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Bibliometric Analysis of Covid 19 and Industry 4.0 Studies Published in Web of Science Database

Neşe SALİK ATA[1]

Abstract

The Covid 19 pandemic, which emerged in 2019 and spread rapidly and became a hot topic in the world, has negatively affected people's lives in every sense. In order to eliminate these negative effects, many practices such as masks, curfews, distance education, working from home and vaccination have been implemented. Despite these, the Covid 19 epidemic has brought the production sector to a halt. It is thought that this situation can only be overcome with Industry 4.0 technologies, which envisage using robots instead of human factors. It is thought that the production style, which requires robots to work 24 hours a day, on which Industry 4.0 is based, may be a good method in combating the Covid 19 epidemic, as it reduces the need for humans. Even in the field of health, Industry 4.0 applications are expected to produce positive results in terms of both treatment and prevention of infection. The idea of benefiting from Industry 4.0 technologies during the Covid 19 pandemic period has been influential in academics turning to this field and many studies have been conducted on the subject. This study was conducted to examine the studies using the bibliometric analysis method. In this context, bibliometric analysis was conducted to determine the number of publications addressing Covid 19 and Industry 4.0 issues, the most cited articles, the most published authors, countries and journals. The Web of Science (WoS) database was used to obtain publications. The keywords used were subjected to a filtering process to prevent the inclusion of articles that did not meet the inclusion criteria, resulting in 305 publications. R statistical software was used to analyze the obtained data. According to the analysis results, India was found to be the country with the most articles on Covid 19 and Industry 4.0 according to the main affiliation of the author.

Keywords: Industry 4.0, Covid 19, Web of Science, Bibliometric Analysis, Fourth Industrial Revolution

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Web of Science Veri Tabanında Yayınlanan Covid 19 ve Endüstri 4.0 Konulu Çalışmaların Bibliyometrik Analizi

Neşe SALİK ATA[1]

Öz

2019 yılında ortaya çıkan ve hızlı bir şekilde yayılarak dünyanın gündemine oturan Covid 19 salgını insanların yaşamlarını her anlamda olumsuz etkilemiştir. Bu olumsuz etkileri yok edebilmek için maske, sokağa çıkma yasağı, uzaktan eğitim, evden çalışma, aşılama gibi pek çok uygulamaya gidilmiştir. Bunlara rağmen Covid 19 salgını üretim sektörünü durma noktasına getirmiştir. Bu durumun ise ancak insan faktörü yerine robot kullanmayı öngören Endüstri 4.0 teknolojileri ile aşılabileceği düşünülmüştür. Endüstri 4.0'ın esas aldığı 24 saat robatların çalışmasını öngören üretim tarzı, insana olan ihtiyacı azalttığından Covid 19 salgını ile mücadelede iyi bir yöntem olabileceği düşülmektedir. Hatta sağlık alanında da Endüstri 4.0 uygulamalarının hem tedavi hem de bulaşı önlemek açısından olumlu sonuçlar doğurması beklenmektedir. Covid 19 pandemi döneminde Endüstri 4.0'ın teknolojilerinden faydalanma fikri akademisyenlerin bu alana yönelmelerinde etkili olmuştur ve konuyla ilgli pek çok çalışma yapılmıştır. Bu çalışma da yapılan çalışmaların bibliyometrik analiz yöntemi ile incelenmesi amacıyla yapılmıştır. Bu bağlamda Covid 19 ve Endüstri 4.0 konularını ele alan yayın sayısını, en çok atıf alan makaleleri, en çok yayın yapan yazarları, ülkeleri ve dergileri tespit etmek için bibliyometrik analiz yapılmıştır. Yayınları elde etmek için Web of Science (WoS) veritabanı kullanılmıştır. Kullanılan anahtar kelimeler, dahil etme kriterlerini karşılamayan makalelerin getirilmesini önlemek için bir filtreleme işlemine tabi tutularak 305 yayına ulaşılmıştır. Elde edilen verileri analiz etmek için R istatistiksel yazılımı kullanılmıştır. Analiz sonuçlarına göre Hindistan, yazarın ana mensubiyetine göre Covid 19 ve Endüstri 4.0 hakkında en çok makaleye sahip ülke olduğu görülmüştür.

Anahtar Kelimeler: Endüstrisi 4.0, Covid 19, Web of Science, Bibliometrik Analiz, Dördüncü Endüstri Devrimi

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Introduction

There has been a global struggle against an invisible force, Covid 19. Although countries such as the USA, England, Italy, and France have developed medical systems, they have been greatly damaged, and millions of people from all over the world have been affected by the virus in a very short period. Covid 19 has affected the general structure of a country including healthcare, supply chain, industry, many other sectors, and has brought many changes in everyone's lifestyle. In order to cope with the current situation, governments, academics, and individuals sought innovative solutions (Rahman et al., 2021, p.2).

This study was carried out to systematically examine the researches dealing with the concept of Industry 4.0 in the context of Covid 19. With this study, it is aimed to reveal the deficiencies in the field, and to contribute to the scientific field. When the studies on the subject of "Industry 4.0 in the Context of Covid 19" were examined in the literature, no similar study was found on bibliometric analysis. In this context, it is thought that the study has an original quality. Examining the studies dealing with Industry 4.0 in the context of Covid 19, and determining which issues stand out; it is important for the use of Industry 4.0 technologies in the fight against the pandemic, unmanned production during restriction periods, and the effective use of the health system. In this context, the following research questions were formed:

1. How is the distribution of articles dealing with Industry 4.0 in the context of Covid 19 by years?

2. Which journals are the most published articles on Industry 4.0 in the context of Covid 19?

3. What are the most cited sources in the articles dealing with Industry 4.0 in the context of Covid 19?

4. What are the most repeated keywords in articles dealing with Industry 4.0 in the context of Covid 19?

5. What is the relationship between journal, author, and keyword in articles dealing with Industry 4.0 in the context of Covid 19?

6. What is the h/g/m index of the journals, and authors in which the articles dealing with Industry 4.0 in the context of Covid 19 are published?

7. What are the results of conceptual structure factorial analysis according to keywords?

8. How did thematic evolution occur according to author keywords?

9. How is the distribution of the articles according to the countries where the authors working on Industry 4.0 in the context of Covid 19 are located?

10. What is the total number of citations received by countries working on Industry 4.0 in the context of Covid 19?

Making a study in this direction in the study constitutes the main contribution of the study to the literature. In line with the purpose of the study, the concepts of Covid 19, and Industry 4.0 will be discussed in the context of the theoretical framework. Then, the bibliometric analysis of the articles dealing with the subject of Industry 4.0 in the

context of Covid 19 will be discussed according to the distribution by years, most published journals, most cited sources, the most repeated keywords in articles, journal, author, and keyword relationship in articles, h/g/m index of the journals, and authors in which the articles were published, distribution of articles according to the countries where the authors are located, the total number of citations received by the working countries.

Literature Review

Industry 4.0

The term "Industry 4.0" first appeared in an article published by the German government in 2011. After electrification, informatics, and mechanization, the fourth stage of the industry has been named "Industry 4.0". At an industrial fair in Hannover Germany in 2013, the term "Industry 4.0" came to the fore again, and quickly emerged as the German national strategy. The concept of "Industry 4.0" has been widely discussed in recent years, and is gaining importance for many information, and global industries. Industry 4.0 is a new industrial revolution that will have a great impact on the international industry (Zhou et al., 2015, p. 429).

In the fourth industrial revolution, which is based on human-machinization, the most efficient production in the economy is provided by the use of smart factories, and efficient production options provided by technological developments. There have been many events that have affected the social, cultural, political economy, and the world economy. The industrial revolutions in history are also these events (Şahin, 2007, p. 415). So far, four industrial revolutions have been the subject of research, although some authors question whether industrial systems came about by evolution or revolution. These revolutions are as follows (Satyro et al., 2023, p. 2):

- Industry 1.0 or the first industrial revolution, took place using steam power, and the mechanization of the loom in the 1780s, when industry succeeded in reducing reliance on human physical power, and reaching new levels of productivity.
- Industry 2.0, or the second industrial revolution, took place with the introduction of mass producion in steel mills in the 1870s.
- Industry 3.0 or the third industrial revolution, began in 1969 with the use of telecommunications, robotics, electronics, and computing.
- Industry 4.0 or the fourth industrial revolution emerged at the Hannover Fair in 2011 in order to increase the competitiveness of German companies.

Industry 4.0 is based on digital simulation, networking production data management, highly automated production processes, and transforming the entire process into access to information (Zhou et al., 2015, p. 431). Industry 4.0; It refers to smart production processes in manufacturing with the development of technologies related to the internet of things, artificial intelligence, cloud computing, and big data (Lu and Liao, 2022, p. 1). There are many terms commonly used to describe Industry 4.0. some of these terms are as follows (Hermann et al., 2016, p. 3923):

- **Smart Factory:** Autonomously controlled smart factories are developing by using smart technology related to holistically digitized product, and factory models, with production fully equipped with autonomous systems, sensors, and actors (Lucke et al., 2008, p.115 - 116).
- **Internet of Things, IoT:** The digital devices used need to transmit data to a digital device or another monitor via sensors during their operation. These digital objects have been named the Internet of Things (IoT) because they transfer their data over the network infrastructure of the Internet (Öztuna, 2017, p. 29).
- **Cyber-Physical Systems:** The digital, and physical level merge. When this encompasses the production level as well as products, systems emerge that can no longer reasonably distinguish between digital, and physical representation (Lasi et al., 2014, p. 4).
- **Autonomous Robots:** Unlike robots designed during Industry 3.0, robots in Industry 4.0 are designed to interact or work with humans, reducing effort, and risk while working (Soares et al., 2021, p. 7).
- **Cyber Security:** Due to the awareness that cyber threats cannot be completely eliminated, research, and technological development is essential to reduce the harmful effects of cyber attacks (Azambuja et al., 2023, p. 3).
- **Cloud Computing**: Cloud computing services allow on-demand network access to computing resources remotely provided by an internet service provider. It helps advanced decision making by connecting different devices, machines or items, and exchanging information in real time (Marinagi et al., 2023, p.11).
- **Augmented Reality:** It is a technology that allows virtual objects or data to enter the field of view of the observer, expanding the physical environment, and thus enabling people to interact with them in a superior way (Satyro vd., 2023, p. 3).

Covid 19

The coronavirus was first identified in 1966 when an experiment was conducted in the virus culture of patients with the common cold. There are four variants of the coronavirus: alpha, beta, delta, and gamma coronavirus. Among these variants, there are seven subtypes that can infect humans, three of which SARS-COV, MERS-COV, and SARS-COV-2 cause fatal respiratory infections (Acioli et al., 2021, p. 993).

In December 2019, an outbreak of novel coronavirus SARS-COV-2 (Covid 19) of unknown origin was reported in Wuhan, Hubei Province of China. Thousands of deaths caused by the novel coronavirus disease (Covid 19) led the World Health Organization to declare a pandemic on March 12, 2020 (Ciotti et al., 2020, p. 366).

The Covid 19 pandemic has affected almost all countries. The development of advanced technologies was needed to overcome the various problems associated with this pandemic. In the case of the implementation of Industry 4.0, which includes advanced manufacturing, and information technologies, all these technologies are interconnected, and medical stakeholders communicate with each other to decide the necessary actions with the production, and use of the vaccine, health equipment, and logistics, control, surveillance, detection, and less human physical power. It is assumed that it will install

(Javaid et al., 2020, p. 419). The expected benefits of Industry 4.0 technologies to the Covıd 19 pandemic are as follows (Haleem and Javaid, 2019, p. 4 ; Ren et al., 2020, p. 1):

- Planning activities related to Covıd 19,
- Precautionary production for the Covıd 19 virus,
- Using robotic-based therapy of the infected patient to reduce the doctor's risk,
- Providing a better experience without posing risks to health services, and other employees,
- Promoting a flexible working environment for treatment,
- Timely delivery of medical supplies using the smart supply chain,
- Digital technologies help people do their daily work during the curfew,
- Use of virtual reality for educational purposes,
- Researchers can use these technologies on social, and media platforms to identify unusual information,
- The emergence of many innovations with the help of advanced production, and digital Technologies.

Method

Research model

Studies on Covid 19, and Industry 4.0 were scanned through the "Title" in the Web of Science (WoS) database. In the research, the studies between the years 2020-2023 were examined within certain criteria, and subjected to bibliometric analysis. In order to collect the data (COVID 19 or covid 19 or cox19 or COVID-19 or cov-19 or pandemic or coronavirus), and "Industry 4.0", the results were examined. As a result of the search, 485 studies were reached. By filtering, the studies that were scanned in the SCI-Exp., SSCI, ESCI indexes, in English language, and open to access were included in the review. 305 articles were reached from the research universe WoS database, and the articles scanned on 30 June 2023 were published in a total of 178 sources. In the articles written, 19077 publications were cited. Table 1 presents general information about the articles used in the research universe

Table 1. Article Data

Description	Results
Maın Informatıon About Data	
Timespan	2020:2023
Sources (Journals, Books, etc)	178
Documents	305
Annual Growth Rate %	30,59
Document Average Age	1,3
Average citations per doc	12,04
References	19077
Document Contents	
Keywords Plus (ID)	636
Author's Keywords (DE)	1286
Authors	

Authors	1015
Authors of single-authored docs	15
Authors Collaboratıon	
Single-authored docs	15
Co-Authors per Doc	3,66
International co-authorships %	43,61
Document Types	
article	260
article; early access	45

Analysis of Data

Bibliometric analysis:

Bibliometrics is derived from the roots "biblio", and "metrics". The word “Biblio” derives from the Latin, and Greek word “biblion”, which is equivalent to the word “bybl(os)” meaning “book”. “Metrics”, on the other hand, comes from the words “metricus” or “metricos” in Latin; Greek, and means “measurement” (Yersüren and Özel, 2020, p. 1144). Bibliometrics, which is widely used in various fields, comes from information science, and the library. It is an effective tool for examining the current academic environment, reviewing historical evolution, and predicting future growth in the field (Wang and Ma, 2016, p.129).

Bibliometric analysis which was put forward by Derek J. De Solla in 1965 (Boyack et al., 2005, p. 351), was used for the first time in Turkey by Özinönü in 1970 (Hotamışlı and Erem, 2014, p. 3). Basically, performing bibliometric analysis is based on articles in large databases. A comprehensive quantitative analysis can be made from the basic features of the publications to the keywords, from the time range to the regional distribution, from the authors to the journal institutions (Qin et al., 2021, p. 168).

R statistical software used by many researchers was used for analysis. The data in the study were examined with bibliometrix, which is the R 4.2.2 package program add-on developed by Aria and Cuccurullo (2017). For the analysis results, R Studio, and R programs, biblioshiny application, and bibilometrix site were used.

Findings

The bibliometric analysis method helps to create a more objective literature review, and a wider scanning area. In addition, it allows authors to better know their fields, and develop a clearer publication policy (Zupic & Čater, 2015, p. 429). According to the results of the bibliometric analysis, it is seen that the studies on “Covid 19, and Industry 4.0” started to be published in 2020 with the occurrence of the “Covid 19 pandemic”, and there was a significant increase in the number of publications, especially in 2021, and 2022. In the table below, the distribution of the number of publications by years is given.

Table 2. Distribution of the number of publications by years

Year	Number of Articles	Percentage %
2020	22	%7.22
2021	97	%31.80
2022	137	%44.91
2023	49	%16.07

With the determination of the journals that publish the most, analyzes will be made for journals, authors, citations, keywords, and countries. Information on the journals with the highest number of publications is presented in Figure 1.

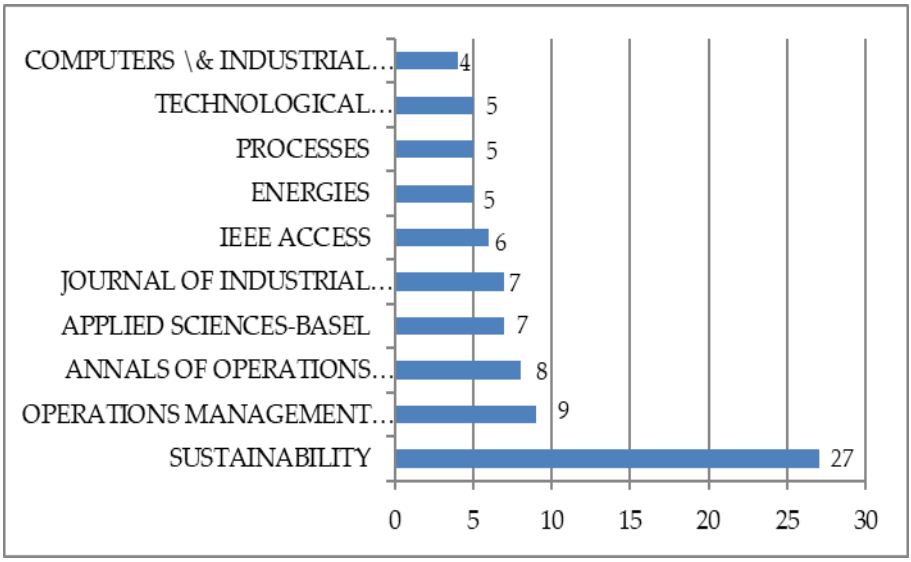

Figure 1. Top Publishing Journals

Between 2020-2023, a total of 83 of 305 articles were published in 10 journals shown in Figure 1. These articles published in 10 journals constitute 27.21% of the total number of articles. The journal "Sustainability" with 27 publications constitutes 8.85% of the total number of publications.

The Bradford scattering law is the most well-known, and popular law. Bradford's law of scattering, first published in 1934, is often associated with Zipf's law, and Lotka's law. The laws mentioned are the three most important bibliometric laws. It is generally accepted as the best scientific research model or example found in Library, and Information Science (Arsenova, 2013, p. 678-679). In this context, the data prepared according to the Bradford scattering law are given in the table below.

Table 3: Journal Table by Bradford Scattering Law

Rank	Journal Name	Frequency	Cumulative Frequency	Zone
1	Sustainability	27	27	Zone 1
2	Operations Management Research	9	36	Zone 1
3	Annals of Operations Research	8	44	Zone 1
4	Applied Sciences-Basel	7	51	Zone 1
5	Journal of Industrial Integration and Management-Innovation and Entrepreneurship	7	58	Zone 1
6	IEEE Access	6	64	Zone 1
7	Energies	5	69	Zone 1
8	Processes	5	74	Zone 1
9	Technological Forecasting and Social Change	5	79	Zone 1
10	Computers \& Industrial Engineering	4	83	Zone 1

The basic idea that still holds true today is that if a scientist reads an article, he or she will get an insight into which articles might cover a similar topic. It is thought that it would be useful to be able to reach other sources on the same subject by looking at the quotations made in the article as a result of an article read briefly. However, a scan made in this way can lead away from the main source, and cause to reach the works that are little quoted, and get away from the subject, and cause loss of time. Bradford's law of scattering provides an important method for directing journals that make extensive evaluations on the subject rather than journals with small citations (Thelwall, 2008, p. 606).

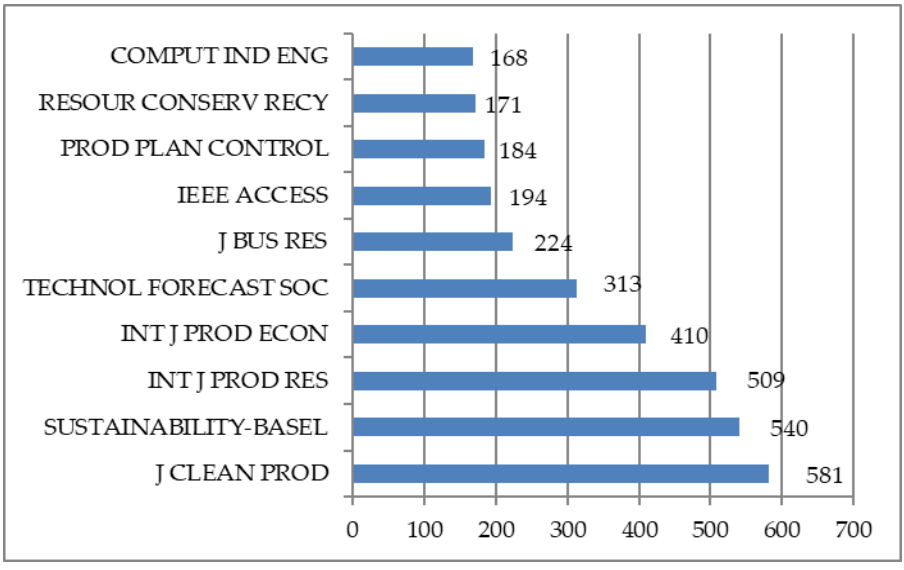

Figure 2. Sources Most Cited by Articles

J Clean Prod ranks first among the most cited journals with 581 citations. The top 10 most cited journals received 17.26% of the total citations. A total of 19077 citations were made in 305 articles, with an average of 62.5 citations per article.

The h index, which was defined by Hirsch in 2005, expresses the value of the scientist's index as h if each of a scientist's article gets the least number of citations, and the other articles get the most h. The H index provides information about the author's publishing activity, and the effectiveness of his publications (Hirsch, 2005). Developed by Egghe in 2006, the g index is an improved version of the h index. While the g index evaluates a particular article group, it shows the index value that also takes into account the highly cited articles in order to calculate the author's effectiveness (Egghe, 2006, p. 131). The median is the number of citations received by the publications in the Hirsch-core in the M index. This value will always be less than the h-index (Bornmann et al., 2008, p. 832). Table 3 presents information on the h/g/m indexes of the journals in which the articles were published.

Table 3. h/g/m Index Table of Journals

Journal Name	h index	g index	m index	Total Number of Citations	Number of Publication	Date of First Article Published
Sustainability	7	13	1,75	205	27	2020
Journal of Industrial Integration and Management-Innovation and Entrepreneurship	6	7	1,5	181	7	2020
Annals of Operations Research	5	8	1,667	110	8	2021
Operations Management Research	5	6	2,5	43	9	2022
Technological Forecasting and Social Change	4	5	1,333	394	5	2021
Applied Sciences-Basel	3	4	0,75	22	7	2020
Computers \& Industrial Engineering	3	4	1,5	42	4	2022
Energies	3	5	1	34	5	2021
Ieee Access	3	6	0,75	76	6	2020
International Journal of Logistics-Research and Applications	3	3	0,75	110	3	2020

It can be said that the h/g/m index of the published journals is affected by the number of journal publications. It seems that this effect stems from the indexes measuring the effectiveness of publications. However, the number of citations to publications is also an important indicator that provides information about the quality of the publication. In this context, it is seen that Sustainability magazine, which publishes the most, fell to the second place. The number of citations comes to the fore especially in the measurements related to indexes.

It is seen that the authors generally do not appear in more than one work. There are various indexes such as h/m/g index for scientific evaluation of productivity status of authors. The data prepared in this context are presented in Table 4.

Table 4. Authors' h/g/m Index Table

Author Name	h index	g index	m index	Total Number of Citations	Number of Publications	First Publication Date
Javaid M	7	7	1,75	455	7	2020
Haleem A	6	6	1,5	440	6	2020
Kazancoglu Y	5	5	1,667	82	5	2021
Kumar A	5	6	1,667	74	6	2021
Mangla Sk	4	4	1,333	55	4	2021
Sıngh Rp	4	4	1	137	4	2020
Belhadi A	3	3	0,75	426	3	2020
Grencıkova A	3	3	1	15	4	2021
Kumar S	3	3	0,75	69	3	2020
Singh Rk	3	3	1	28	3	2021

In Table 4, the index values of the published authors are given. It is seen that the h/g/m index of the authors differ according to the number of citations. Javaid M took the first place in the list according to the value of the g index. Among the authors on the list, it is seen that the first works of the authors who started production in the magazine were published in 2020, and the author who started production at the latest published their first work in the magazine in 2021. For example, although there are 3 articles in total, Belhadı A received 426 citations, while Singh Rk received 28 citations. For authors, the h/g/m index covers the efficiency of publications as well as the citation efficiency of others, making it possible to estimate the quality, and quantity of publications.

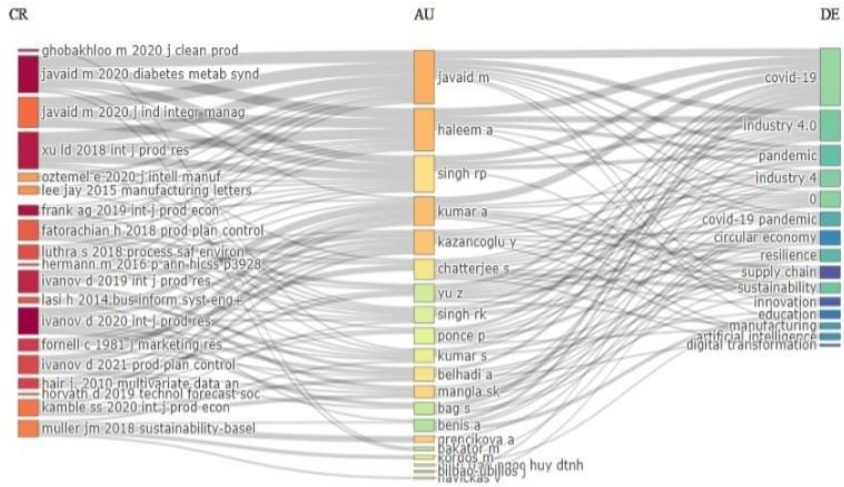

Figure 3. Tree-Field Plot

The distribution of keywords, authors, and bibliographies used is schematized in Figure 6. There are keywords on the right, authors in the middle, and references on the left. In the figure, "Covid 19", "Industry 4.0", "Pandemic", and "Covid 19 Pandemic" are the most common words in the keywords section. Its most prolific authors were previously mentioned in Table 4. It is understood that the keywords most used by Javaid M., the most productive writer, are "Covid 19", "Industry 4.0," and "Pandemic". In this way, the flow to the publications of Haleem A, Kazancoglu Y, Kumar A, and Mangla Sk, who are the authors who published the most on the research topic, and from there to the sources are visualized. In the sources section, it is understood that the works of Javaid M 2020, Xu Id 2018, and Ivanov D 2020 are used more intensively as sources compared to others.

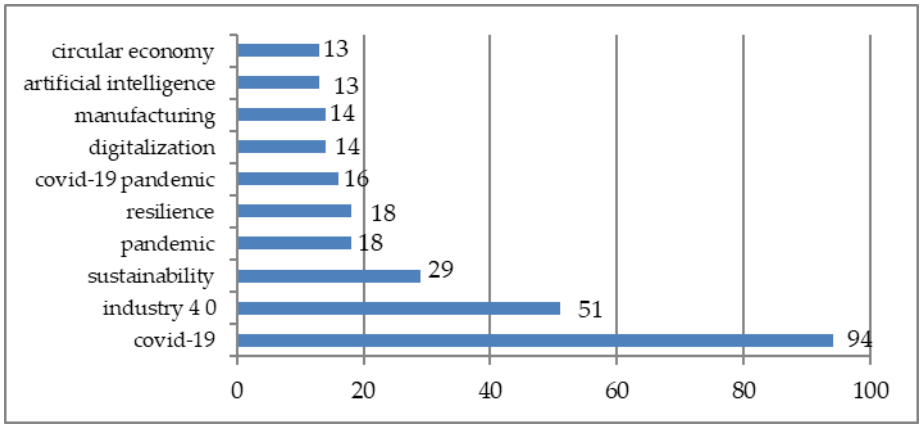

Figure 4. Most Repeated Keywords

As seen in Figure 4, among the keywords of 305 published studies, the word "Covid 19" was repeated 125 times, and the word "industry 4.0" 65 times. The word cloud for words is given in Figure 5.

Figure 5. Word Cloud of Most Repeated Keywords

When the word cloud is examined, it is seen that the word Covid 19 comes to the fore. Another way to understand the relationship between words is a network maps.

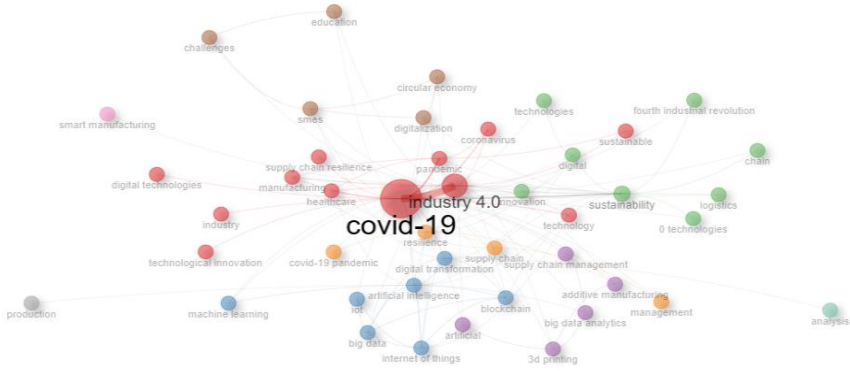

Figure 6. Network Map of Most Repeated Keywords

Network maps are visual forms that reveal hidden connections between words, and make it easier for the reader to understand. The network map of the keywords is shown in the figure above. The values for the nodes are seen in Table 5.

Table 5. Co-Association Network Analysis

Node	Cluster	Betweenness	Closeness	PageRank
covid-19	1	430,6952876	0,017857143	0,142893716
industry 4.0	1	126,1402595	0,013333333	0,06170822
sustainability	1	8,157885629	0,012345679	0,037754052
pandemic	1	3,966457249	0,012195122	0,025774615
digitalization	1	1,60882131	0,011764706	0,020590253
artificial intelligence	1	6,443936475	0,011904762	0,015519657
smes	1	0,474358974	0,010752688	0,013138739
education	1	10,91595936	0,011494253	0,014185284
digital transformation	1	0	0,010526316	0,008816565
innovation	1	0,272334406	0,011494253	0,011940199

When Table 5 is examined, it is seen that the most effective words of the red cluster according to the betweenness value are Covid 19 and Industry 4.0. Figure 7 shows the usage increase rates of the keywords used in the studies by year.

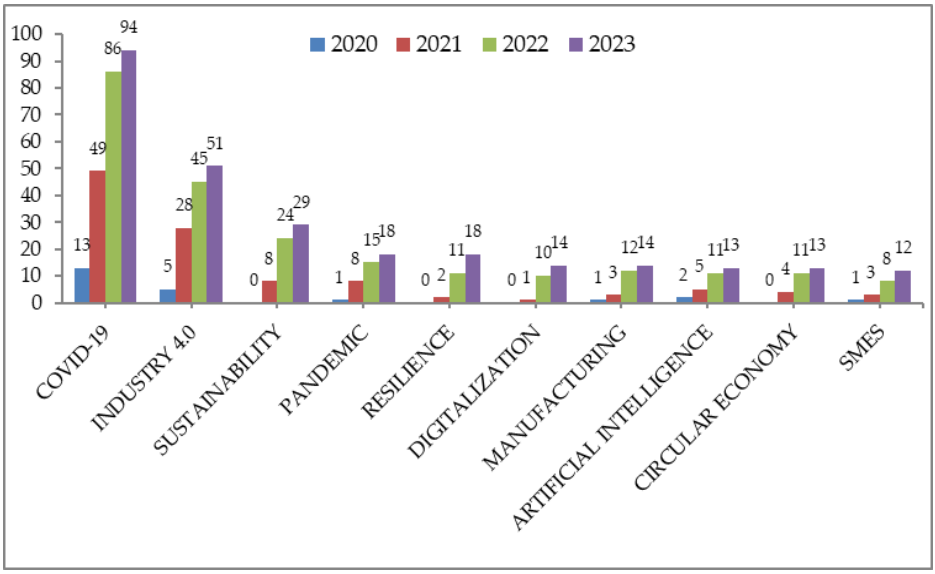

Figure 7. Increase in Words Over the Years (by keywords)

When Figure 7 is examined, it was observed that the most used keyword was "Covid 19". Covid 19 was first used in 2020, and gained momentum in 2022. The second most used keywords were the concepts of "Industry 4.0", and "Sustainability".

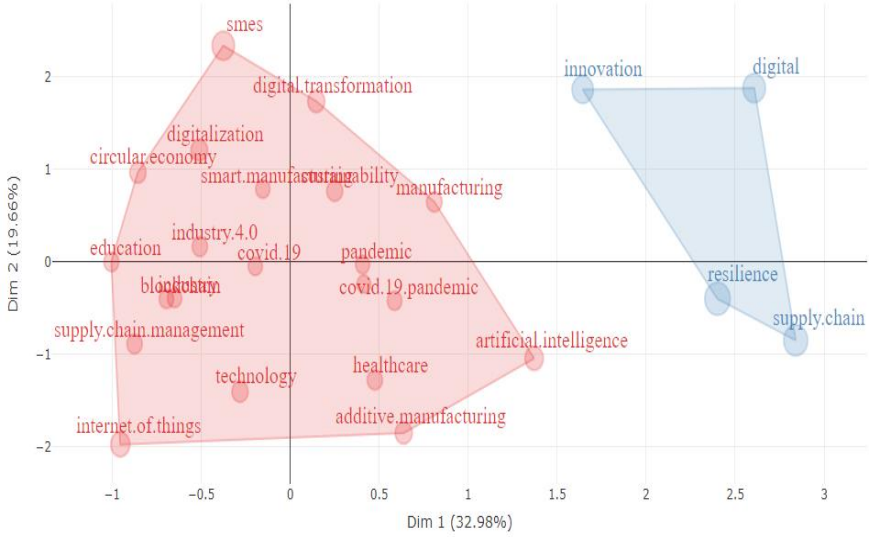

Figure 8. Conceptual Structure Factorial Analysis According to Keywords (Multiple Correspondence Analysis)

In the research, a multidimensional scaling analysis (Multiple Correspondence Analysis) was performed, where keywords were clustered through factor analysis depending on whether they were used together or not, their closeness or distance. Figure 8 shows that the conceptual structure of the studies conducted in this field consists of two main clusters (red, and blue colored region). It seems that this main cluster consists mostly of Covid 19, and Industry 4.0 (red zone), and supply chain, innovation (blue zone).

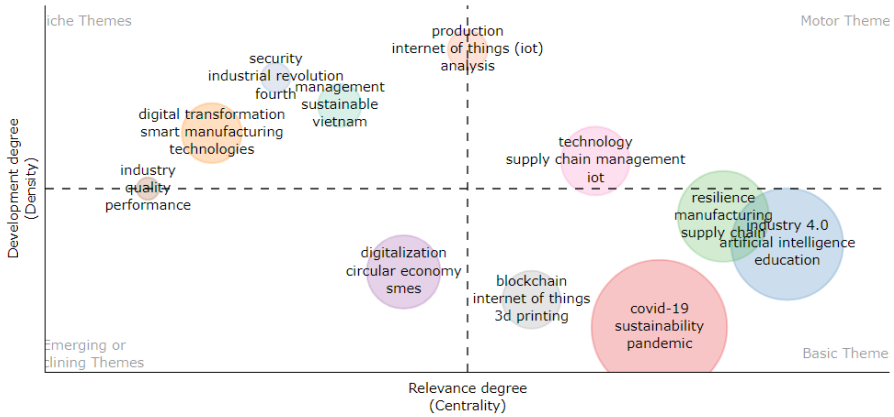

Figure 9. Thematic Evolution (by author keywords)

In Figure 9, the main topics according to the degree of interest in the center (central degree) consist of topics such as Covid 19, Industry 4.0, supply chain management, digitalization, industry, smart production, sustainability, quality. In this context, the most studied engine topics by the authors are technology, supply chain management, and the internet of things. Common topics include Covid 19, sustainability, pandemic, Industry 4.0, 3D printing, supply chain, resilience, manufacturing, artificial intelligence, and education. Among the niche topics, digital transformation, smart production, technology, sustainability, management, industrial revolution, Vietnam are among the common topics. Digitalization, circular economy, and SMEs, which are among the emerging, and clining topics, are among the common topics.

Table 6. Distribution of Articles by Country of Corresponding Authors

Country	Articles	SCP	MCP	Freq	MCP_Ratio	
INDIA		43	28	15	0,141	0,349
POLAND		17	12	5	0,056	0,294
CHINA		16	6	10	0,052	0,625
USA		13	7	6	0,043	0,462
FRANCE		12	3	9	0,039	0,75
ITALY		12	9	3	0,039	0,25
UNITED KINGDOM		11	1	10	0,036	0,909
AUSTRALIA		10	5	5	0,033	0,5
BRAZIL		10	5	5	0,033	0,5
SPAIN		10	8	2	0,033	0,2

When the countries where the responsible authors of the written works are examined, it is seen that 43 of 305 articles are from India. While 28 of the 43 articles were written by authors from the same country (SCP), 15 articles were written by authors from different countries (MCP). The total citations received by the publications of the countries, and the average citation values per article are given in the table below.

Table 7. Total Number of Citations by Countries

Country	Total Citation	Average Article Citations
INDIA	881	20,50
FRANCE	463	38,60
GERMANY	417	59,60
CHINA	223	13,90
AUSTRALIA	192	19,20
GREECE	166	33,20
UNITED KINGDOM	149	13,50
USA	107	8,20
TURKEY	88	9,80
VIETNAM	87	9,70

When Table 7 is examined, it has been determined that India has very important studies in terms of citation. It is seen that the majority of the total citations received from 305 works are made to authors in India.

Conclusion

Issues such as the fact that Covid 19 has become a global pandemic, its health, and economic effects, the use of Industry 4.0 technologies to combat Covid 19, unmanned production or online work to prevent the spread of the pandemic, the importance of industry 4.0 technologies in the health sector have attracted the attention of academics; researchers and many studies have been carried out in this area (Hussain et al., 2021, p. 2).

With this study, it is aimed to contribute to the literature by examining the studies on Covid 19, and Industry 4.0 in the WoS database with bibliometric analysis. In this context, the studies in the WoS database, which are the subject of Covid 19, and Industry 4.0 together, were evaluated within the scope of this research. 305 English articles in the database were examined.

According to the results of the analysis, it is seen that the Covid 19, and industry 4.0 researches conducted in 2022 cover 44.91% of the studies that are the subject of the research. This situation reveals that Covid 19, and industry 4.0 researches understand the academic importance of industry 4.0 technologies in combating the pandemic. In addition, it has been determined that the authors who publish on the subject are generally from India.

It is known that keywords give ideas about publications on the subject, and make the publications more visible, and frequently used word groups indicate the most studied concepts on that subject. In studies on Covid 19, and Industry 4.0 concepts, the most studied topics (when these concepts are excluded) are, according to keywords, internet of things, Pandemic, management, digitalization, 3D printing, healt care, supply chain, resilience, manufacturing, artificial intelligence, It has been observed that education, digital transformation, smart production, technology, sustainability, management, and industrial revolution are formed. Looking at the words, it can be said that conceptual studies focused on the concept of industry 4.0 in the field of health due to Covid 19.

In this research, studies on Covid 19, and Industry 4.0 in the WoS database were compiled. With this study, it is expected to present a different perspective to the authors in future studies on the subject by revealing the quantity of studies on Covid 19, and Industry 4.0 in the international literature. However, as in every study, this study also has some limitations. The foremost of these limitations is the scope of the research, and the focus on the WoS database in terms of the sample selected for the research.

However, when looking at the limitations of the study, it is seen that although important points have been tried to be revealed on Covid 19, and Industry 4.0, the data is limited only to the core collection of WoS and the data dated 30.06.2023. It is possible to obtain different results in studies conducted after this date. Therefore, combining the data with different international databases (e.g. WoS, PubMed, Google Scholar) may yield better results. Based on these limitations, further research and a deeper content analysis are recommended when characterizing subsequent bibliometric analyzes to be conducted.

Peer-Review	Double anonymized - Two External
Ethical Statement	It is declared that scientific and ethical principles have been followed while carrying out and writing this study and that all the sources used have been properly cited
Plagiarism Checks	Yes - Ithenticate
Conflicts of Interest	The author(s) has no conflict of interest to declare.
Complaints	itobiad@itobiad.com
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Benzerlik Taraması	Yapıldı – Ithenticate
Etik Bildirim	itobiad@itobiad.com
Çıkar Çatışması	Çıkar çatışması beyan edilmemiştir
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