Society 5.0 Concept: Biometric Analysis Via Vosviewer

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Abstract

Society 5.0 is a new human-centered vision of society launched in the 5th phase after Industry 4.0. Society 5.0 is defined as a process that aims to increase human security and well-being through cyber-physical systems. This research aims to identify trends in the concept of Society 5.0 by evaluating 376 articles in the Web of Science (WoS) database through bibliometric analysis. The publications were compiled from indexing systems such as SCI-Expanded, SSCI and ESCI. According to the results of the analysis, Japan stands out as the country with the highest number of publications and citations, while Susumu Noda was identified as the most influential author. The keyword analysis showed that the term "society 5.0" was the most frequently used keyword, and the terms Society 5.0 and Industry 4.0 were prominent. In addition, Kyoto University and George Washington University stood out with high citation numbers. Limitations of the study include the use of only the keyword "society 5.0" and the limitation to the WoS database. In the future, the scope of the literature review can be expanded by using a wider range of keywords and databases, and it is thought that different perspectives can be brought to the concept of Society 5.0 by adding interdisciplinary approaches.

Keywords: Society 5.0, industry 5.0, blockchain, artificial intelligence, sustainability.

Jel codes: O33, O35, O38.

Toplum 5.0 Kavramı: Vosviewer İle Bibliyometerik Analiz

Öz

Toplum 5.0, Endüstri 4.0 dan sonra 5. aşamada başlatılan insan merkezli yeni toplum vizyonudur. Toplum 5.0, siber-fiziksel sistemler aracılığıyla insan güvenliği ve refahını artırmayı amaçlayan bir süreç olarak tanımlanmaktadır. Bu araştırma, Web of Science (WoS) veri tabanında yer alan 376 makaleyi bibliyometrik analiz yöntemiyle değerlendirerek, Toplum 5.0 kavramına dair eğilimleri belirlemeyi amaçlamaktadır. Yayınlar, SCI-Expanded, SSCI ve ESCI gibi indeksleme sistemlerinden derlenmiştir. Analiz sonuçlarına göre, Japonya en yüksek yayın ve atıf sayısına sahip ülke olarak öne çıkarken, Susumu Noda en etkili yazar olarak belirlenmiştir. Anahtar kelime analizi, "society 5.0" teriminin en sık kullanılan anahtar kelime olduğunu ve Toplum 5.0 ile Endüstri 4.0 terimlerinin öne çıktığını göstermiştir. Ayrıca, Kyoto Üniversitesi ve George Washington

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Üniversitesi yüksek atıf sayılarıyla dikkat çekmiştir. Araştırmanın kısıtları arasında yalnızca "society 5.0" anahtar kelimesinin kullanılması ve WoS veri tabanı ile sınırlı kalınması yer almaktadır. Gelecekte, daha geniş anahtar kelime ve veri tabanı kullanımıyla literatür taramasının kapsamı genişletilebilir ve disiplinler arası yaklaşımlar eklenerek Toplum 5.0 kavramına farklı bakış açıları kazandırılabileceği düşünülmektedir.

Anahtar kelimeler: Toplum 5.0, endüstri 5.0, blok zinciri, yapay zeka, sürdürülebilirlik.

Jel kodları: O33, O35, O38.

1. Introduction

The utilization of machine power in human production activities began with the use of steam engines in Industry 1.0, followed by Industry 2.0, which was powered by electricity, Industry 3.0 with the introduction of automation, and Industry 4.0 characterized by digital transformation (Kaya, 2021, s. 66). Today, the most advanced stage of this evolution is Society 5.0.

Throughout this development and transformation process humanity has transformed societies by utilizing technological developments with the aim of a better life in every period. Today, the rapid development of information and communication technologies has triggered digital transformation, leading to radical changes in society and sectors. Technological advances are now of great importance not only in the field of industry but also for a human-centered vision. In this context, in 2016, Japan initiated a technology-supported social transformation process with Society 5.0 following Industry 4.0. The Society 5.0 model aims to provide innovative solutions not only in industrial production but also in areas such as health, transportation, security, agriculture, finance, energy and food production based on sustainable development goals. Furthermore, the move from Industry 4.0 to Society 5.0 marks a major shift from societies focused on labor and capital to one centered on knowledge. Industry 4.0 has led digital transformation by using advanced technologies like artificial intelligence, big data, the Internet of Things, augmented reality, cloud computing, cybersecurity, smart robots, and simulations. These technologies have transformed industries, making production processes more efficient and intelligent (Kaya, 2021, s. 68). Society 5.0 builds on these advancements by focusing on the integration of data processing and artificial intelligence to generate knowledge-based value, rather than relying solely on physical products. This transformation has the potential to foster innovation across sectors like agriculture, services, and manufacturing, and even facilitate the emergence of new industries. For instance, in Japan, the integration of drones and robotics with detailed spatial and weather data holds the potential to revitalize agricultural productivity, exemplifying how Society 5.0 could reshape industrial structures (Deguchi vd., 2020, s. 11).

In summary, Society 5.0 envisions a future where advanced technologies not only drive industrial innovation but also enhance quality of life by creating a more interconnected, knowledge-driven society that addresses complex social challenges.

2. Conceptual framework

2.1. Society 5.0 definition

The concept of Society 5.0 was officially introduced in Japan in the 5th Science and Technology Basic Plan approved by the Cabinet on January 22, 2016. As of April 2016, the Japanese government has started to promote this human-centered and sustainable society that aims to improve human productivity and quality of life through cyber physical systems (Çalış Duman, 2022, s. 313; Fukuda, 2020, s. 1). Society 5.0 has become a very popular concept in today's social and economic environments. It is the process of evolving towards the super-intelligent society envisioned by the

Japanese government (C. T. Santos vd., 2024). Fukuda's (2020) according to the Japan Society 5.0 is a new vision in the fifth stage in which Japan aims to create a people-oriented society. In other words, Society 5.0 is a strategy by the Japanese government to create a people-oriented society by using digital technologies to drive economic development and solve sustainability challenges (Moradi vd., 2023). Society 5.0 was proposed by the Japanese Cabinet to solve social problems in Japanese society and balance economic progress (Huang vd., 2022). The main objective of Society 5.0 is to improve quality of life, social responsibility and sustainability by leveraging the effects of technology and Industry 4.0, and to place people at the center of innovation through technological integration (Carayannis & Morawska-Jancelewicz, 2022; Çalış Duman, 2022, s. 313).

According to Deguchi vd. (2020), Society 5.0 is based on the principle of collecting data from the "real world," processing it through computers, and applying the results back into the real world. A distinguishing feature of this model is that the systems operate in an integrated manner across society as a whole, rather than being limited to specific areas. This approach aims to enhance people's quality of life by providing comfort in various domains such as energy, transportation, and healthcare. Society 5.0 continuously carries out data collection and analysis processes in a cyclical manner. In other words, Society 5.0 seeks to develop integrated systems across all sectors of society through the collection and processing of data, with the overarching goal of improving the quality of life for individuals. These systems operate in a continuous cycle, merging physical and cyber spaces to enhance the happiness and comfort of individuals' lives.

2.2. The development of society 5.0 and its relationship with industry 4.0

While Industry 4.0 revolutionized production and industry with technologies such as cyber-physical systems, cloud computing and smart manufacturing, Society 5.0 aims to use these technologies to create a human-centered and super-smart society. In other words, Society 5.0 emphasizes the integration of digital transformation and artificial intelligence into all areas of life and focuses on ensuring the most efficient human-machine interaction. In this context, it aims to implement the technological innovations offered by Industry 4.0 in a way that is compatible with the social, demographic and ethical dimensions of society. In short, Society 5.0 uses the technological infrastructure of Industry 4.0 to support a human-centered and sustainable social model (Yacan, 2021, s. 33). In other words, Industry 4.0 and Society 5.0 share common elements such as technology use, the Internet of Things (IoT), artificial intelligence (AI), and big data analysis. Both industrial revolutions involve collaboration among industry, academia, and the public sector. However, there are some significant differences between Industry 4.0 and Society 5.0. According to the study by Deguchi et al. (2020), Industry 4.0 supports smart factories, while Society 5.0 aims for a super-smart society. Additionally, although both visions advocate for the implementation of cyber-physical systems, the scope of these implementations differs. In Industry 4.0, cyber-physical systems are applied in the production environment, whereas Society 5.0 aims for the spread of these systems throughout society. While Industry 4.0 focuses on creating new values and minimizing production costs, Society 5.0 aims to create a super-smart society.

The comparison of Industry 4.0, launched at the Hannover Fair in Germany in 2011, and Society 5.0, introduced in Japan in 2016, was conducted by Deguchi vd. (2020).

Table 1: Industrie 4.0 vs. Society 5.0.

Title	Industrie 4.0 (Germany)	Society 5.0 (Japan)
Design	• High-Tech Strategy 2020 Action Plan for Germany (BMBF, 2011) • Recommendations for implementing the strategic initiative INDUSTRIE 4.0 (Industrie 4.0 Working Group, 2013)	• 5th Science and Technology Basic Plan (released 2016) • Comprehensive Strategy on Science, Technology and Innovation for 2017 (released 2017)
Objectives, scope	• Smart factories • Focuses on manufacturing	• Super-smart society • Society as a whole
Key phrases	• Cyber-physical systems (CPS) • Internet of Things (IoT) • Mass customization	• High-level convergence of cyberspace and physical space • Balancing economic development with resolution of social issues • Human-centered society

Soruce: Deguchi et al. (2020)

The strategic approaches of Germany's "Industrie 4.0" and Japan's "Society 5.0" are compared in Table 1, created by Deguchi vd. (2020). According to Table 1, Germany focused on smart factories with its 'High-Tech Strategy 2020 Action Plan' published in 2011, while Japan presented a comprehensive perspective on society with its '5th Basic Plan for Science and Technology' published in 2016. Germany's strategy emphasizes production processes and smart factories, whereas Japan aims to create a 'super-smart society.' While Germany concentrates on technologies like 'cyber-physical systems' and the 'Internet of Things,' Japan emphasizes the integration of cyber and physical domains, balancing economic development with solutions to societal issues, and promoting a human-centered society.

2.3. Development and socioeconomic impacts of society 5.0

Keidanren's (2018) view, firstly, during the hunter-gatherer society period, people made a living through hunting and gathering and adopted a nomadic lifestyle. This period marks the emergence of humanity and dates back to approximately 13,000 BC. The transition to an agricultural society began with the discovery of agriculture around 10,000 years ago. During this period, people developed a settled lifestyle based on agriculture. Starting in the late 18th century, the Industrial Society period saw significant developments in areas such as heavy and chemical industry. In the late 20th century, the era of information society began. The computer and the internet are the prominent elements of this period. In the 21st century and beyond, the Society 5.0 phase began. This is a phase in which advanced technologies such as high technology, artificial intelligence and the Internet of Things transform the social structure.

Society 5.0 projects have many important social and economic contributions and examples of this. For example, within the scope of the Society 5.0 project, 229 smart city projects have been launched in Japan in partnership with public-private-academia. The city of Maebashi has become a pilot center for driverless public transportation due to its high elderly population. In addition, 455 cities in the US and Japan were declared sister cities and joint projects were developed. This cooperation contributed to improving the transportation of the city of Birmingham in the state of Alabama with human-centered solutions (Deguchi, 2020). Also in Japan, three main goals have been identified within the scope of

Society 5.0 to cope with rising medical and social security costs. These are the provision of medical data sharing, the implementation of remote medical care services, and increasing the self-sufficiency of patients by using artificial intelligence and robots. This will enable more effective treatment and remote health monitoring of the elderly (BTİK, 2024, s. 24).

In summary, similar to Industry 4.0, Society 5.0 uses digital technologies such as the Internet of Things, artificial intelligence, big data and robotics, but focuses not only on industrial production but also on health, transportation, security, agriculture, finance, energy and food production. The United Nations' sustainable development goals also make a major contribution to Society 5.0. To realize these goals, 29 cities in Japan have been selected as cities of the future (Öztürk & Ateş, 2021, s. 34).

3. Theoretical exploration of the concept

In recent years, there has been an increase in research on Society 5.0. These studies highlight various aspects and significance of its development. This study analyzes 376 scientific papers from the Web of Science (WoS) database, evaluating these works based on citation counts. The literature presents different perspectives on social transformation in the context of technological advancements. For instance, Riminucci's (2018) examined the Japanese government's preparedness for the fourth industrial revolution and the changes it has brought to the labor market. This research emphasizes strategies that contribute to the success of Society 5.0 by focusing on the impact of digitalization on employment.

Gladden's research in (2019) addressed the human-centered aspect of the Society 5.0 initiative, discussing the contradiction between creating a human-centered society and the use of autonomous robots and artificial intelligence systems. Aquilani *et al.* (2020) highlighted the importance of innovation and value creation in the transition from Industry 4.0 to Society 5.0, arguing that these technologies not only improve working conditions but also contribute to social welfare. Fukuda (2020) pointed out the need for systematic changes in Japan's science, technology, and innovation policies. Potočan *et al.* (2021) examined the balance between Society 5.0 and Industry 4.0 in the context of corporate social responsibility, integrating technology with corporate social responsibility models to address social issues. This idea is also supported by Santos *et al.* (2021), who studied the effects of Industry 4.0 on quality management.

Additionally, the global pandemic, specifically the COVID-19 pandemic, and its role in the transition to Society 5.0, was explored by Sarfraz *et al.* (2021). They noted that the pandemic accelerated advancements in Industry 4.0. Huang *et al.* (2022) indicated an increasing interest in Industry 5.0 and Society 5.0, suggesting a need for comparative analysis of these two concepts.

Carayannis & Morawska-Jancelewicz (2022) stressed that Society 5.0 and Industry 5.0 should not be viewed solely as extensions of Industry 4.0; rather, they represent distinct approaches aimed at enhancing quality of life and sustainability. Coronado *et al.* (2022) highlighted the importance of human-centered intelligent environments within Industry 5.0. Carayannis *et al.* (2022) proposed a collaborative approach for developing human-centered applications by applying these concepts to the aviation sector.

Moradi *et al.* (2023) discussed the significance of resilience in communities at risk of disasters. Their research indicated that systematic assessments are essential to minimize disaster-related damages. Usta Bakï & Boyacioğlu (2023) examined the impact of new media on crime and victimization in the context of Society 5.0.

Finally, Bag & Sengupta (2024) investigated the application of computational technologies in controlling zoonotic diseases, emphasizing the contribution of human-centered innovations to early detection and intervention processes.

Overall, research related to Society 5.0 underscores the necessity of considering technological advancements and their impacts on society. Therefore, adopting a comprehensive approach in this field is crucial.

4. Research design and methodological approach

In the bibliometric analysis, the WoS database was searched and the widely used VOSviewer program (version 1.6.19) was used. The VOSviewer program provides a map where the relationship of items can be explained by the distance between them. The shorter the distance between items, the more related they are. This is based on the "visualization of similarities" (VOS-Visualization of Similarities) (van Eck & Waltman, 2010, p. 524).

4.1. Purpose of the study

The purpose of the bibliometric analysis conducted in this study is to provide a comprehensive overview of the existing literature on the concept of 'Society 5.0.' Specifically, this analysis seeks to identify and map out key data points, including the most influential authors, prevalent research subjects, contributing countries, and prominent publishers. Additionally, it aims to examine the most commonly used terms within these publications and to explore the interrelationships among these various data points. By doing so, the study seeks to uncover underlying patterns and trends, offer insights into the development and evolution of the concept within academic discourse, and highlight potential areas for future research.

4.2. Results and insights

On 27.07.2024, a data analysis on the concept of Society 5.0 was conducted on articles published in various scientific categories and indexed in the WoS database using the keyword "society 5.0". The publications selected for the analysis were compiled from qualified and scientifically accepted indexing systems.

In this context, Science Citation Index Expanded (SCI-Expanded), which is the extended version of the Science Citation Index (SCI) covering leading journals in fields such as science, engineering and medicine, Social Sciences Citation Index (SSCI), which indexes important journals in the field of social sciences, and Emerging Sources Citation Index (ESCI), which includes journals that are not yet included in SCI or SSCI but have the potential for scientific quality and impact. In total, 376 publications were reached. The data analyzed within the scope of the analysis were evaluated on parameters such as author information, citations, abstracts, keywords, countries and institutions where the publications were made.

4.2.1. Analysis of society 5.0 publication output by years

As of 27.07.2024, the number of publications for the years in the bibliometric analysis study is given in Table 2. It is seen that the highest number of publications on the subject was made in 2022 and 2023

with 95 publications each, and the first study on the concept started in 2018. Between 2018 and 2024, 376 published articles were indexed.

Table 2: Number of publications by year

Years	Quantity
2024	52
2023	95
2022	95
2021	84
2020	33
2019	14
2018	3
Total	**376**

Source: WoS

4.2.2. Patterns of co-authorship among researchers

There are a total of 1.160 authors in 376 studies, and these 1.160 authors have at least 1 document. During the research process, it was found that some authors were not linked to each other in the network with a total of 1.160 authors. The largest set of connected authors consists of 86 authors. This is a limitation encountered in network analysis and a factor that may affect the integrity of the data. The presence of unconnected authors prevents the network from being fully represented and affects the results of the analysis. In order to obtain more meaningful results, only the set of linked items with 86 authors was considered in the analysis. In the analysis, it was determined that the author with the most documents was Susumu Noda with 17 documents. Susumu Noda has 237 citations and 115 total link strength. He is followed by Takuya Inoue with 16 documents; Inoue has 230 citations and 111 total link strength. Meneka De Zoysa and Kenji Ishizaki each have 15 documents, 230 citations and 109 total link strength. Atsuko Miyaji has 14 documents, 9 citations and 27 total link strength. Hiroshi Ishiguro has 12 documents, 35 citations and 49 total link strength. Masahiro Yoshida has 11 documents, 151 citations and 83 total link strength. John Gelleta and Ryoichi Kurose have 10 documents each. Gelleta has 140 citations and 75 total link strength, while Kurose has 28 citations and 33 total link strength. The author with the highest total link strength is Susumu Noda (115 total link strength). He is followed by Takuya Inoue (111 total link strength) and Meneka De Zoysa and Kenji Ishizaki (109 total link strength each). As a result of the analysis, 8 clusters, 86 items, 396 links and 483 total link strengths were identified.
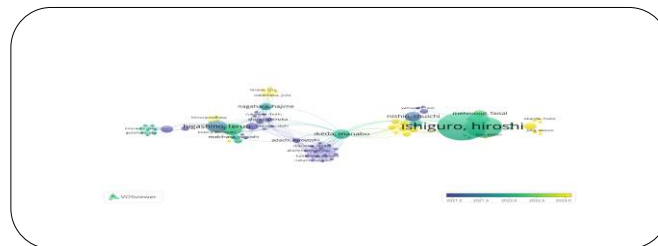

Figure 1. Authors' common citation similarity visualization

Figure 1. shows a visualization of the co-citation similarity of authors in the bibliometric analysis on the Society 5.0 concept. By highlighting the scientific interactions and connections between specific studies in the literature, this visual highlights the patterns of co-citation between authors, allowing for a better understanding of the scientific communication network and knowledge sharing in the field of Society 5.0.

Table 3. Prominent authors and publication performances in publications on society 5.0 (distribution by number of works)

Author	Document	Citation	Total Link Strength
Susumu Noda	17	237	115
Takuya Inoue	16	230	111
Menaka De Zoysa	15	230	109
Kenji Ishizaki	15	230	109
Atsuko Miyaji	14	9	27
Hiroshi Ishiguro	12	35	49
Masahiro Yoshida	11	151	83
John Gelleta	10	140	75
Ryoichi Kurose	10	28	33

Source: WoS

4.2.3. Citation patterns and author impact analysis

In the application of the author citation analysis, the author with the maximum number of authors and the minimum number of citations per document was selected as the criterion and a network map was created. During the research process, it was found that some authors were not connected to each other in the network with a total of 1.160 authors. The largest set of connected authors consists of 266 authors. In order to obtain more meaningful results, only the set of linked items with 266 authors was taken into consideration in the analysis. The analysis revealed that the most cited author was Elias G. Carayannis with 319 citations. Carayannis has 8 documents and 111 total link strengths. He is followed by Susumu Noda (17 documents and 185 total link strength) with 237 citations. Meneka De Zoysa (15 documents and 185 total link strength), Takuya Inoue (16 documents and 185 total link strength) and Kenji Ishizaki (15 documents and 185 total link strength) each received 230 citations. In addition, Dimitris Mourtzis has 210 citations, 3 documents and 48 total link strength. The four authors with the highest total linking power each have 185 total linking power, namely Susumu Noda, Meneka De Zoysa, Takuya Inoue and Kenji Ishizaki. As a result of the analysis, 15 clusters, 266 items, 1.277 links and 1.339 total link strengths were identified.
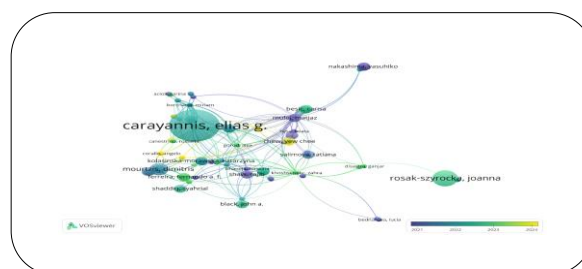

Figure 2. Authors' citation analysis visualization

Figure 2. shows a visualization of the citation analysis of authors in the bibliometric analysis on the Society 5.0 concept. The visual highlights how often the work of various researchers is cited by each other and the important links in the literature.

Table 4. Authors featured in publications on society 5.0 by number of citations, number of documents and link strength (distribution by number of citations)

Author	Document	Citation	Total Link Strength
Elias G. Carayannis	8	319	111
Susumu Noda	17	237	185
Menaka De Zoysa	15	230	185
Takuya Inoue	16	230	185
Kenji Ishizaki	15	230	185
Dimitris Mourtzis	3	210	48
Ivan Cvitic	3	173	12
Dragan Perakovic	3	173	12
Baicun Wang	2	169	48
Lihui Wang	2	169	48

Source: WoS

4.2.4. Analyzing co-citation networks and scholarly citation patterns

In the analysis, 3 citations were selected as the lower limit among 826 authors. 14.701 authors were linked according to the criteria. The largest set of linked authors consists of 810 authors. In order to obtain more meaningful results, only the set of linked items with 810 authors was taken into consideration in the analysis. In the analysis, Elias G. Carayannis (128 citations and 3.537 total link strength), Y. Shiroishi (48 citations and 962 total link strength), M. Fukuyama (42 citations and 887 total link strength), M. Yoshida (32 citations and 421 total link strength) and A. Deguchi (24 citations and 399 total link strength) were determined as the most cited authors among the co-cited authors. In line with this criterion, 18 clusters, 810 items, 15.402 links and 38.551 total link strength were identified.
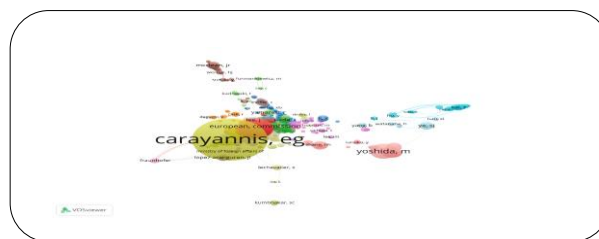

Figure 3. Authors' joint citation and author citation analysis visualization

Figure 3. shows a visualization of the co-citation and author citation analysis of authors in the bibliometric analysis on the Society 5.0 concept. The visual highlights the sources that various researchers co-cite and the links between these sources, and through the author citation analysis, it shows which researchers are cited more frequently by others and thus the level of interaction within

the field. This visualization contributes to our understanding of the place of the Society 5.0 concept in the scientific literature and the collaborations between researchers.

Table 5. Co-citation and total link strength of authors in publications on society 5.0 (distribution by number of citations)

Author	Citation	Total Link Strength
Elias G. Carayannis	128	3.537
Y. Shiroishi	48	962
M. Fukuyama	42	887
M. Yoshida	32	421
A. Deguchi	24	399

Source: WoS

4.2.5. Exploring co-occurrence patterns among keywords

Among the 1.408 observations that appear at least once in the analysis and are related to each other, the largest linked word analysis set consists of 995 items. In order to obtain more meaningful results, only the set of linked items with 995 items was taken into consideration in the analysis. The most frequently used keyword in publications related to the concept of society 5.0 is "society 5.0" and this term stands out with 80 observations and 426 total link strength. This keyword is followed by the term "society 5" with 46 observations and 301 total link strength. Other important keywords are "Industry 4.0" with 20 observations and 105 total link strength, "sustainability" with 18 observations and 113 total link strength, "artificial intelligence" with 16 observations and 111 total link strength and "Japan" with 14 observations and 84 total link strength. The analysis revealed 76 clusters, 4.858 links and 5.126 total link strength. According to the total link strength in keywords, it was determined that the words Society 5.0 and Industry 4.0 are the strongest words.
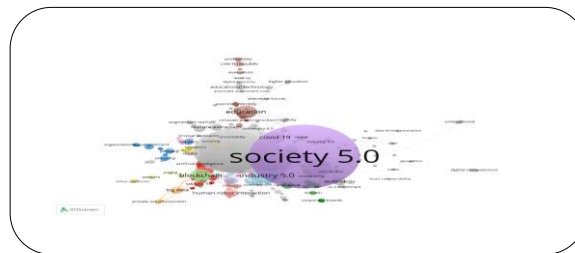

Figure 4. Word analysis visualization

Figure 4. shows the word analysis visualization in the bibliometric analysis on the concept of Society 5.0. Figure 4, which visually presents important keywords and their frequencies by analyzing the texts of scientific studies in the field of Society 5.0, contributes to our understanding of the keywords around the concept of Society 5.0 and the relationships between these words, and helps us identify the main themes and emphases in the literature.

Table 6. Number of observations and total link strength of keywords in publications on society 5.0 (distribution by number of observations)

Keyword	Number of Observations	Total Link Strength
Society 5.0	80	426
Society 5	46	301
Industry 4.0	20	105
Sustainability	18	113
Artificial intelligence	16	111
Japan	14	84
Industry 4	13	92
Industry 5	12	77
Industry 5.0	12	75
Blockchain	9	69

Source: WoS

4.2.6. Evaluating organizational citations within source networks

A network map was created by determining the number of citations according to the sources in which the works on the subject were published. In the creation of the network map, the criterion of publishing at least 1 work for each source was applied. Out of 525 sources with a relationship between them, the largest linked source analysis set consists of 176 sources. In order to obtain more meaningful results, only the set of linked items with 176 items was evaluated in the analysis. The 32 works published at Kyoto University were identified as the most cited source with a total of 294 citations. This source is followed by 8 works published at George Washington University with 292 citations, 56 works published at Osaka University with 234 citations and 3 works published at University of Patras with 210 citations. In addition, Osaka and Kyoto Universities stand out in terms of the number of publications, followed by the University of Hradec Králové in Hradec Králové, Czech Republic, with 14 publications and 23 citations. The analysis revealed 16 clusters, 176 items, 593 links and 633 total link strength.
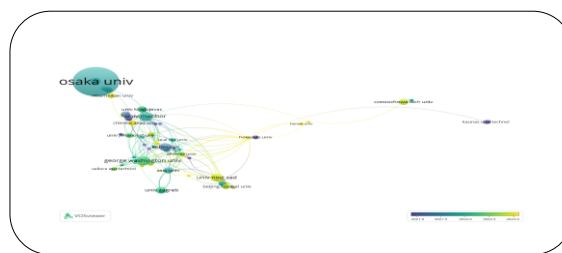

Figure 5. Source citation analysis visualization

Figure 5. shows the source citation analysis visualization in the bibliometric analysis on the concept of Society 5.0. The image represents the frequently cited sources and their relationships in scientific studies in the field of Society 5.0. This visual analysis helps us understand the foundations of the Society 5.0 concept in the literature and the interactions of important studies in this field.

Table 7. Distribution of documents, citations and link strength by universities in publications on society 5.0 (distribution by number of citations)

University	Document	Citation	Total Link Strength
Kyoto University	32	294	13
George Washington University	8	292	60
Osaka University	56	234	3
University of Patras	3	210	24
Asia University	4	195	33
University of Zagreb	5	179	13
KTH Royal Institute of Technology	2	169	24
Zhejiang University	2	169	24
National Institute of Technology, Kurukshetra	2	167	12
Japan Science and Technology Agency	2	140	0

Source: WoS

4.2.7. Analyzing citation patterns by country

A network map was created by analyzing the number of citations of the articles published on the subject according to their countries. While creating the network map, the criterion of having at least 1 article for each country was used. Out of 63 countries with a relationship between them, the largest linked source analysis set consists of 52 countries. In order to obtain more meaningful results, only the set of linked items with 52 countries was taken into consideration in the analysis. As a result of the analysis, 9 clusters, 52 items, 212 link strengths and 322 total link strengths were identified. The country with the highest number of citations was identified as Japan. Japan's 164 works received 1,016 citations. Japan is followed by the United States of America (USA) with 30 works and 650 citations. Poland and Italy have 273 citations each, with Poland having 15 works and Italy 13. Greece has 266 citations for 4 works, the People's Republic of China has 263 citations for 17 works, India has 260 citations for 19 works and Taiwan has 225 citations for 8 works. Following Japan in terms of the number of works, the USA ranks second with 30 works and 650 citations, while Indonesia ranks third with 21 works and 82 citations.
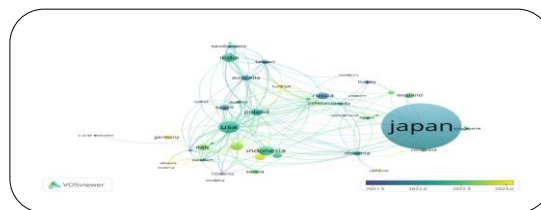

Figure 6. Country citation analysis visualization

Figure 6. shows the country citation analysis visualization in the bibliometric analysis on the concept of Society 5.0.

Table 8. Distribution of works, citation and link strength among countries in publications on society 5.0 (distribution by number of citations)

Country	Document	Citation	Total Link Strength
Japan	164	1.016	30
United States of America	30	650	86
Poland	15	273	40
Italy	13	273	25
Greece	4	266	26
People's Republic of China	17	263	44
India	19	260	25
Taiwan	8	225	28
Croatia	5	179	11
Sweden	5	179	24

Source: WoS

4.2.8. Analyzing bibliographic coupling among researchers

Since there are many publications with 0 citations in the study, at least 1 published publication and 0 citations were chosen as criteria. In total, 1.160 authors were bibliographically matched. With 319 citations, the author with the highest bibliographic match was Elias G. Carayannis, and the link strength of the author was determined as 5.321. The author with the highest total link strength was Susumu Noda (237 citations and 17 documents) with a total link strength of 11.821. This author was followed by Takuya Inoue with 11.375 links (230 citations and 16 documents) and Menaka De Zoysa and Kenji Ishizaki with 11.330 links each (230 citations and 15 documents). Out of the 1.160 items with a relationship between them, 879 items were linked, and according to the results of the analysis, 36 clusters, 879 items, 37.753 links and 240.227 total link strength were identified.
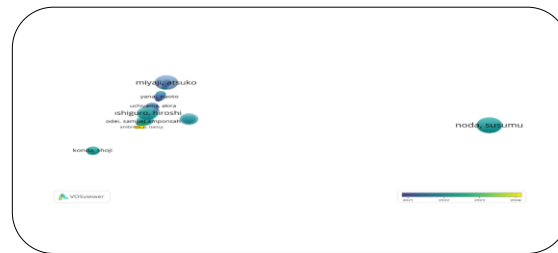

Figure 7. Bibliographic match analysis visualization

Figure 7. shows the bibliographic match analysis visualization in the bibliometric analysis on the concept of Society 5.0. The image highlights common references and bibliographic matches in the works of different authors.

Table 9. Authors' number of works, number of citations and link strength in publications on society 5.0 (distribution by number of citations)

Author	Document	Citation	Total Link Strength
Elias G. Carayannis	8	319	5.321
Susumu Noda	17	237	11.821
Takuya Inoue	16	230	11.375
Menaka De Zoysa	15	230	11.330
Kenji Ishizaki	15	230	11.330
Dimitris Mourtzis	3	210	888
Ivan Cvitic	3	173	576
Dragan Perakovic	3	173	576
Baicun Wang	2	169	649
Lihui Wang	2	169	649

Source: WoS

4.2.9. Analyzing bibliographic coupling among academic documents

A bibliographic match is defined as two different sources citing a common publication (Dirik vd., 2023, s. 178). In the analysis, the minimum citation criterion was automatically taken as 0 due to the presence of publications that were not cited at all. The analysis was made with 376 publications with links between them. The publication with the highest bibliographic match is Fukuda (2020) with 140 citations. After this publication, the next highest match is Huang (2022) with 119 citations, followed by Cvitic (2021) with 114 citations. According to the total link strength, the publications with the highest link strength are Yitmen (2023) with 296 total link strength, Zizek (2021) with 286 total link strength, Bartoloni (2022) with 256 total link strength and Alimohammadlou (2023) with 231 total link strength. Out of 376 publications with a relationship between them, 259 publications were strongly linked, and 17 clusters, 3.159 links and 5.763 total link strength were identified as a result of the analysis.
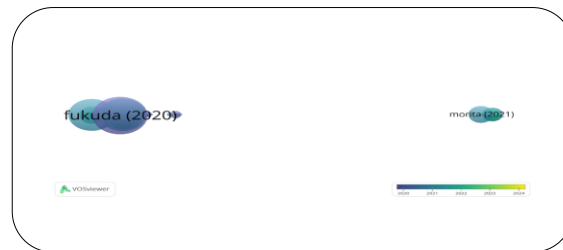

Figure 8. Image of bibliographic match analysis of texts

Figure 8. shows the bibliometric match analysis of the texts on the concept of Society 5.0. In the image, common references and bibliographic matches between different texts are highlighted.

Table 10. Number of citations and link strength of publications on society 5.0 (distribution by number of citations)

Document	Citation	Total Link Strength
Fukuda (2020)	140	8
Huang (2022)	119	91
Cvitic (2021)	114	10
Carayannis (2022a)	105	69
Potocan (2021)	75	94
Coronado (2022)	69	120
Foresti (2020)	66	30
Acioli (2021)	64	85
Santos (2021)	64	40
Aquilani (2020)	58	89

Source: WoS

5. Research limitations and future studies

The analysis of the research topic was conducted using only the keyword "society 5.0", only on documents published in the WoS Core Collection database and in various indexes. The use of only the keyword "society 5.0", which is among the limitations of the research, has the potential to exclude studies published using different keywords or terms that may be related to Society 5.0. In addition, only the WoS database was accessed in the study and other academic databases (e.g. Scopus, Google Scholar) were not examined. This limits the scope of the literature review and ignores publications outside WoS. Even though the indexes used in the research (SCI-Expanded, SSCI, ESCI) are of a certain scientific quality, it should be taken into account that some quality studies may not have been included in these indexes. In addition, the fact that the publications analyzed are limited to certain categories (science, engineering, medicine, social sciences) leaves interdisciplinary perspectives incomplete.

In future studies, several strategies can be adopted to overcome the limitations of this research. First, a broader literature review can be conducted with different keywords and terms. The inclusion of other academic databases may make the study more comprehensive. The addition of interdisciplinary perspectives can contribute to the evaluation of the concept of Society 5.0 from different perspectives. We believe that these approaches will contribute to a more comprehensive and in-depth examination of the concept of Society 5.0 and enrich the literature in this field.

6. Discussion and conclusion

This study examines the concept of Society 5.0 through a bibliometric analysis of 376 articles in the WoS database. The publications were compiled from indexing systems such as SCI-Expanded, SSCI and ESCI. Instead of examining the content of the articles in depth, bibliometric analysis is used to identify trends in the field of Society 5.0 and an overall assessment is presented. The distribution of the concept of Society 5.0 in the literature is examined according to years, institutions and countries. In addition, the bibliometric analysis method was used to identify the authors and studies that shape the field by analyzing the co-citation of publications related to Society 5.0.

Kabakuş *et al.* (2023) analyzed 456 publications indexed in the WoS database from 2016 to 2022. Their study identified that 38% of the examined documents were articles, 37% were conference papers, 1% were book chapters, and 3% were review articles. It was found that Japan stands out with the highest number of publications, and the keyword analysis revealed frequent use of the term "Society 5.0.". In contrast, our study aims to determine trends related to the Society 5.0 concept by examining publications indexed in more selective indexing systems, thereby utilizing a more refined dataset. Specifically, we employed high-quality indexes within the WoS database, such as SCI-Expanded, SSCI, and ESCI, which enhances the reliability and scientific validity of our findings. This approach ensures that the research results meet higher scientific standards.

In their 2024 study, Seçkin & Köse, (2024) examined the Vision of Society 5.0 by analyzing 465 sources indexed in Scopus from 2017 to 2022. The analysis revealed that 38% of the works were conference papers, while 37% were journal articles. The most prolific year was 2022. The countries with the highest number of publications were Japan, Indonesia, India, the United States, and Italy. Keyword analysis highlighted terms such as "Industry 4.0", "Student", "Artificial Intelligence" and "Internet of Things".

In contrast, our study aims to identify trends related to the Society 5.0 concept by employing a bibliometric analysis of 376 articles indexed in the WoS database. Specifically, our research utilized the WoS database and included high-quality publications indexed in SCI-Expanded, SSCI, and ESCI. By leveraging the WoS database, our study provides a broader and more comprehensive analysis. The WoS database generally contains higher-quality and more impactful research. The advantages of our extensive data source and indexing system coverage suggest that our study makes significant contributions to the existing literature and deepens the understanding of the Society 5.0 concept.

Based on the study's findings, Japan stood out as the country with the highest number of publications and citations. 164 works received 1.016 citations. In other words, Japan stands out with both the highest number of publications and the highest number of citations. The USA, Poland, Italy and other countries follow Japan. In terms of number of works, Japan is followed by the USA and Indonesia. On an author basis, Susumu Noda has the highest performance with 17 works and 237 citations, and is identified as the author with the highest total link strength. Elias G. Carayannis, the most cited author, and the authors with high link strength (Susumu Noda, Takuya Inoue, Meneka De Zoysa and Kenji Ishizaki) stand out. In particular, Susumu Noda's total link strength of 11.821 indicates that he is the most influential and connected author in this field. However, limitations such as disconnectedness among some authors and underrepresentation of the network were identified. Therefore, only the largest sets of linked authors were considered in the analysis.

Keyword analysis reveals that the term "society 5.0" is the most frequently used keyword. In terms of link strength, the terms Society 5.0 and Industry 4.0 stand out. Among the publication sources, Kyoto University and George Washington University had the highest number of citations.

Finally, the fact that the research is limited to the keyword "society 5.0" and the WoS database narrows the scope of the literature review. Not including other databases and keywords makes it difficult to see the full scope of the literature. In future studies, it is thought that the use of various keywords and databases can expand the scope of the literature review and also bring different perspectives to the concept of Society 5.0 with interdisciplinary approaches.

References

Aquilani, B., Piccarozzi, M., Abbate, T., & Codini, A. (2020). The Role of Open Innovation and Value Co-creation in the Challenging Transition from Industry 4.0 to Society 5.0: Toward a Theoretical Framework. *Sustainability*, *12*(21), 8943. https://doi.org/10.3390/su12218943

Bag, A. K., & Sengupta, D. (2024). Computational frameworks for zoonotic disease control in Society 5.0: Opportunities, challenges and future research directions. *AI & SOCIETY*. https://doi.org/10.1007/s00146-024-01992-2

BTİK. (2024). *Toplum 5.0*. Bilgi Teknolojileri ve İletişim Kururmu Sektörel Araştırma ve Strateji Geliştirme Dairesi.

Carayannis, E. G., Dezi, L., Gregori, G., & Calo, E. (2022). Smart Environments and Techno-centric and Human-Centric Innovations for Industry and Society 5.0: A Quintuple Helix Innovation System View Towards Smart, Sustainable, and Inclusive Solutions. *Journal of the Knowledge Economy*, *13*(2), 926-955. https://doi.org/10.1007/s13132-021-00763-4

Carayannis, E. G., & Morawska-Jancelewicz, J. (2022). The Futures of Europe: Society 5.0 and Industry 5.0 as Driving Forces of Future Universities. *Journal of the Knowledge Economy*, *13*(4), 3445-3471. https://doi.org/10.1007/s13132-021-00854-2

Coronado, E., Kiyokawa, T., Ricardez, G. A. G., Ramirez-Alpizar, I. G., Venture, G., & Yamanobe, N. (2022). Evaluating quality in human-robot interaction: A systematic search and classification of performance and human-centered factors, measures and metrics towards an industry 5.0. *Journal of Manufacturing Systems*, *63*, 392-410. https://doi.org/10.1016/j.jmsy.2022.04.007

Çalış Duman, M. (2022). Toplum 5.0: İnsan Odaklı Dijital Dönüşüm. *Sosyal Siyaset Konferansları Dergisi / Journal of Social Policy Conferences*, *0*(0), 0-0. https://doi.org/10.26650/jspc.2022.82.1008072

Deguchi, A. (2020, Haziran 10). *Toplum 5.0 ve Amerikan akıllı şehirlerine uygulanması—Amerikan Şehri ve İlçesi*. https://www.americancityandcounty.com/2020/06/10/society-5-0-and-its-application-to-american-smart-cities/

Deguchi, A., Hirai, C., Matsuoka, H., Nakano, T., Oshima, K., Tai, M., & Tani, S. (2020). What Is Society 5.0? Içinde Hitachi-UTokyo Laboratory(H-UTokyo Lab.) (Ed.), *Society 5.0: A People-centric Super-smart Society*. Springer Singapore. https://doi.org/10.1007/978-981-15-2989-4

Dirik, D., Eryılmaz, İ., & Erhan, T. (2023). Post-Truth Kavramı Üzerine Yapılan Çalışmaların VOSviewer ile Bibliyometrik Analizi. *Sosyal Mucit Academic Review*, *4*(2), 164-188. https://doi.org/10.54733/smar.1271369

Fukuda, K. (2020). Science, technology and innovation ecosystem transformation toward society 5.0. *International Journal of Production Economics*, *220*, 107460. https://doi.org/10.1016/j.ijpe.2019.07.033

Gladden, M. E. (2019). Who Will Be the Members of Society 5.0? Towards an Anthropology of Technologically Posthumanized Future Societies. *Social Sciences*, *8*(5), 148. https://doi.org/10.3390/socsci8050148

Huang, S., Wang, B., Li, X., Zheng, P., Mourtzis, D., & Wang, L. (2022). Industry 5.0 and Society 5.0—Comparison, complementation and co-evolution. *Journal of Manufacturing Systems*, *64*, 424-428. https://doi.org/10.1016/j.jmsy.2022.07.010

Kabakuş, A. K., Özköse, H., & Ayaz, A. (2023). Society 5.0 Research: Performance Analysis and Science Mapping. *Gümüşhane Üniversitesi Sosyal Bilimler Dergisi*, *14*(1), 311-328.

Kaya, M. (2021). Sanayi 4.0'da Yapay Zekâ ve Türkiye. *Fırat Üniversitesi. İİBF Uluslararası İktisadi ve İdari Bilimler Dergisi*, *5*(2), 63-94.

Keidanren. (2018). *Society 5.0-Co-creatingthefuture-(Excerpt 1)*. https://www.keidanren.or.jp. https://www.keidanren.or.jp/en/policy/2018/095_proposal.pdf

Moradi, S., Khan, M. M., Hossain, N. U. I., Shamsuddoha, M., & Gorod, A. (2023). Modeling and assessing seismic resilience leveraging systems dynamic approach: A case study of society 5.0. *International Journal of Critical Infrastructure Protection*, *43*, 100639. https://doi.org/10.1016/j.ijcip.2023.100639

Öztürk, F., & Ateş, E. (2021). Teknolojik Dönüşüm: Toplum 5.0. *Bilim ve Teknik*, 30-39.

Potočan, V., Mulej, M., & Nedelko, Z. (2021). Society 5.0: Balancing of Industry 4.0, economic advancement and social problems. *Kybernetes*, *50*(3), 794-811. https://doi.org/10.1108/K-12-2019-0858

Riminucci, M. (2018). Industry 4.0 and Human Resources Development: A View from Japan-Web of Science Core Collection. *E-Journal Of International And Comparative Labour Studies*, *7*(1). https://a8f59890210bb2a36cc265c34c80a801c14e01d5.vetisonline.com/wos/woscc/full-record/WOS:000495430100001

Santos, C. T., Ferreira, F. A. F., Dabić, M., Ferreira, N. C. M. Q. F., & Ferreira, J. J. M. (2024). "Too Small to Shine? Not Really!": Developing Society 5.0 Adaptation Initiatives for SMEs. *IEEE Transactions on Engineering Management*, *71*, 9058-9079. https://doi.org/10.1109/TEM.2023.3321747

Santos, G., Sa, J. C., Felix, M. J., Barreto, L., Carvalho, F., Doiro, M., Zgodavova, K., & Stefanovic, M. (2021). New Needed Quality Management Skills for Quality Managers 4.0. *Sustainability*, *13*(11). https://doi.org/DOI10.3390/su13116149

Sarfraz, Z., Sarfraz, A., Iftikar, H. M., & Akhund, R. (2021). Is COVID-19 pushing us to the Fifth Industrial Revolution (Society 5.0)? *Pakistan Journal of Medical Sciences*, *37*(2). https://doi.org/10.12669/pjms.37.2.3387

Seçkin, Z., & Köse, Y. (2024). Toplum 5.0 ile İlgili Çalışmaların Bibliyometrik Analizi: Scopus Örneği. *The International Journal of Economic and Social Research*, *20(1)*(228-245).

Usta Baki̇, B., & Boyacioğlu, A. (2023). Yeni Medyada Suç Haberleri ve Gündelik Hayatta Dolaylı Mağduriyet. *Türkiye İletişim Araştırmaları Dergisi*, *42*, 63-83. https://doi.org/10.17829/turcom.1122390

van Eck, N. J., & Waltman, L. (2010). Software survey: VOSviewer, a computer program for bibliometric mapping. *Scientometrics*, *84*(2), 523-538. https://doi.org/10.1007/s11192-009-0146-3

Yacan, İ. (2021). Endüstri 4.0 Teknolojileri ve Toplum 5.0 Kavramı. *Yeni Fikir Dergisi*, *13*(27), Article 27.

Özet

Toplum 5.0, Endüstri 4.0'ın ardından insan merkezli bir vizyon olarak geliştirilen yeni bir toplumsal modeldir. Bu model, siber-fiziksel sistemler kullanarak insan güvenliği ve refahını artırmayı hedeflemektedir. Bu araştırma, WoS veri tabanında yer alan 376 makaleyi bibliyometrik analiz yöntemiyle değerlendirerek Toplum 5.0 kavramına dair eğilimleri belirlemeyi amaçlamaktadır. Yayınlar, SCI-Expanded, SSCI ve ESCI gibi indeksleme sistemlerinden ve nitelikli yayınlardan derlenmiştir.

Analiz sonuçlarına göre, Japonya en yüksek yayın ve atıf sayısına sahip ülke olarak öne çıkmıştır. Ayrıca, Susumu Noda, alanın en etkili yazarı olarak belirlenmiştir. Anahtar kelime analizi, "society 5.0" teriminin en sık kullanılan anahtar kelime olduğunu ve Toplum 5.0 ile Endüstri 4.0 terimlerinin öne çıktığını göstermiştir. Kyoto Üniversitesi ve George Washington Üniversitesi ise yüksek atıf sayılarıyla dikkat çekmiştir.

Araştırmanın kısıtları, yalnızca "society 5.0" anahtar kelimesinin kullanılması ve sadece WoS veri tabanıyla sınırlı kalınmasıdır. Gelecekte, daha geniş anahtar kelime ve veri tabanı kullanımıyla literatür taramasının kapsamı genişletilebilir ve disiplinler arası yaklaşımlar eklenerek Toplum 5.0 kavramına farklı bakış açıları kazandırılabilir.

Kabakuş ve arkadaşları (2023), WoS veri tabanında 2016-2022 yılları arasında 456 yayını analiz etmiştir. Çalışma, incelenen belgelerin %38'inin makale, %37'sinin konferans bildirisi, %1'inin kitap bölümü ve %3'ünün derleme makalesi olduğunu ortaya koymuştur. Japonya, en fazla yayına sahip ülke olarak öne çıkarken, anahtar kelime analizi "Society 5.0" teriminin sıkça kullanıldığını göstermiştir. Çalışmamız Kabakuş ve arkadaşları (2023)'ten farklı olarak, SCI-Expanded, SSCI ve ESCI gibi yüksek kaliteli indekslerin kullanılmasını içermekte ve bu durum da bulguların güvenilirliğini ve bilimsel geçerliliğini artırmaktadır.

Seçkin ve Köse (2024), Society 5.0 vizyonunu 2017-2022 yılları arasında Scopus'ta indekslenen 465 kaynağı analiz ederek incelemiştir. Bu analiz, çalışmaların %38'inin konferans bildirisi, %37'sinin dergi makalesi olduğunu ve en verimli yılın 2022 olduğunu ortaya koymuştur. Japonya, Endonezya, Hindistan, Amerika Birleşik Devletleri ve

İtalya, en fazla yayına sahip ülkeler olarak sıralanmıştır. Anahtar kelime analizi "Endüstri 4.0", "Öğrenci", "Yapay Zeka" ve "Nesnelerin İnterneti" terimlerini vurgulamıştır. Çalışmamızda Seçkin ve Köse (2024)'e göre, geniş veri kaynağı ve indeksleme sistemlerinin kapsamı gibi üstünlüklerin, mevcut literatüre önemli katkılarda bulunduğu ve Toplum 5.0 konusundaki bilgi birikimini derinleştirdiği düşünülmektedir.

Özetle, bu çalışmanın amacı, WoS veri tabanında indekslenen 376 makaleyi bibliyometrik analiz yöntemiyle inceleyerek Society 5.0 kavramına dair eğilimleri belirlemektir. WoS veri tabanının kullanımı, araştırmanın geniş bir veri seti ve yüksek kaliteli indeksler içermesini sağlar ve sonuçların bilimsel standartları karşılamasını sağlar. Japonya, en fazla yayına ve atıfa sahip ülke olarak öne çıkarken, en etkili yazar Susumu Noda'dır. Anahtar kelime analizi, "society 5.0" teriminin öne çıktığını ve Society 5.0 ile Endüstri 4.0'ın sıkça kullanıldığını göstermiştir. Ancak, araştırmanın sınırlamaları arasında yalnızca "society 5.0" anahtar kelimesinin kullanılması ve WoS veri tabanı ile sınırlı kalınması yer almaktadır. Gelecekte, daha geniş anahtar kelimeler ve veri tabanları kullanılarak literatür taramasının kapsamı genişletilebilir ve disiplinler arası yaklaşımlar eklenerek Society 5.0 kavramına farklı bakış açıları kazandırılabilir.