it to achieve those objectives. This means informing readers about the relationship and methodological compatibility between the research objective and bibliometric analysis.

The research objective and justifications for employing bibliometric research must always be specified in the introduction to the article (Gastel & Day, 2022). Therefore, the introduction is a crucial element in bibliometric research, and the research questions are the most important part of the introduction (Fisch & Block, 2018). Whatever best describes the research is its purpose statement, and the data that best reflects the research purpose are the research questions. Therefore, it is suggested that research should always be developed in line with its explicitly stated objective in the introduction (Linnenluecke, Marrone, & Singh, 2020). Bibliometric analysis has a unique nature (Ozturk, 2021). Therefore, research questions in bibliometric research should be specific to the nature of the analysis (Mishra, Raj, & Pani, 2020). The research objectives and questions determine the focus, scope, and direction of the research (Andrés, 2009). Clarity makes it possible to draw the scope and boundaries of the research more clearly and transparently. Depending on the research objective and questions, the type and scope of data and analyses we use may differ (J. H. Block & Fisch, 2020), and the distance between the research objectives and questions and the analyses that were conducted is of utmost importance for a high-quality study. If this is not given, there is a risk of conducting a random analysis separate from the research objective in question.

#### **Stage 2: Data collection**

After we have determined the goal and questions of the research, the next step is to define the literature or what is known as the field of research in it. We determine the literature to be examined and create a data set for the relevant literature. A systematic search must be conducted to identify this literature because bibliometric research must be replicable,

which requires complete transparency regarding the steps that are implemented within the scope of the research(J. H. Block & Fisch, 2020; Tranfield, Denyer, & Smart, 2003). In other words, the processes in bibliometric research must be repeatable by other researchers(Linnenluecke et al., 2020), so the entire process must be implemented transparently, especially about data(Zupic & Čater, 2015). Then it must be ensured that each step of the procedure followed to obtain a set of data related to the relevant literature identified in line with the research objective and research questions is explained transparently and clearly(Andrés, 2009).

This suggests that all steps of the procedure followed to obtain the required data should be specified in a way that readers can follow. Therefore, in bibliometric research, researchers cannot include any paper “randomly” in the review; instead, they are expected to explain the steps taken in finding those relevant papers to be added to the analysis(Linnenluecke et al., 2020). The study by Horvatinovic et al. (2023) serves as an example of a transparent data collection process. In bibliometric research, four steps are typically followed in identifying relevant literature in a transparent and reproducible manner:

## 2.1 Selecting the database

There are many databases that provide datasets for bibliometric research (e.g., WoS, Scopus, Google Scholar, PubMed, Microsoft Academic, Dimensions, EmBase, and Springerlink)(Cobo, López-Herrera, Herrera-Viedma, & Herrera, 2011; Moral-Muñoz, Herrera-Viedma, Santisteban-Espejo, & Cobo, 2020). These databases were developed for different purposes and have diverse characteristics.

WOS has long been the most comprehensive citation data source worldwide(Birkle, Pendlebury, Schnell, & Adams, 2020). SCOBUS, on the other hand, is the second-largest comprehensive citation database (Zhu & Liu, 2020). Although it has a broader scope than either database(Vandagriff, 2023), Google Scholar is not usually preferred by researchers because it does not allow them to download data in a format suitable for use with bibliometric software tools. Which makes it unable to provide a breakdown of the complete data set in one file(Donthu, Kumar, Mukherjee, Pandey, & Lim, 2021; Moral-Muñoz et al., 2020). Researchers must choose one or more databases depending on the research objectives and this is based on bibliometric search criteria. Some criteria that can be used in choosing a bibliometric research database(Ozturk, 2021):

1. The number of journals included in the field of research
2. Access to the database
3. Factors in the journal’s functioning and its pioneering capabilities in the field

4. The ability to download data in a format that is compatible with bibliometric analysis programming.
5. The ability to filter data in a way that is compatible with programs that allow addressing research questions
6. The number of records that can be exported from the database

Researchers should have clear information about the advantages and disadvantages of various databases and should also determine how to define the scope of the search and what type of papers to include in the analysis. After choosing the appropriate database The first thing researchers do is to identify the terms (keywords and concepts) that will be used in the initial search from the selected database to include papers that best represent the relevant field.

## 2.2 Identifying search terms

When using bibliometric analysis to examine any field of research(Dong, Dong, & Buckingham, 2023), research should be conducted based on the topic, and then that research should be conducted using terms that describe the literature to be examined. Search terms are words or concepts used to access any form of publication (article, research paper, book, report, etc.) related to relevant literature(Öztürk, Kocaman, & Kanbach, 2024). The researcher obtains accurate and reliable results whenever these terms are directly linked to the research questions and to obtain the desired results about the relevant literature(Snyder, 2019). The symbols that are used in addition to the terms found in the initial search are very important, and symbols are symbols. (\*,"...") Short conjunctions, (for example, and 'or, etc) would limit the scope (either narrow or expand) of the search results if more than one search term was used in the initial search(Zupic & Čater, 2015). In primary research, even a slight change in the research body can cause the number of papers to differ significantly, and this may negatively affect the ability of the papers to represent the relevant literature(Linnenluecke et al., 2020). Such problems occur when papers are included in the analysis that do not fall within the scope of the research, or when papers are excluded that do not fall within the scope of the research(Andrés, 2009). This issue is only addressed by using the correct set of search terms, however, the issue of whether or not we are truly using the relevant literature remains even if we use the correct search terms in the initial search. To avoid such doubts, the papers that were available in the initial search are usually manipulated

## 2.3 Filtering

Researchers must determine how to limit the scope of the search in bibliometric research and decide which papers will be included in the data set. Filtering should be used on search results even when search terms are very carefully defined, as databases often find

papers outside the scope(Tranfield et al., 2003). These papers will affect the validity of the analysis as well as the validity of the final results (Zupic & Čater, 2015). Accordingly, a set of exclusion criteria is developed and applied to relevant research papers, according to the research objective and research questions(Snyder, 2019). These criteria have significant impacts on the final data set and thus on the results of the analysis. These criteria that will be applied must be very justified(J. H. Block & Fisch, 2020). These criteria can be determined using practical criteria. For example, the language database, publication, etc., or these standards are updated in systematic ways, such as the field of research, document type, time, etc(Fisch & Block, 2018; Glänzel, 2008). In the filtering process, a specific criterion requires the exclusion of another criterion. For example, selecting only publications from certain types of documents or articles within a certain general category means excluding others automatically(Linnenluecke et al., 2020). It is generally excluded because it is considered knowledge that is still under development and may be repeated or interfered with when it is converted into articles All filtering operations can be easily performed through the search engines WOS, or Scopus Researchers are advised to manually search the ages for papers related to the research topic that cannot be identified in the first search. Searches can be conducted on the best papers to ensure comprehensiveness. In addition, databases can sometimes display studies that are not related to the research topic because it is unable to filter or exclude papers that do not fully meet the research topic, that is, papers that do not meet the pre-specified criteria. Therefore, it is necessary to exclude papers that were found in the initial search results but are not related to the research topic, as researchers recommend reviewing the titles and abstracts of all research papers. In this way, irrelevant papers can be identified and then excluded from the scope of the research. It is necessary to define each of these procedures to ensure transparency and methodology in Bibliometric research In bibliometric research, the system logic and methodology that require defining the scope of the research based on specific criteria provide a great deal of transparency but may lead to a problem of representation concerning the relevant literature(Sauer & Seuring, 2023). It can be expressed as one of the limitations of biometric research. The data set obtained after carefully applying the inclusion and exclusion criteria constitutes the final sample for the research.

## 2.4 Downloading the dataset

Databases provide different formats for saving relevant files and transferring them to computer programs(Andrés, 2009). After examining the initial search results, the final sample of data must be downloaded in a file That corresponds to the software tools that will be used for the analysis. Moreover, the download options provided by databases affect the information in the research papers that will be included(Mokhnacheva, 2023) for example by selecting the option (author, source title). From the WAS database, one can obtain a list listing the titles, authors, publication names for each study, etc. in the

downloaded file, on the other hand. One can access the file with more comprehensive information for each paper by selecting the full history and references(Vandagriff, 2023). The researcher can select from various options to download the file including the data required during the analysis process(Dong et al., 2023).

### Stage 3: Analysis and Visualization

In bibliometric research, the data must be cleaned first to obtain accurate and reliable results. After cleaning the data, the analysis must begin by applying pre-processing to the data. For example (i) references included in citations which sometimes refer to several editions of the same book.

Two main analysis procedures are applied in bibliometric research(Cobo et al., 2011; María Gutiérrez-Salcedo, Martínez, Moral-Munoz, Herrera-Viedma, & Cobo, 2018): Firstly, performance analysis (which serves as a general overview of the entire field in terms of scientific outputs) and drawing scientific maps such as (Networks of relationships between authors, papers, concepts, and citations) and all of this depending on the research objective and research questions, Researchers can do one or both, as Figure (1) shows. Analyzing bibliometric research, as shown above. The choice of the relevant bibliometric analyses must be consistent with the research event and the research questions.

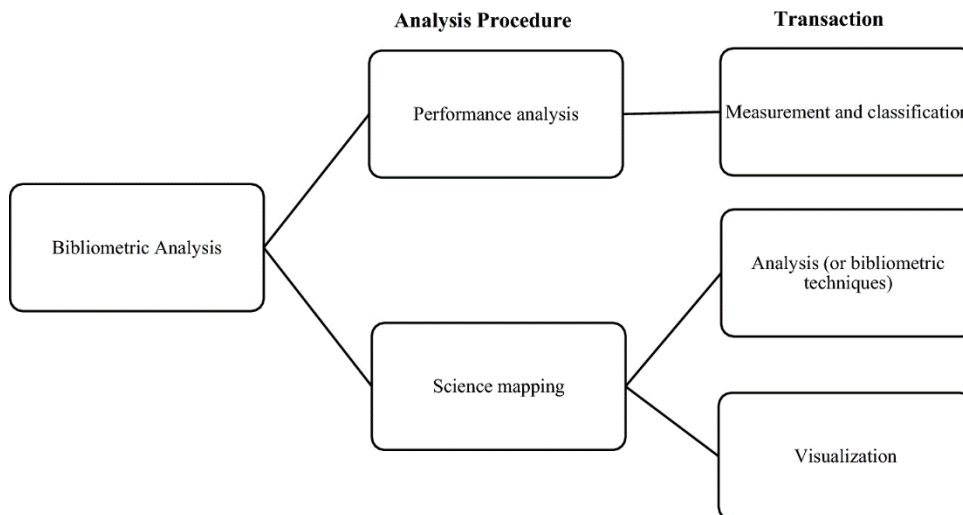


Fig 1 Analysis procedure in bibliometric research Source Drawn by utilizing from Cobo et al. (2011), Zupic and Cater (2015), Aria and Cuccurullo (2017), Gutierrez-Salcedo et al. (2018), Block and Fisch (2020), and Donthu et al. (2021)

### 3.1 Performance analysis procedure

By conducting a performance analysis, the performance of the various scientific elements is evaluated through a set of bibliometric indicators that were developed based on research and citation data, and thus a general overview of each field is provided (Cobo et al., 2011).

This analysis aims to evaluate the "publication" and "citation" performance of researchers/authors, institutions/universities, countries, and journals (Öztürk & Dil, 2022). In this regard, after conducting a performance analysis, we evaluated the scientific outputs in terms of quality and quantity indicators about the elements (author, journal, country, institution/university). In the downloaded data set related to the researched field. Moreover, within this analysis, an occupation analysis is also conducted. This is to know the effectiveness of the outputs of the existing elements in the relevant field.

**Table 1: shows the diplomatic indicators used to evaluate the performance (or scientific outputs) of the relevant elements.**

Indicators	Content
Publication indicators	Total number of papers, number of papers by years, authors-countries-institutions with the most studies, journals where the most papers were published
Impact indicators based on received citations (Citation analysis)	Total number of citations of papers (or authors-journals-countries-universities) including or excluding self-citations, average number of citations per paper, self-citation rate, most cited (most influential) papers or authors, authors' h-index, g-index, hg-index, etc.
Indicators based on the impact of the journal	Impact Factor, most cited journals, SJR, h-index of journals, relative citations ratio, normalized impact factor, etc.

As shown, without the need for calculations or programming formulas, the information obtained through performance analysis can be accessed only from databases or journal websites. Therefore, the analysis procedure can be carried out without the need to use software. It is enough to classify the relevant elements and compare the outputs/quantities of each with each other, and the results can be presented through a set of tables (J. Block, Fisch, & Rehan, 2020).



In this step, “citation analysis” is used only for bibliometric analysis techniques. Accordingly, it may be necessary to use a program specifically for this analysis(Ozturk, 2021).

Descriptive analysis is the simplest way to begin bibliometric research by describing the basic performance characteristics of scientific elements in the relevant field(Cobo et al., 2011)

An experimental research paper always begins with descriptive statistics about the results of the analyses, so bibliometric research must begin with an overview of the relevant literature(J. H. Block & Fisch, 2020).

In this regard, performance analysis is an important part of bibliometric research. Because biometric research papers edit the members only, the research must go beyond this stage.

### 3.2 Science mapping procedure

Scientific mapping reveals the intellectual, social, and conceptual structure and evolutionary processes of literature (research field)(Aria & Cuccurullo, 2017; Cobo et al., 2011). Accordingly, it is not enough to classify the elements, measure their performance, or conduct a simple citation analysis in the downloaded data set. Rather, further analysis is necessary (J. H. Block & Fisch, 2020).to reveal the intellectual structure and dynamics of the field. Therefore, it is necessary to conduct more analyses at the macro level, as performance analysis leads to results about the performance of scientific bodies In this analysis, the reader is unable to obtain information regarding the relationship/interaction/cooperation between these effective parties(Ozturk, 2021). Because this analysis alone cannot provide a comprehensive view of the basic structure and dynamics of the relevant field, scientific mapping was then used to get the big picture of the interactions between scientific actors.? From multiple points of view(Van Eck & Waltman, 2014), It is considered a visualization of the network of relationships/cooperation between scientific elements(J. H. Block & Fisch, 2020), which allows for the mapping of the relevant literature. In short, scientific mapping is a spatial representation of the relationship/interaction between authors, concepts (keywords), and citations (in terms of papers, journals, or authors) in any research field. (M. Gutiérrez-Salcedo, Martínez, Moral-Munoz, Herrera-Viedma, & Cobo, 2018) To reveal and examine networks of relationships between scientific elements, co-authorship, common words, and common citations.

The mapping procedure is a combination of the analysis and visualization processes. In the analysis, similarity matrices and relationships between elements are calculated(Boyack & Klavans, 2014). After that, the cooperation relationship networks

between related elements are visualized(Ozturk, 2021). Although BibExcel is one of the first programs to follow this principle(“Persson O, Danell R, Schneider JW (2009) How to use Bibexcel for various types of bibliometric analysis. Celebrating scholarly communication studies: a Festschrift for Olle Persson at his 60th Birthday Special Volume of the e-Newsletter of the International,” n.d.), researchers lack the necessary skills to manually calculate similarity and relationship/cooperation matrices between these elements. Therefore, they usually use modern software tools to implement bibliometric techniques to obtain relevant visual(Pan, Yan, Cui, & Hua, 2018) images, and some programs can, for example (VOSviewer, Biblioshiny, and SciMA) directly display visual elements related to bibliometric analysis techniques without the need to perform additional analysis due to the advanced coding embedded within it. Such programs provide great convenience and advantages for researchers(Zupic & Čater, 2015), as they can

- 1/ Export papers from databases as a file, save them in the appropriate file type and easily upload them to the programs.
- 2/ Similarity matrices between elements can be calculated without the need for manual processing.
- 3/ Easily create visual images of networks of relationships between elements.
- 4/ Export these visual images and save them in formats that can be used in related research. The studies conducted by Alyo, Molina Garcia, and others are examples of drawing scientific maps as part of bibliometric research.

#### **Stage 4: Interpreting the findings and results**

The final stage is the interpretation of the results and outputs in the field of research(Zupic & Čater, 2015). Although the analysis is the basic part of the research, it is not sufficient to report the results of the relevant analyses and visuals(J. H. Block & Fisch, 2020).

It deals with performing analyses and compiling multiple lists of relevant literature (performance analysis), revealing the relationship between scientific elements, and presenting relevant visual elements (scientific mapping)However, they are merely working at the beginning of bibliometric research(Cobo et al., 2011). Accordingly, bibliometric research must depict the current state of the literature, organize the existing body of knowledge, and determine the general trend and direction of the literature. It should also pave the way for discussions on what is already known clarify gaps in the literature and set an agenda and road map for future research(J. H. Block & Fisch, 2020). To do this, the extent to which the bibliometric research supports the intended research

goal must be discussed and interpreted, and the extent to which it can address the research questions must be determined.

In bibliometric research, a common problem that needs to be addressed is when many bibliometric research findings do not relate to the gap in the literature and, as a result, are unlikely to yield important conclusions for the topic under consideration. This means that this analysis is used only because of its widespread use, but regardless of the logic and intent behind the analysis, this leads to the start of research without relying on identification, curiosity, claim, or assumption. The gap appears in the interpretation of the results/perception obtained through the analysis. In addition, the interpretations of the results do not turn into satisfactory results about the field in question. When researchers lack intimate knowledge of the field they are studying, it requires experience in the field(Ozturk, 2021) and a field perspective(Fisch & Block, 2018) to interpret the results and outcomes. Researchers who already have good experience in the research field can also discuss the structure of the research field, its underlying dynamics, the evolutionary past, or unfinished research gaps(Zupic & Čater, 2015). The focus of researchers' efforts in their research affects how the results and outputs are interpreted. This focus indicates what the researchers seek to achieve through bibliometric research. Will the research provide:

- 1/The overall structure of the field of relevance
- 2/Derives an integrative framework for current knowledge of the field
- 3/Reveals the evolutionary growth of the field
- 4/Addresses only a few questions based on a set of identified gaps in the relevant field
- 5/Identifies potential avenues for future research.

**Table 2: for interpreting the findings and results Source: (Mukherjee, Lim, Kumar, & Donthu, 2022; Zupic & Čater, 2015) and authors' analysis**

Research focus	Interpretation ways
Presenting the field's overall structure	<p>Introduction to the general structure of the field</p> <p>The general structure of the field is introduced when attempting to present the conceptual, social, and intellectual structure of a particular research area. Based on an overview of the relationship between bibliometric elements (e.g., papers, authors, concepts, citations, publication groups, journals, universities, institutions, and countries), the discussion should be conducted in the Results and Discussion section with an emphasis on the current state, trends, and relevant gaps in the field. Most bibliometric researchers prefer this approach. See Schroeder et al. (2021), Amerato et al. (2023), and Tiberius and Wieland (2023) for a presentation of the general structure of the field.</p>
Deriving an integrative framework of the field's current knowledge	<p>An integrative perspective on knowledge in the relevant research area can be derived based on the synthesis of science maps. This (practical) framework typically includes different variables (e.g., independent, dependent, antecedent, outcome, facilitators, mediators), contextual factors, and applied theoretical perspectives. See Tiberius et al. (2021), Fernandes and Ferreira (2022), Kimpimäki et al. (2022), and Horvatinovic et al. (2023) for integrative frameworks.</p>
Revealing the field's evolutionary growth	<p>It is used when trying to reveal the evolution of a research field over time. Data on the relevant literature should be divided into several periods that are important for the dynamics of the field, as this research focuses on this type of issue and the structure of the field should be considered separately for each period. When interpreting the results, one should try to explain why and how the structure of the research field has evolved. New or declining elements/topics in a given period should also be identified (e.g., Vogel 2012). See Halder et al. (2021) for an example of presenting the evolutionary growth of a field.</p>
Seeking answers to a set of bounded research questions	<p>Some bibliometric research may focus on very specific research questions and gaps in the relevant literature. Such studies typically include a “methods section” where different bibliometric analysis techniques are used to prove or support the authors’ assertions and share their findings regarding those assertions, and a “results section” where the relationship between the</p>

	<p>assertions and the existing literature is comprehensively discussed. To illustrate this, Ozturk (2021) conducted bibliometric research with a focus on identifying "the overlap between the resource dependence theory (RDT) literature and the strategic management discipline." The research conducted a co-citation and co-word analysis to uncover the conclusion that the RDT literature largely focuses on strategic actions rather than the underlying concepts and assumptions of the theory. In the results and discussion section of the study, the findings from the analyses are discussed based on evidence supporting the identified gaps and research gaps.</p>
<p>Outlining potential avenues for future research</p>	<p>Future research paths can be identified based on the analyses, especially the integrated knowledge within the derived collections. It is important to infer such directions and provide progress in the field rather than just making superficial recommendations. Through this contribution, authors of a bibliometric paper have the opportunity to guide the future development of a field. See Vallaster et al. (2019), Fernandes and Ferreira (2022), and Horvatinovic et al. (2023) for examples of specific paths for future research.</p>

**Table 3: The bibliometric research stages and steps**

From: [How to design bibliometric research: an overview and a framework proposal](#)

<b>Stages</b>	<b>Steps (Practice Guidelines)</b>
(1) Defining the aim of the research	<ul style="list-style-type: none"> <li>• What is the aim of the research?</li> <li>• What are the expected results from the research?</li> <li>• In line with the resarch aim, what are the research questions?</li> <li>• What is the scope and focus of the research? (e.g., performance analysis, science mapping, network analysis, etc.)</li> </ul>
(2) Collecting data on the relevant literature	<ul style="list-style-type: none"> <li>• Selecting the database(s) (e.g., WoS, Scopus, Google Scholar, PubMed, Microsoft Academic, Dimensions, EmBase, SpringerLink, etc.)</li> <li>• Initial search process: Identifying search terms</li> <li>• Filtering: Determining and applying the inclusion or exclusion criteria.</li> <li>• Downloading the dataset file (file format should be compatible with the preferred software to analyze).</li> </ul>
(3) Analysis and visualization	<ul style="list-style-type: none"> <li>• Identifying the bibliometric analysis techniques to meet the aim and scope of the research (e.g., citation analysis, co-citation analysis, co-word analysis, etc.)</li> <li>• Determining the appropriate software(s) for analysis (e.g., VOSviewer, BibExcel, Histcite, Bibliometrix, SciMat, etc.)</li> <li>• Determining the appropriate software(s) for visualization (e.g., VOSviewer, Pajek, Gephi, UCINET, etc.)</li> <li>• Analyzing the data and visualizing the findings.</li> </ul>
(4) Interpreting the findings and results	<ul style="list-style-type: none"> <li>• Were the research questions successfully addressed?</li> <li>• Did the study provide a new insight into the relevant literature?</li> <li>• Has the researcher drawn any determinations or inferences regarding the research field/literature?</li> <li>• Any suggestions for future research?</li> </ul>

## Chapter Three:

### Application and Results:

Bibliometric analysis utilizes various methods to evaluate the impact and relationships within scientific literature. The results of such analysis can generally be classified into two main types:

#### **Evaluative**

#### **Metrics:**

These metrics assess the quality or impact of scientific outputs and include:

**Impact Factor (IF):** Measures the average number of citations received by recent articles in a specific journal.

**h-index:** Evaluates a researcher's productivity and the citation impact of their work.

**g-index:** Places greater emphasis on highly-cited articles, serving as a complement to the h-index.

**SNIP (Source Normalized Impact per Paper):** Accounts for differences in citation practices across disciplines.

#### **Relational**

#### **Metrics:**

These metrics focus on exploring the structures and connections within the scientific community, such as:

**Co-citation Analysis:** Identifies how often two or more articles are cited together, highlighting topical relationships.

**Bibliographic Coupling:** Examines the number of references shared by two documents, indicating content similarity.

**Co-authorship Analysis:** Studies collaborative networks among researchers, institutions, or countries.

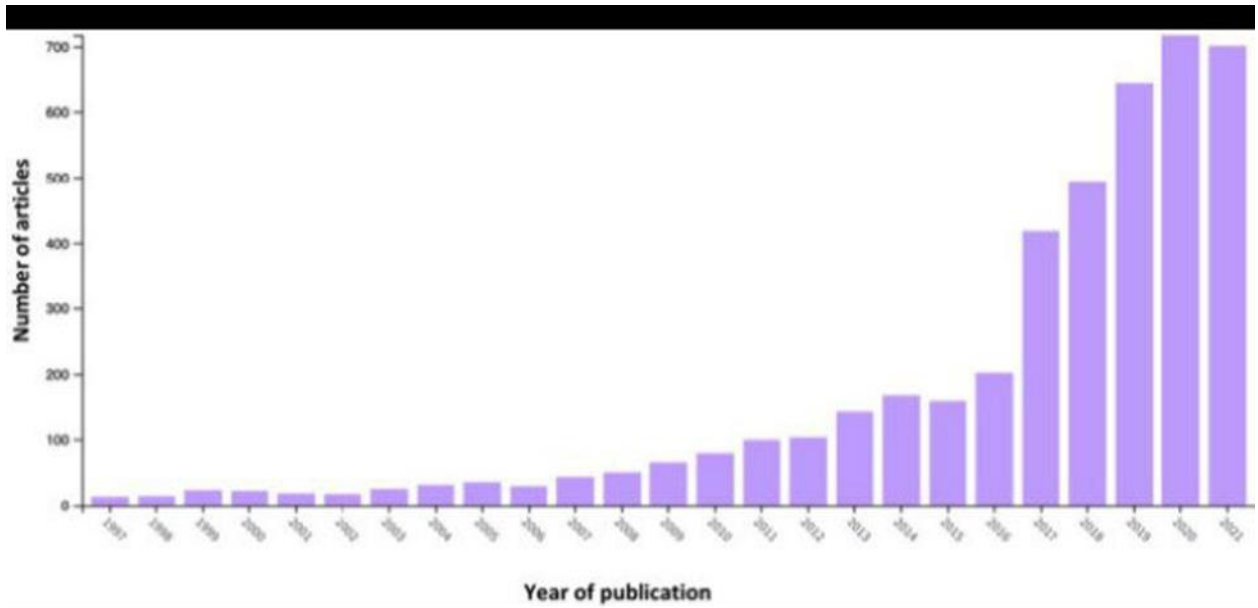
### **1.Applying bibliometric Analysis:**

Bibliometric analysis was employed as a core tool to assess the relationship between leadership and employee employability. This chapter focuses on interpreting the results from the perspective of applying bibliometric analysis, including performance evaluation and visual network analysis.

#### **Application example: Leadership's Impact on Employability**

As part of this research, a bibliometric analysis was conducted to explore the relationship between leadership and employee employability, using the example of the study titled "The Influence of Leadership on Employees' Employability." This study aimed to determine whether leadership styles influence employability and the mechanisms through which this occurs.

The example integrates a systematic literature review alongside bibliometric techniques, employing databases like the Web of Science to identify relevant articles.



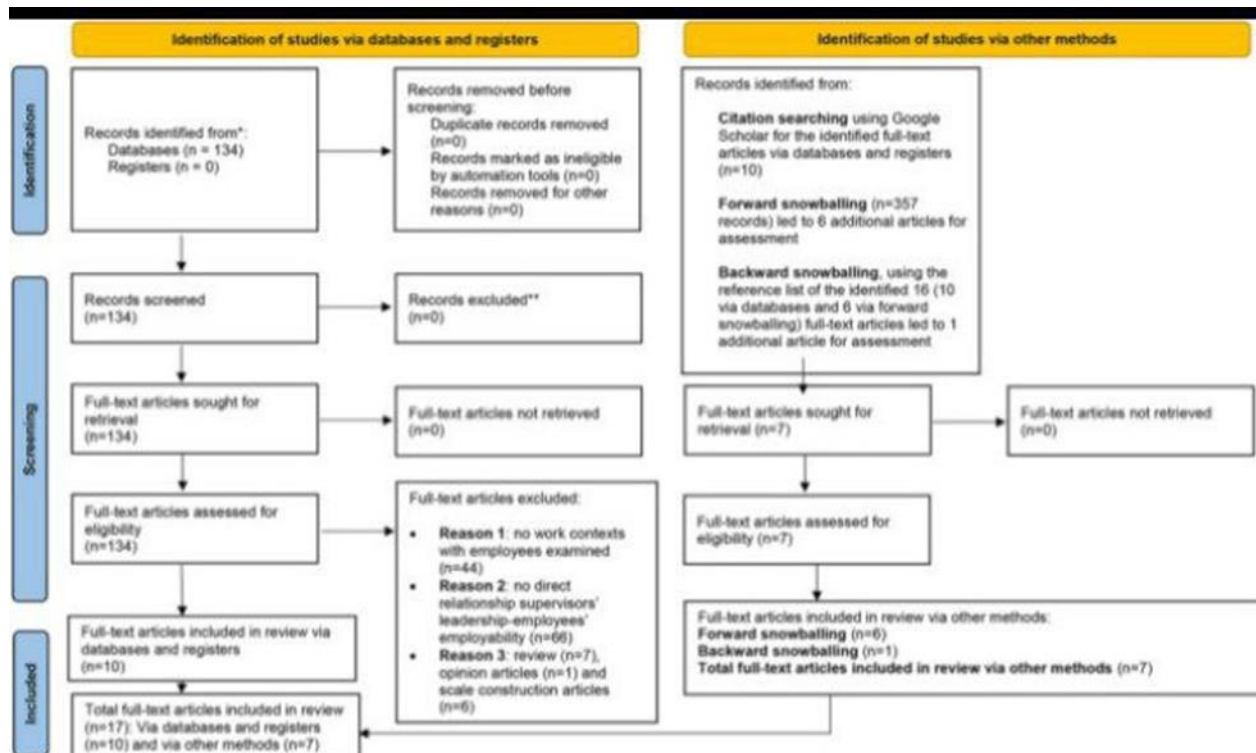
**Figure 1: Yearly Number of Articles Published on "Employability" (1997–2021)**

This figure illustrates the temporal trend of publications related to employability. A notable increase in academic attention to this field is observed in recent years, reflecting the growing significance of employability in understanding dynamic changes in labor markets.





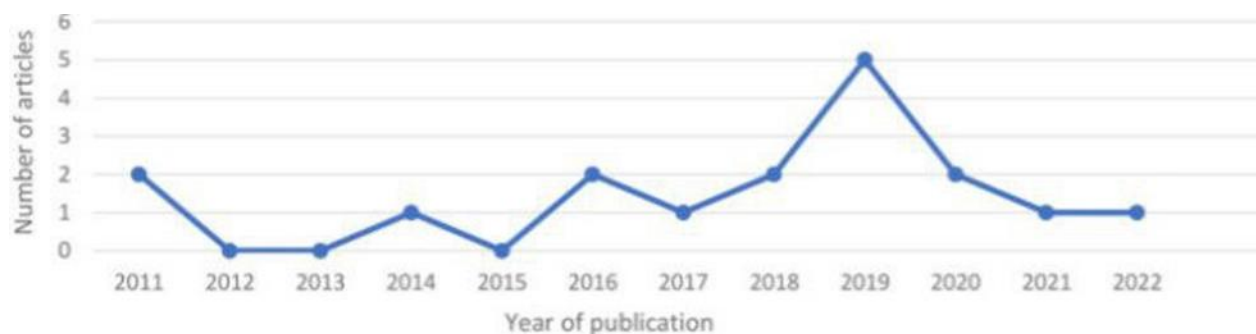




**Figure 5: PRISMA 2020 Flowchart for Study Selection**

This flowchart outlines the systematic process used to identify and select studies for the analysis. It includes key steps such as initial identification of records, screening based on inclusion criteria, and final selection of articles for full-text analysis. The flowchart ensures transparency and replicability in the research process, highlighting the rigorous methodology applied to build the dataset.

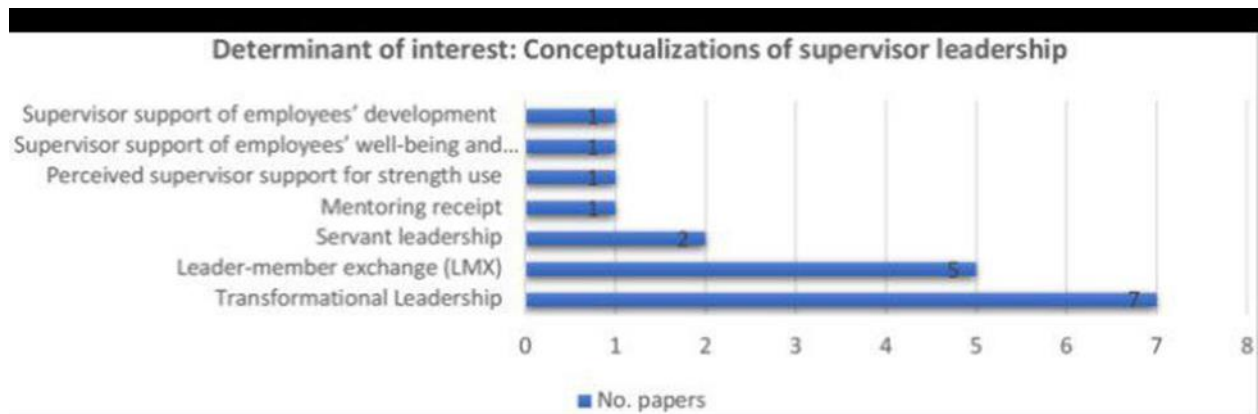
Demonstrates the importance of a structured and transparent approach in bibliometric studies, ensuring all included articles meet rigorous standards.



**Figure 6: Yearly Publication of Articles on Leadership and Employability (Included Studies)**

This figure tracks the yearly distribution of the 17 selected studies focusing on the relationship between leadership and employability. It shows variations in publication trends over the years and reflects how interest in this specific intersection has evolved. Peaks in the data may indicate periods where this topic gained heightened academic attention, likely due to shifts in workplace dynamics or societal needs.

Highlights evolving research focus and academic interest in leadership and employability, which can guide future research directions.



**Figure 7: Conceptualizations of Supervisor Leadership in the Included Studies (n=17)**

This figure categorizes the types of leadership frameworks and styles discussed in the 17 selected articles. Key leadership styles include transformational leadership, leader-member exchange (LMX), and servant leadership, among others. These conceptualizations provide insight into how different leadership approaches influence employee employability. For instance, transformational leadership often focuses on inspiring and empowering employees, while LMX emphasizes the quality of relationships between leaders and their teams.

Offers a nuanced understanding of how various leadership styles interact with employability, providing practical frameworks for organizations to enhance employee development.

## 2. Results of Network Analysis

Through visual network analysis, leadership emerged as a primary driver of employability. The networks indicate that the relationship between leadership and employability is often explained through a social exchange perspective. This underscores that the quality of the relationship between leaders and employees determines the effectiveness of leadership support, such as training and guidance.

The bibliometric analysis not only organizes knowledge but also provides a clear roadmap for understanding the dynamics of leadership's role in enhancing employability. This structured and analytical approach ensures actionable insights for policymakers, researchers, and practitioners.

Leadership plays a pivotal role in enhancing employability by fostering a two-way social exchange between supervisors and employees.

Transformational leadership and LMX emerged as dominant styles influencing employability across diverse industries and geographic contexts.

Practical implications suggest that organizations should invest in leadership development as part of their HR strategies to promote employability.

## **Chapter four:**

### **Future Work and Recommendations:**

Although bibliometric analysis provides important insights into the relationships between research, there is a lack of its application to the study of the links between interdisciplinary research. This gap represents a challenge, as understanding collaboration between different disciplines is essential for the advancement and development of scientific knowledge.

In addition, bibliometric analysis relies heavily on quantitative measures such as citation counts and collaborative networks, but qualitative analysis of full-text papers is absent. This limits a deeper understanding of the development of scientific ideas and how they influence future research. Therefore, combining quantitative and qualitative analysis may be useful to provide a more comprehensive and objective view. ,investing in leadership training programs to enhance employees' functional skills and promoting the use of bibliometric tools to analyze interdisciplinary research.

### **Conclusion**

The application of bibliometric analysis proves highly effective in organizing knowledge and understanding research dynamics. The results emphasize that leadership is a vital strategy for enhancing employability, offering valuable insights for policymakers and practitioners.

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