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Trends in City Resilience Research: Bibliometric Analysis with Rstudio and Biblioshiny

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Abstract

Given the increased frequency and severity of natural catastrophes in recent years, it is evident that city design, planning, and central and local government policies are crucial to urban resilience. Resilience has evolved as a fundamental foundation for effectively managing the functioning of vital systems in the face of unexpected shocks, stress, and disaster events. However, it is clear that there is room for improvement in the selection and standardization of resilience assessment frameworks identified in the research, and resilience should begin at the community level. As a result, in order to define the notion of resilience, an extensive literature research was done, and the data gathered were analyzed using the bibliometric analysis method. Within the purpose of this study, the Web of Science (WoS) database was used, and studies from 1975 to 2024 were examined. "Resilience" and "urban" were selected as keywords. The database search on November 1, 2024 yielded 419 documents. The first document study on architecture was undertaken in 2004. The data was processed with the "biblioshiny for bibliometrix" application. As a result, it was emphasized that in order to become a sustainable city, cities must have resilient critical infrastructures, the importance of building stock, resilience must begin at the community level, and local governments, as the closest unit to the community, must play an important role.

1. INTRODUCTION

Cities' critical systems are complex networks that collaborate with various transdisciplinary components to ensure their long-term viability [1]. These systems are designed to address the demands of society by providing essential services such as shelter, energy, water, heating, cooling, transportation, and communication while also protecting society's integrity and functionality [2]. Furthermore, these systems struggle to retain their biological structure in the face of a variety of dangers, including natural disasters, accidents, cyber assaults, terrorism, vandalism, criminal activity, and neglect. As a result, ensuring key system resilience through reliable assessments and presented frameworks is critical to societal survival and sustainability.

The notion of resilience in the built environment first appeared in the late 1990s and gained popularity following numerous disasters [3,4,5]. Resilience seeks to build more resilient, secure, and flexible systems [6,7,8,9]. The resilience strategy takes a hybrid approach to the physical and technological parts of the city's key systems, as well as the socio-ecological-technical aspects. It examines the social, environmental, and economic implications [10,11,12,13]. This concept shows that urban resilience is made up of complex, interrelated systems. Social activities such as societal harmony and social networks are critical in intervention and recovery, particularly following a tragedy [13,14,15]. Services and interventions for green infrastructure and ecosystem protection are important for urban resilience as they support the fight against climate change, water management and biodiversity. In addition, technological developments increase the robustness of the critical systems that make up the city, making monitoring, intervention and recovery processes more efficient [16,17,18]. By establishing the existing conditions for the preservation and continuity of resources, economic resilience promotes societal sustainability [13,19].

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A more thorough and successful resilience strategy is made possible by acknowledging and incorporating these intricate, interdependent, and highly interrelated networks, which guarantees that every facet of urban systems is taken into account and reinforced [13,20,14,15,19,21]. For instance, strong social networks can boost the efficacy of technical solutions, while technological advancements and innovations can enhance ecological monitoring and management. In addition to enhancing quick reactions to unexpected shocks and pressures, this all-encompassing and inclusive strategy supports the long-term sustainability and adaptation of urban ecosystems.

The ability of a city and its systems to prevent and recover from a negative consequence by reducing the time needed to eradicate a specific shock or threat is known as resilience [22,23,24,25,26]. Effectively and efficiently planning and adjusting the structural integrity and functions of all the fundamental systems that comprise a society can increase its resistance to unforeseen shocks and stressful situations. Critical systems should therefore be assessed before to, during, and following an unexpected outage [27,28,29]. By evaluating the system's resilience prior to disruption and putting the right preventive measures in place to manage the process, it becomes more resilient and even offers financial advantages by enhancing its functionality. Public health and the built environment are greatly impacted when one of the vital systems that comprise the city fails [5,30,31]. The issue of climate change has spread throughout the world. One of the most important systems in the city, agriculture, is directly impacted by rising temperatures, erratic precipitation, and catastrophic weather events. Consequently, this condition has a detrimental impact on food security, income from food, city livelihoods, and population distribution. Given the global impacts of climate change and its implications for the sustainability of natural resources, as well as the fact that by 2050, 70% of the world's population is predicted to reside in urban areas, developing nations in particular must create effective adaptation and mitigation plans to eradicate the negative effects and boost the resilience of the vital systems that comprise cities. The economic, environmental, and social aspects that make up sustainability should all be compatible with a resilient system, which incorporates sustainability principles [29,32]. It directly aligns with the United Nations-established Sustainable Development Goals 9 and 11, which went into effect in 2016.

Innovation, safe environments, inclusive and sustainable urbanization movements, resilient infrastructure, and resilient and sustainable cities are its main objectives [27,29]. By anticipating the vulnerabilities of cities and the dangers they are likely to face, the UN acknowledges the significance of lowering and eradicating the risk of failure of the vital systems that make up the city. It guarantees the creation of risk-reduction strategies to control and lessen the impact of any adverse consequences brought on by unexpected shocks and pressures [27,32]. Ensuring the long-term sustainability and resilience of the city's vital systems is crucial with this strategy. Numerous techniques, definitions, and measuring strategies have been established and defined in the literature on the evaluation of the resilience of key systems in urban areas. Examining the methodologies reveals that they comprise both qualitative and quantitative methods, as well as empirical methods based on data and assumptions [6,17,33,34,35]. Nevertheless, it is noted that these approaches have drawbacks, including assessing resilience using data and information already in existence, the subjectivity of the responses, and their exclusive focus on particular critical systems or likely occurrences, which restricts the methods' ability to be applied generally [9,34,35,36]. Multiple viewpoints should be considered, a thorough and in-depth assessment should be conducted, and complex dynamics that are interdependent and interconnected should be addressed when assessing the resilience of the city's vital systems [22,10,37]. Because a significant system failure might have a cascading effect on other systems.

This research study investigates the notion of urban resilience using bibliometric and scientific mapping studies. The relationships among scientific publications, research institutes, journals, countries, researchers, and keywords are examined. Furthermore, it seeks to uncover new patterns in resilience research, identify major contributors in terms of keywords, nations, authors, and journals, and provide ideas for future studies through co-authorship, co-creation, bibliographic linkage, and co-citation analysis. To attain these objectives, the essay covers crucial research concerns about performance analysis and the scientific mapping of resilience literature or research articles. It seeks to identify the most productive or influential authors, institutions, countries, and journals in resilience research, as well as to assess the current state of their work, using citation analysis, co-keyword formation, co-country authorship,

institutional bibliographic linkage, and co-source citation patterns. In order to model and thoroughly assess the resilience of many important systems, a common resilience framework is necessary. In order to generate theories on resilience trends, future research must conduct a thorough analysis of the literature on the standards and criteria for evaluating urban critical systems. In order to direct future resilience research and policy activities, this research article attempts to identify important study topics, trends in recent publications, and gaps in the field.

2. RESILIENCE

According to historical analysis, the idea of resilience initially arose as ecological research intended to bolster ecological system shocks [17,18]. A more thorough analysis of risks and uncertainties is now possible thanks to recent developments in resilience studies that have extended to a variety of disciplines, including engineering, sociology, and economics [9,17,18,35,38]. One of these has been the ability of metropolitan areas, where the majority of human-nature interactions take place, to withstand the severe consequences of disasters [14,39,40]. Based on ecological resilience, which Holling first proposed in 1973, urban resilience is the ability of a system to withstand shocks, adapt, and carry on with its operations in the face of change [41]. Holling and Gunderson created the Panarchy Model, which outlines interdependent and interconnected hierarchical systems, to aid in the comprehension and resolution of challenging issues. By assessing these disturbances for a possible transformation, this model not only preserves critical functions in the case of a systemic disruption, but it also refocuses attention on resilient cities [14,15,40].

Holling's 1996 study highlighted that engineering resilience derived from ecological resilience is what determines the capacity and aptitude of urban infrastructure to withstand natural disasters [9,18]. In order to limit the ability, reaction, and loss of the desired function during system disruptions and to prevent dysfunction, engineering systems' resilience is closely related to the effectiveness of transformation and the robustness of urban infrastructure systems [14,15,40,42]. This idea has made it possible for planners, designers, implementers, and both municipal and federal legislators to concentrate on enhancing cities' resilience and the mechanisms that shield them from natural disasters. In order to better prepare for unforeseen shocks, stress, and disasters, urban resilience has emerged as a key concept in urban planning, design, and development [40,42,43,44]. The ability of an urban system, including its socio-ecological and socio-technical networks, to sustain or quickly sustain desired operations in the face of disruptions in various locations and at various times, to adjust to changes, and to quickly alter systems that impede the current or future system's adaptability is known as urban resilience [15,44,45,46]. This definition offers a foundation for enhancing urban systems' capacity to adapt, grow, and withstand changes and uncertainty. By increasing the transparency of the connections between the city's vital systems, it is portrayed as a significant factor influencing urban resilience [13,20,19,39,43,44].

Research has been done to better comprehend, spread, and increase public understanding of the idea of urban resilience on a global basis. In order to build sustainable communities, strategies are being put into place for urbanization, disaster management, climate change and global warming, sustainable development, and the economy. The OECD carried out one of these studies. To overcome, recover from, and get ready for possible or unanticipated disasters in cities, a resilience framework has been developed. The OECD's resilience framework is displayed in Figure 1 [47].

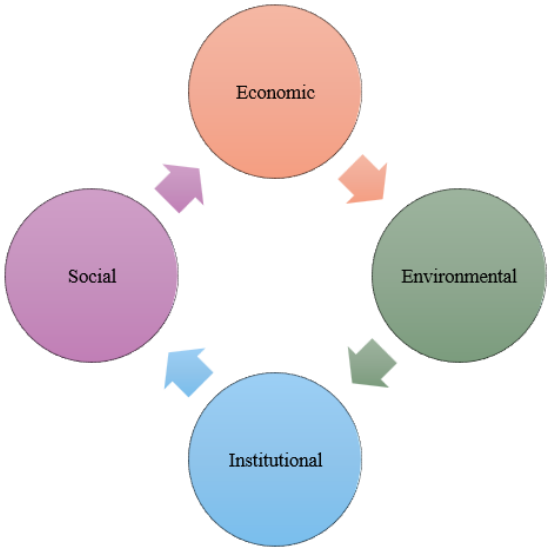

Figure 1. *Resilience Framework [47].*

According to the OECD's resilience framework, cities' critical systems need to be ready in four areas (social, environmental, institutional, and economic) and be able to react, adjust, and change in the event of an unexpected disruption.

Only then can their resilience capabilities become apparent. Urban resilience has been a popular notion in recent years, but when the evaluation methods are examined, they are applied narrowly and only address certain facets of the city's systems [39,40,43,44]. Given the ongoing and extensive effects of natural disasters and increasing urban growth, there is a need for a comprehensive resilience assessment that takes into account the interconnectedness of the city's systems, vulnerability levels, and capabilities [14,15,39,40,45]. Comprehensive approaches are required to establish acceptable time periods for studying disaster life cycles and developing effective intervention methods that take into account the relationship between humans and nature. The concept of resilience, as described in several disciplines, necessitates extensive planned evaluation approaches to increase understanding of urban ecosystems and dynamics. Figure 2 depicts the fields that use the concept of resilience.

Figure 2. *Disciplines Where the Concept of Resilience is Used.*

Given the negative repercussions of disasters, resilience is an important aspect of urban system design, planning, and decision-making by central and local governments. Examining urban resilience allows for a

full assessment of disaster-related hazards as well as the city's vital systems' ability to withstand these difficulties [13,20,15,19,40,43,45]. Five important features explain the city's and its constituent systems' ability to prepare, absorb, improve, adapt, and transform at various phases of resilience [13,15,19,40,44]. Monitoring these features during the process provides insight into a system's resilience level and allows for the development of measures to increase its resilience structure. The preparation stage involves the ability to plan and prepare for potential or unforeseen disasters, which is required for decision-making based on the city's typical structure and vulnerable places prior to disasters [14,15,43,44]. The absorption stage refers to the ability to resist a disruption in the system, handle its consequences, and, if possible, preserve the operation of the process without deterioration. It highlights the potential of urban systems, including resilience, diversity, and redundancy [48,49,50]. The recovery stage tries to quickly recover from a system disturbance while also reorganizing and restoring functionality through rapid response mechanisms and self-directed efforts. Recovery entails not just fixing the city's physical infrastructure, but also maintaining social functionality [25,51,52,53]. The adaptation step involves reviewing the opportunities discovered during the process and providing long-term applications in response to changing situations in order to sustain the desired functionality. The transformation stage is the ability to create a fundamentally new system through significant changes in infrastructure, functions, and relationships when the existing economic, ecological, and social systems become untenable as a result of a disruption during the process [20,14,15,54,19,39,43,44]. Urban resilience and its assessment methodologies provide key studies in economics, ecology, and sociology. Understanding the links between these sectors is critical for developing strategies to improve urban system resilience [15,39,43]. Sharifi and Yamagata (2016) identified five fundamental parameters for assessing urban resilience [43]. Figure 3 shows these qualities.

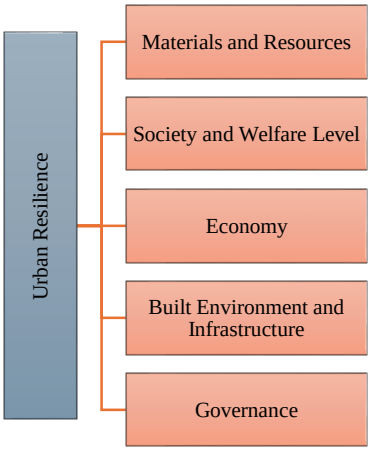

Figure 3. *Urban Resilience Characteristics (Adapted from Sharifi and Yamagata [56]).*

When evaluating Figure 3, materials and resources determine the availability and accessibility of clean and inexpensive resources required to survive natural disasters. Social capital, a sense of belonging, a secure society and spaces, equality, and an accessible distribution of learning processes all fall under the umbrella of society and wellbeing. A resilient economy is defined as the equitable distribution of resources required to recover from and eliminate system disturbances and the resulting situation. The built environment and infrastructure aspect reflects the fragility and efficiency of the infrastructure, ensuring the supply of necessary services in the city. Leadership, resource management, emergency planning, collaboration, and education are all aspects of governance that are required for urban system operations [39,43,44].

With the density of people and activity in metropolitan areas, city sustainability faces a number of challenges. These issues have brought the notion of social resilience in the built environment to the forefront in recent years among both scientists and central and municipal governments [43,55,56,57,58]. While acknowledging that risks to the social structure cannot be avoided, the growing interest in the notion of community resilience highlights the importance of measures for mitigating social structure

disruption. Furthermore, resilience entails learning from negative results and employing adaptive and transformational measures to promote the system's slow, long-term evolution [43,44,46].

Research has been performed to establish several ways for assessing and developing the idea of community resilience. Community resilience assessment has been acknowledged as a critical component of resilience, particularly in recent years [13,15,19,59,40,46]. The growing emphasis on community resilience derives from a desire to better understand the negative effects of climate change in cities, determine the necessary budget for developing urban resilience, and track progress toward international risk reduction targets [48,56,57,60,61]. Assessing community resilience is critical for lowering catastrophe risk and preparing for both natural and man-made disasters. Community resilience is critical for understanding and improving urban resilience. As urban regions confront rising challenges from catastrophes and other risks, establishing and implementing community resilience assessments is critical for building sustainable communities [40,43,46,62,63].

3. RESEARCH AND METHOD

This research article uses bibliometric analysis. Bibliometric analysis was defined by Pritchard [64] as "the quantitative and qualitative analysis of published academic literature to monitor the development of a particular research area over a long period". A different definition is the analyses conducted to reveal the profile sequence and development of research conducted in a particular field [65]. The bibliometric analysis process consists of many processes that start with selecting any database, then obtaining the data as a result of scanning the selected database and transferring the data to the bibliometric software. According to the bibliometric analysis method used in the article, the Web of Science (WoS) database was selected to collect data in the determined study area. This database is prominent among scientific citation search and analytical information platforms [66]. The reason for choosing this database to obtain the data in the article is; the most effective and essential data in different fields of study are included in this database, and it contains comprehensive data that makes it easy to follow the development process of the data [67,68]. The data obtained from the Web of Science (WoS) database were evaluated using the "biblioshiny for bibliometrix" application running in the RStudio Version (4.4.1) program. This application is software developed by Massimo Aria and Corrado Cuccurullo (University of Naples Federico) [69]. This software analyses annual scientific production, the most productive authors, the most frequently used keywords, the most popular journal, and the co-authorship related to the selected research topic. This analysis helps to update the current status and the progress of the trending research topic. There are also different software for performing bibliometric analysis. The "biblioshiny for bibliometrix" software tool was selected for the article. Because data analysis is easier and faster, visualization and data can be read more clearly, and analysis can be done under many headings.

In order to reach resilience studies, which is an interdisciplinary concept in the Web of Science (WoS) database, a search was conducted on 01.11.2024 by writing "All Fields" in the search section and "resilience" in the keyword section, covering the years 1975-2024. As a result, 20.848 studies were obtained. In order to reach studies on resilience in the field of architecture, the search was narrowed down by adding "Architecture" to the category section. As a result of this narrowed-down search, 419 studies on resilience were reached in the architecture category. The data reached are in varying categories: article, report, book chapter, book, note to the editor, early view, essay, book review, art exhibition review, news, reprint and withdrawn publication. In this context, the analyses in this article are based on 419 documents obtained in the architecture category between 1975 and 2024, according to the scan conducted on 01.11.2024. The obtained data was transferred to Web of Science (WOS), and the "biblioshiny for bibliometrix" program for the analysis process began. While evaluating the data obtained as a result of the scan, the selected titles aimed to present the current status of the trends in resilience in the field of architecture; at the same time, they were selected in order to understand the development and direction of the process on the relevant subject and to create future scenarios. In this context, in order for the article to achieve its purpose, the following questions were answered within a general framework:

1. What are the results of the bibliometric analysis of publications on resilience in the field of architecture?
2. How many publications on resilience have been accessed? (Web of Science)

3. How have resilience research, citations, articles, keywords, countries producing articles, and country collaborations changed over the years in the field of architecture?

The flow diagram for the method used in the article is shown in Figure 4.

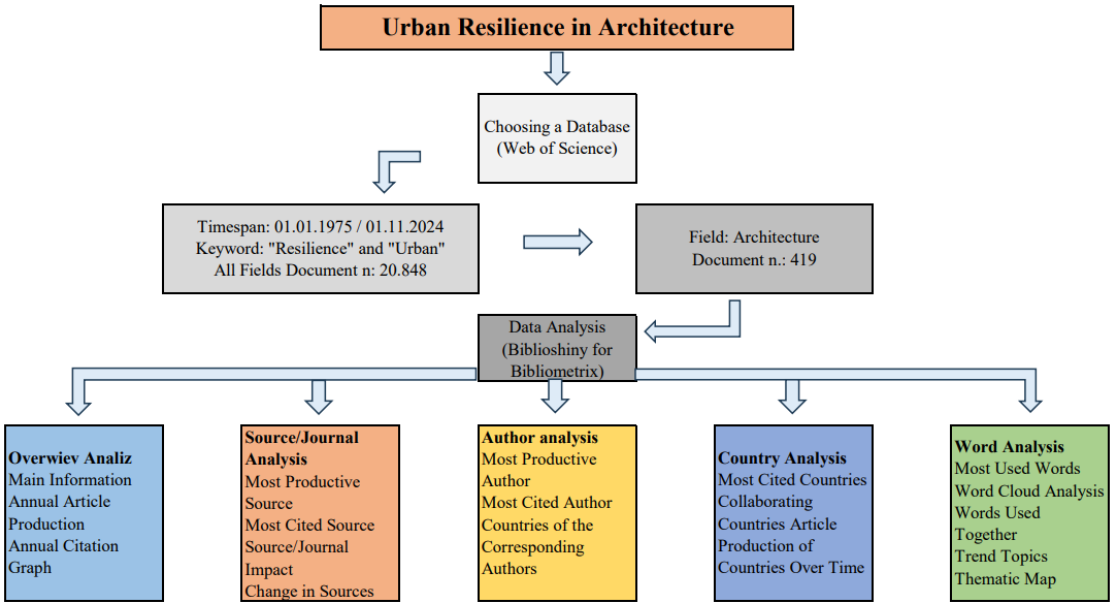

Figure 4. *Flow Diagram of The Method Used in the Article.*

4. FINDINGS

The data published on resilience in the field of architecture scanned and obtained from the Web of Science (WOS), are listed in Table 1. According to this table, it was determined that the first document on resilience in the field of architecture was conducted in 2004. In this context, it is seen that there are a total of 419 documents between 2004-2024. It was determined that 266 of these studies were articles, 20 were book chapters, 8 were early/previewed articles, 2 were proceedings papers, and 1 was withdrawn.

Table 1. *Data on Documents Between 2004-2024.*

Explanation	**Results**
Main Information About Data	
Timespan	2004:2024
Sources (Journals, Books, Etc)	118
Documents	419
Annual Growth Rate %	14,31
Document Average Age	6,08
Average Citations Per Document	3,695
References	12759
Document Contents	
Keywords Plus (ID)	357
Author's Keywords (DE)	1354
Authors	
Authors	934
Authors Of Single-Authored Docs	130
Document Types	
Article	266
Article; Book Chapter	20
Article; Early Access	8
Article; Proceedings Paper	2
Article; Retracted Publication	1
Book	1
Book Review	5
Editorial Material	15
Editorial Material; Book Chapter	3
News Item	1
Proceedings Paper	88
Reprint	1
Review	8

The analyses of the data transferred to the Biblioshiny for Bibliometrix program are shown in Figure 5.

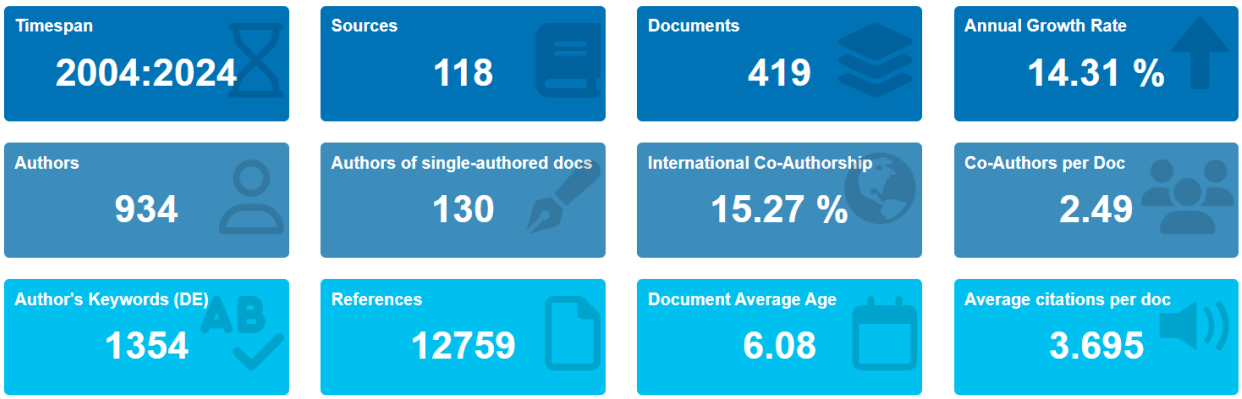

Figure 5. *General Information.*

Figure 6 shows the distribution of studies and citations to studies over time according to the data obtained from the Web of Science (WOS). According to the Biblioshiny for Bibliometrix software data, the annual document production rate is 14.31%.

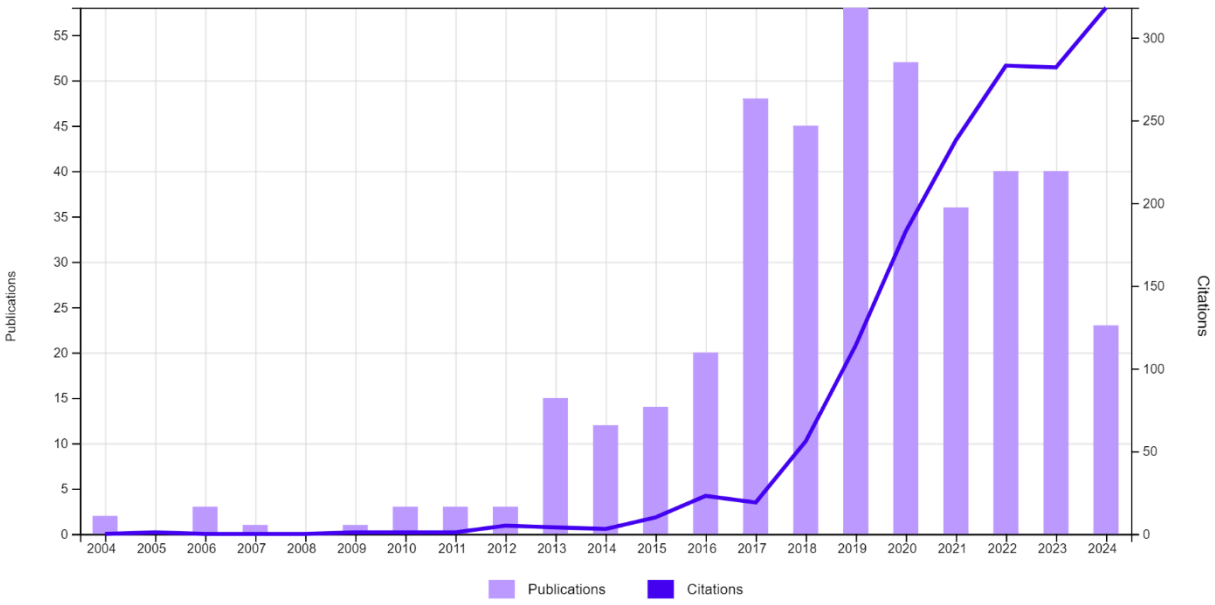

Figure 6. *Studies and Citations Produced Over Time.*

When Figure 6 is examined, the first documents was conducted in 2004. Interest in studies on resilience in the field of architecture increased after 2013 and reached its peak in 2019. Although it tended to decline in the following years, there was an increasing interest. The same situation is also seen in the annual average citation graph. The Sankey Diagram was used to measure the relationship between the authors of the obtained studies, the keywords they used, and the sources where the studies were published. In this way, the relationship was revealed with a triple-area graph. The diagram is shown in Figure 7.

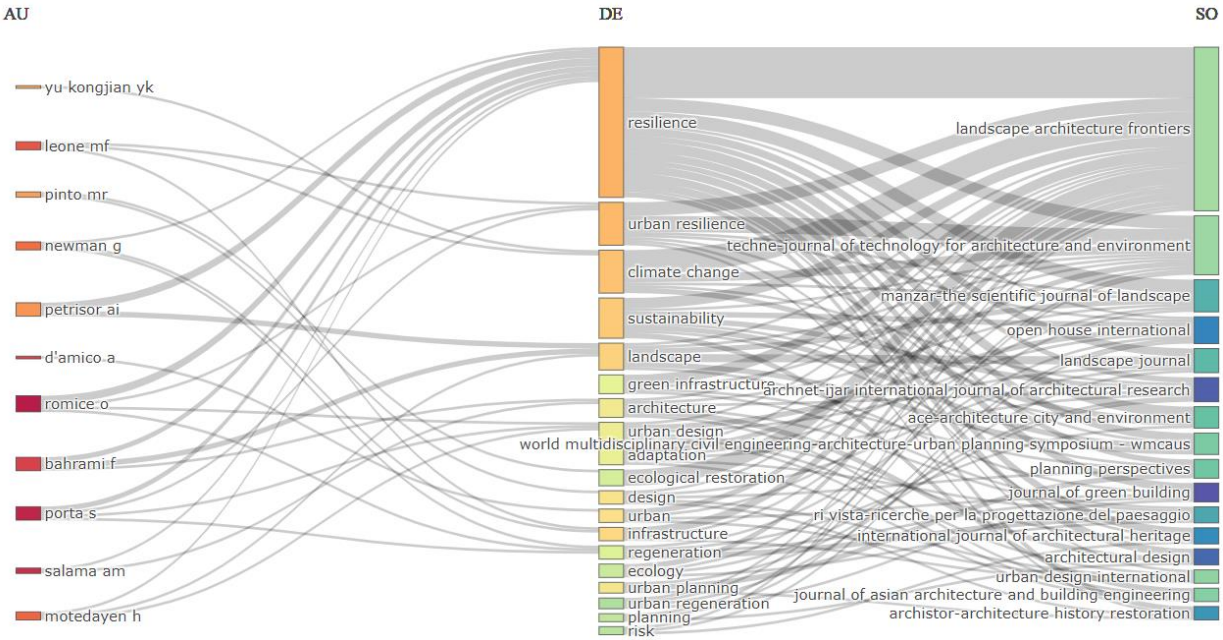

Figure 7. *Relationship Between Authors, Keywords Used and Published Sources.*

According to the Sankey Diagram in Figure 7, the sources where the studies on resilience in the field of architecture are mostly published, the authors whose work is included in these sources, and the keywords frequently used by the authors are included. The connection between these three selected titles is shown with gray lines. The thinness or thickness of the gray line provides information about the use density. In addition, the size of the rectangles in the diagram also shows the density related to the relevant title. Accordingly, the authors are located on the left of the diagram. The names of 11 different authors are listed here. The prominent authors are Petrisor A.I., Romice O. and Bahrami F. In the middle of the diagram, the authors frequently use 20 keywords. "Resilience" stands out among the keywords used. Then come the keywords “urban resilience”, “climate change”, “sustainability”, and “landscape”. When the keywords are examined, the frequent use of the keywords “resilience and "urban resilience" confirm that this research article, which examines trends in urban resilience research, serves its purpose. The sources of the studies are on the right side of the diagram. It is seen that the authors mostly prefer the source "Landscape Architecture Frontiers" for their studies on resilience in the field of architecture. Other sources are "Techne-Journal of Technology for Architecture and Environment", "Manzar-The Scientific Journal of Landscape", "Open House International", and "Landscape Journal". Figure 8 shows the most productive sources in studies on resilience in the field of architecture.

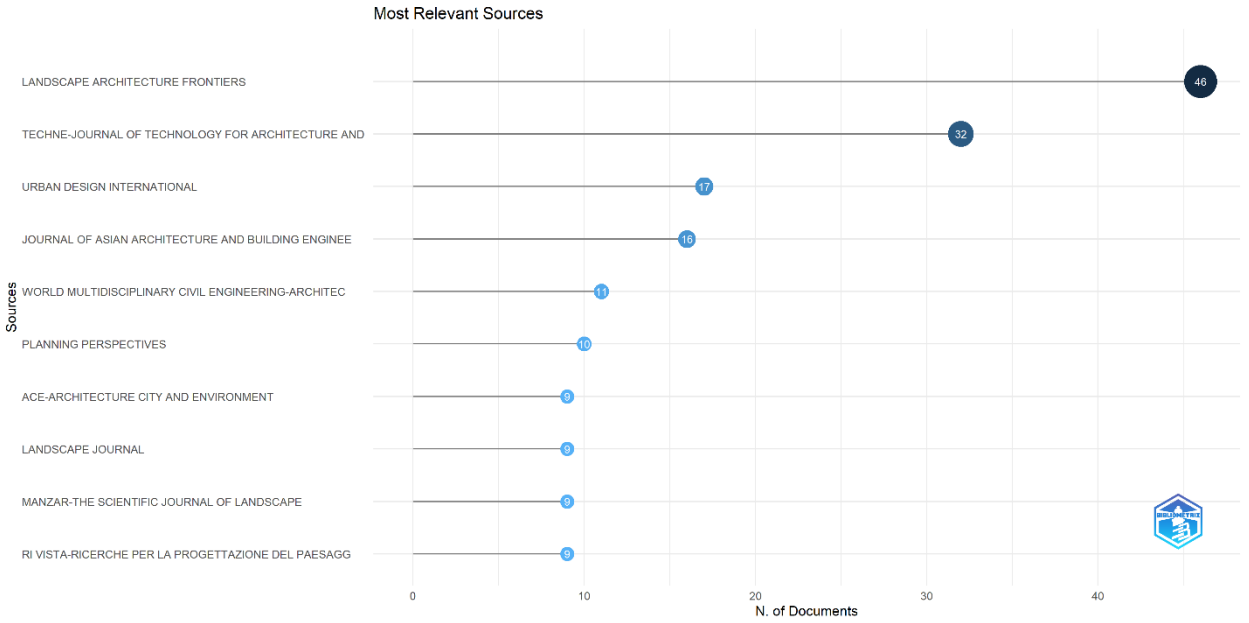

Figure 8. *The Most Productive Sources (Publishers).*

The number of publications increases as the circles in Figure 8 get more prominent and darker. Accordingly, Landscape Architecture Frontiers ranks first with 46 publications. Figure 9 shows the sources most cited by the authors. Accordingly, Landscape and Urban Planning stands out with 191 citations.

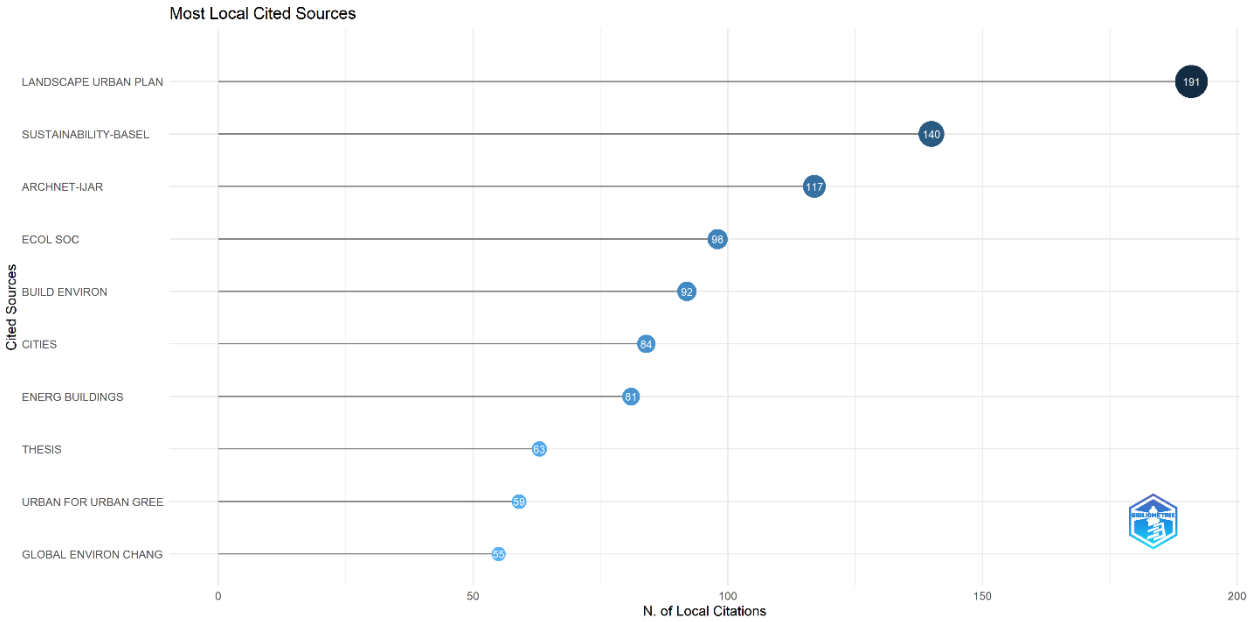

Figure 9. *Most Cited Sources.*

Figure 10 shows the H-index information of the journals in which studies on resilience in architecture are published. The magnitude of the H-index value shows that the source is influential. Accordingly, the "Landscape Journal" source ranks first with a value of 7.

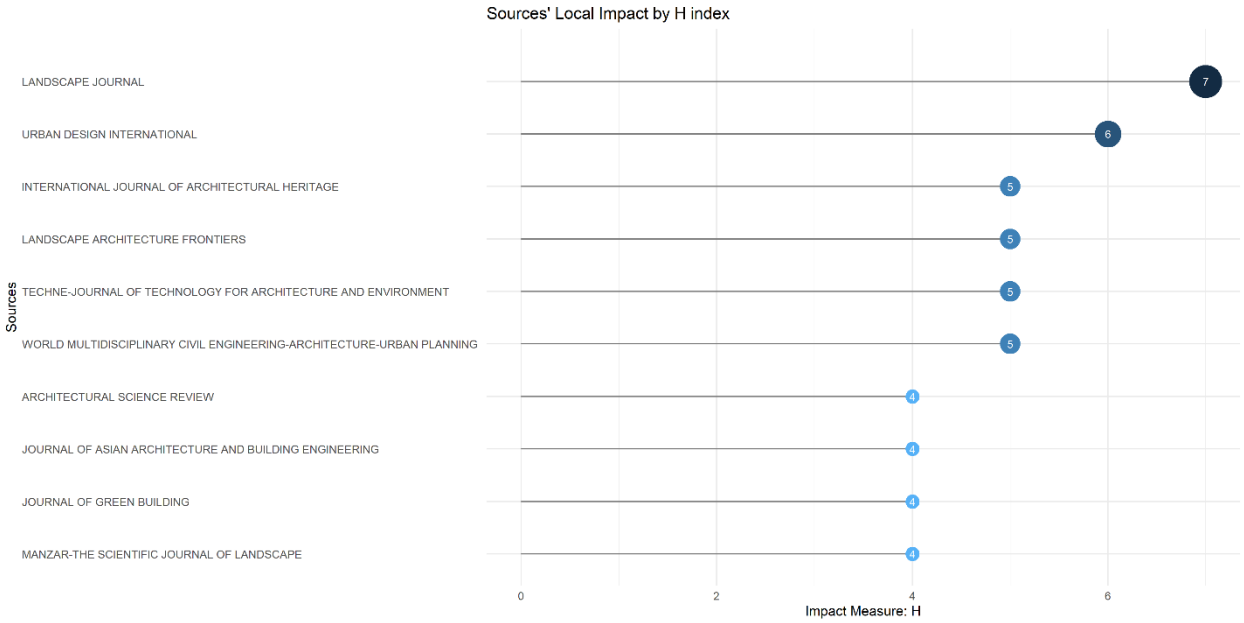

Figure 10. *The Most Influential Sources.*

Figure 11 shows the current status of the interest in the sources of resilience studies in the field of architecture throughout the historical process. Considering that the first document on resilience in the field of architecture was produced in 2004, it is seen that the interest in the subject has increased and that resilience is given more place in the sources than before. The negativities experienced in cities around the world can be shown in this. As indicated in Figure 11, the source that gives the most place to the subject of resilience is the "Landscape Architecture Frontiers".

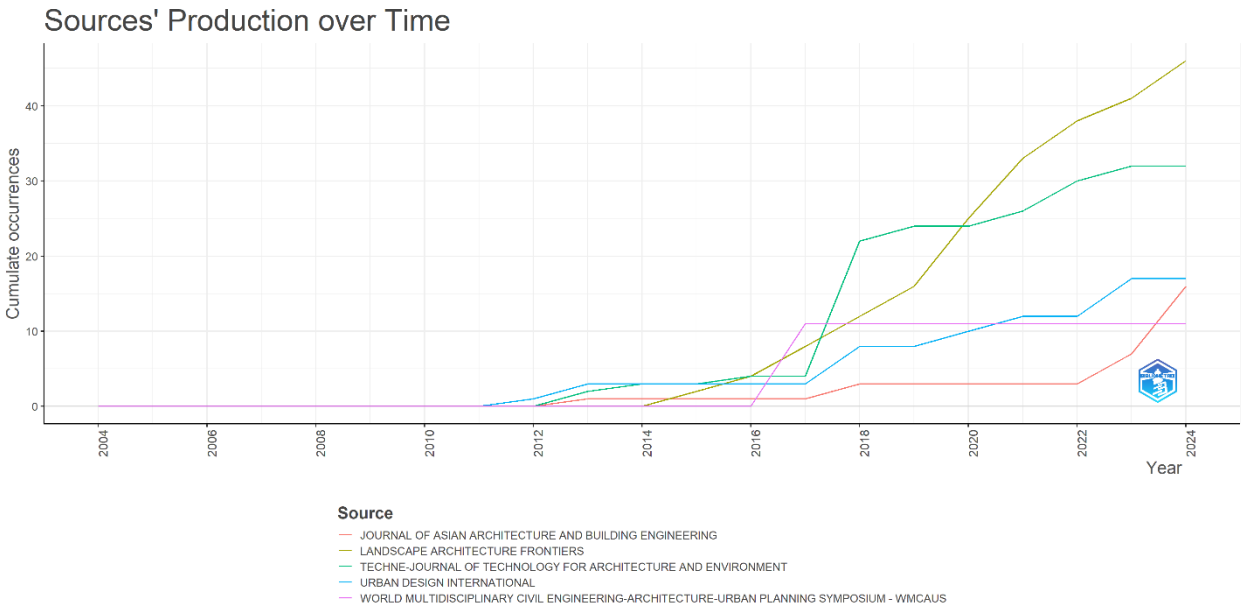

Figure 11. *Documents Production of Sources Over Time.*

In order to determine the authors who are most interested in the subject of resilience and produce studies on this subject, the data obtained from the Web of Science (WoS) database was analyzed with the "biblioshiny for bibliometrix" software tool. Accordingly, Kaewunruen S. stand out with 13 publications. Figure 12 lists the 10 most interested and productive authors on the subject of resilience in the field of architecture.

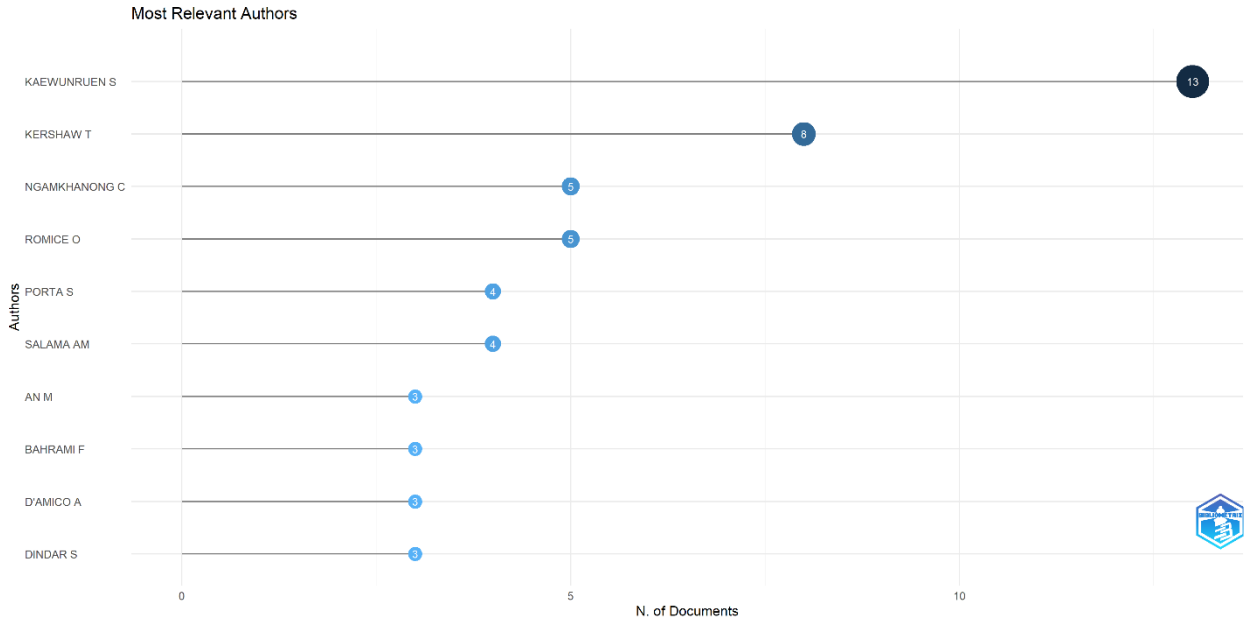

Figure 12. *The Most Productive Writers.*

Among the authors interested in the subject and producing documents, the most cited author is Bahrami F. with 4 citations. Figure 13 shows the top 10 most cited authors.

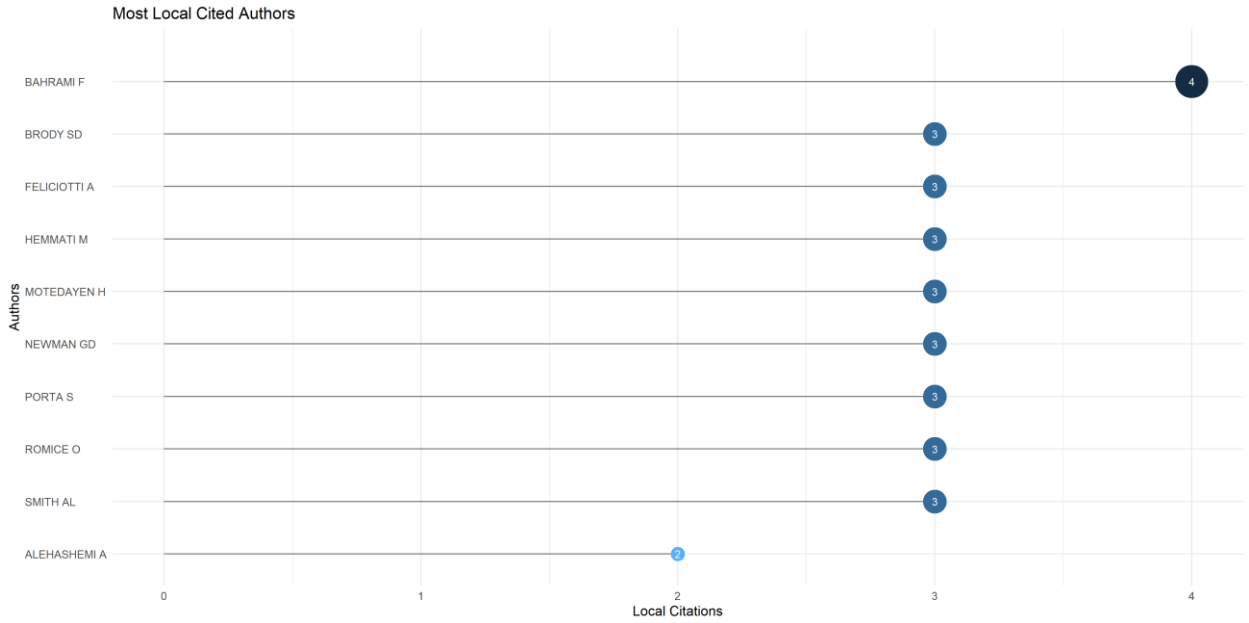

Figure 13. *Most Cited Authors.*

Figure 14 shows the 20 countries where studies on resilience in the field of architecture are produced and their responsible authors. It is seen that the distribution of studies produced by the country is between 0 and 100. In addition, two different colours are in the lines in the figure. Red color indicates publications produced with the participation of authors from more than one country, while Turquoise color indicates studies produced with the participation of authors from only one country. According to Figure 14, Italy stands out as the country that produces the most documents, and it is seen that the majority of this production is realized through single country collaborations (SCP). The USA and the United Kingdom are in second and third place respectively, and authors from these countries produce documents through both single country (SCP) and multi-country collaborations (MCP). Countries such as China, Spain, Poland and Canada have also made significant contributions and have achieved a certain level of multi-country collaborations. Figure 14 also shows that Turkey is also active in the field. When Figure 14 is

analyzed, it is seen that Italy is the country that produces the most documents with 85 documents, but the MCP collaboration rate is only 8.2%. The Netherlands, which has 7 publications on the subject of "resilience" in the field of architecture, ranks first with a 42.9% MCP collaboration rate. While 9 of the 11 documents produced in Turkey were produced through single country collaborations (SCP), 2 were produced through multi-country collaborations (MCP). The multi-country collaboration (MCP) rate is 18.2%.

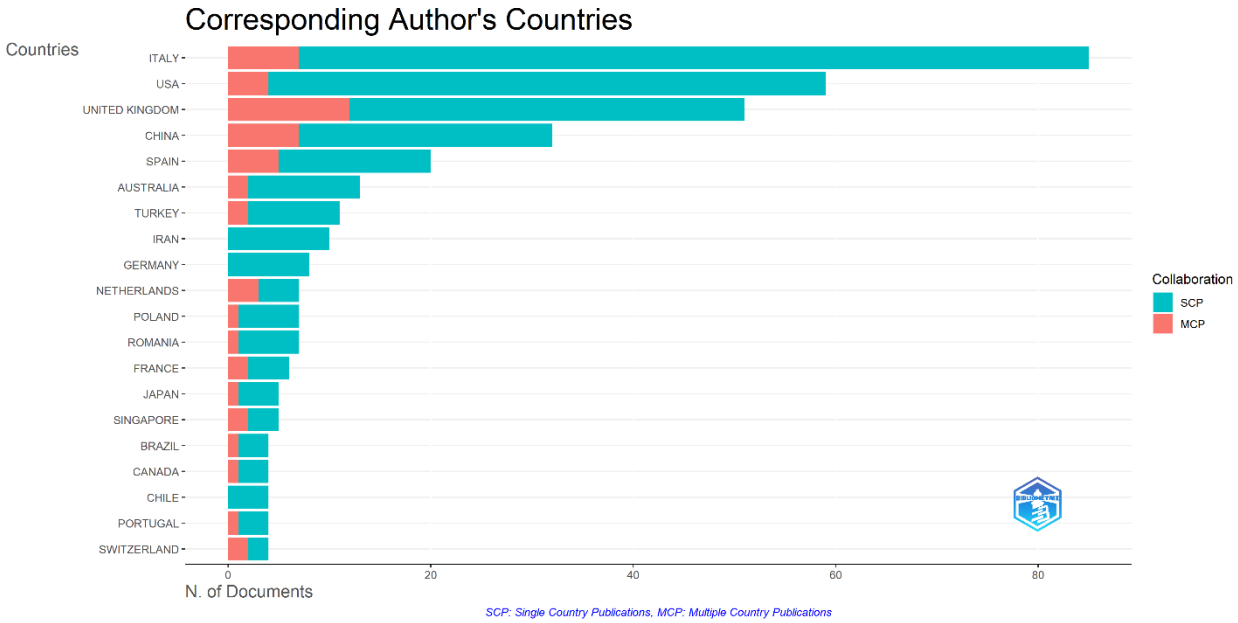

Figure 14. *Countries of Corresponding Authors (Single/Multiple).*

The top 20 most cited authors who produced documents on resilience in the field of architecture are shown in Table 2.

Table 2. *Top 20 most cited authors.*

Author	Year	Document Name	Source	Citation	Amaç Yöntem
Soltani, A and Sharifi, E	2017	Daily Variation of Urban Heat Island Effect And Its Correlations to Urban Greenery: A Case Study of Adelaide	Frontiers Of Architectural Research	118	A fieldwork was conducted to determine the surface temperature and urban heat island effects in the temperate city of Adelaide.
Boeing, G	2018	Measuring the Complexity of Urban Form And Design	Urban Design International	75	A typology of measures and indicators was developed to assess the physical complexity of the built environment at the urban design scale.
Feliciotti, A; Romice, O and Porta, S	2016	Design for Change: Five Proxies for Resilience in the Urban Form	Open House International	58	The concepts of urban morphology and resilience are combined under the headings of diversity, redundancy, modularity, connectivity and efficiency. The components and their interconnections are explained.
Feldhoff, T	2013	Shrinking Communities in Japan: Community Ownership of Assets As A Development Potential for Rural Japan?	Urban Design International	45	Current and future economic and socio-demographic challenges, population decline, and government policies facing shrinking communities in Japan are analyzed.
Hunter, M	2011	Emerging Landscapes Using Ecological Theory to Guide Urban Planting Design: An Adaptation Strategy for Climate Change Marycarol	Landscape Journal	33	Adaptation strategies have been developed to overcome the challenges of urban green space design in a changing climate.
Sterling, R and Nelson, P	2013	City Resiliency and Underground Space Use	13th World Conference of Associated-Research-Centers-for-the-Urban-Underground-	29	Examines the importance of understanding and improving the resilience of cities. Provides a general picture of the advantages and disadvantages of underground utilities in relation to various disaster events.

			Space (ACUUS)		
Fezi, BA	2020	Health Engaged Architecture in the Context Of Covid-19	Journal Of Green Buıldıng	28	In the context of COVID-19, this article demonstrates the potential of architecture and urbanism to play an active role in the prevention and control of epidemics and human health.
Cara, S; Aprile, A; (...); Roca, P	2018	Seismic Risk Assessment and Mitigation at Emergency Limit Condition of Historical Buildings along Strategic Urban Roadways. Application to the "Antiga Esquerra de L'Eixample" Neighborhood of Barcelona	International Journal Of Architectural Heritage	27	It provides a management tool for large-scale assessment and reduction of seismic risk of urban systems.
Newman, GD; Smith, AL and Brody, SD	2017	Repurposing Vacant Land through Landscape Connectivity	Landscape Journal	26	It describes the creation of a regional growth framework that balances the need to reuse vacant land with the provision of ecosystem services.
Ahern, J	2016	Novel Urban Ecosystems: Concepts, Definıtıons and A Strategy to Support Urban Sustainability and Resilience	Landscape Architecture Frontiers	23	A new urban ecosystem strategy is presented to provide essential ecosystem services to support urban sustainability and resilience.
Marcus, L; Pont, MB and Barthel, S	2019	Towards A Socio-Ecological Spatial Morphology: Integrating Elements of Urban Morphology and Landscape Ecology	Urban Morphology	21	Strategies for developing an integrated socio-ecological urban morphology based on developments in each area are presented.
Putri, PW	2019	Sanitizing Jakarta: Decolonizing Planning and Kampung Imaginary	Planning Perspectives	19	This article provides a critical overview of the water and sanitation sector within the broader trajectory of Jakarta's spatial development and planning.
Feliciotti, A; Romice, O and Porta, S	2017	Urban Regeneration, Masterplans and Resilience: The Case of Gorbals, Glasgow	Urban Morphology	19	A 150-year study of the Gorbals borough of Glasgow explored the concept of resilience by comparing examples of nineteenth-century, modernist and recent masterplans.
Newman, G; Li, DY; (...); Ren, DD	2019	Resılıence through Regeneratıon: The Economıcs of Repurposıng Vacant Land wıth Green Infrastructure	Landscape Architecture Frontiers	18	Performance measurements were conducted to evaluate the economic and hydrological performance of green infrastructure renovation projects for three neighborhoods in Houston, Texas, USA.
Roberts, AR	2019	"Until the Lord Come Get Me, It Burn Down, Or the Next Storm Blow It Away" The Aesthetics of Freedom in African American Vernacular Homestead Preservation	Buıldings & Landscapes-Journal of the Vernacular Architecture Forum	17	It is argued that more attention should be paid to the preservation of rural grassroots homes.
Dindar, S; Kaewunruen, S; (...); Gigante-Barrera, A	2017	Derailment-based Fault Tree Analysis on Risk Management of Railway Turnout Systems	World Multidisciplinary Civil Engineering-Architecture-Urban Planning Symposium (WMCAUS)	17	The aim is to identify product risks and defects in official accident reports and to analyze the impact of the possible process using Boolean algebra.
Brotas, L and Nicol, F	2017	Estimating Overheating in European Dwellings	Architectural Science Review	16	Energy performance and thermal comfort of residences were evaluated using transformed climates in 2020, 2050 and 2080 to assess overheating.
Chomicz-Kowalska, A; Mrugala, J and Maciejewski, K	2017	Evaluation of Foaming Performance of Bitumen Modified with the Addition of Surface Active Agent	World Multidisciplinary Civil Engineering-Architecture-Urban Planning Symposium (WMCAUS)	16	The article presents the analysis of the performance of foamed bitumen modified using surfactants.
Staniscia, S; Spacone, E and Fabietti, V	2017	Performance-Based Urban Planning: Framework and L'Aquila Historic City Center Case Study	International Journal of Architectural Heritage	16	Possible applications of seismic risk assessment are described in a sub-area of the historic centre of L'Aquila, considering only buildings, roads and open spaces.
Bobylev, N; Hunt, DVL; (...); Rogers,	2013	Sustainable Infrastructure for Resilient; An Environments	13th World Conference of Associated-Research-	16	The academic perspectives and progress to date of the Sustainable Infrastructure for Resilient Urban Environments research project, carried out at the

CDF	Centers-for-the-Urban-Underground-Space (ACUUS)	University of Birmingham, funded by the European Commission's 7th Framework programme between 2012 and 2014, are described.

The graph showing the interest of publication-producing countries in the field of resilience in architecture over the years is given in Figure 15. Accordingly, the Italy ranks first with 217 document, and it is seen that there has been an accelerated increase in production.

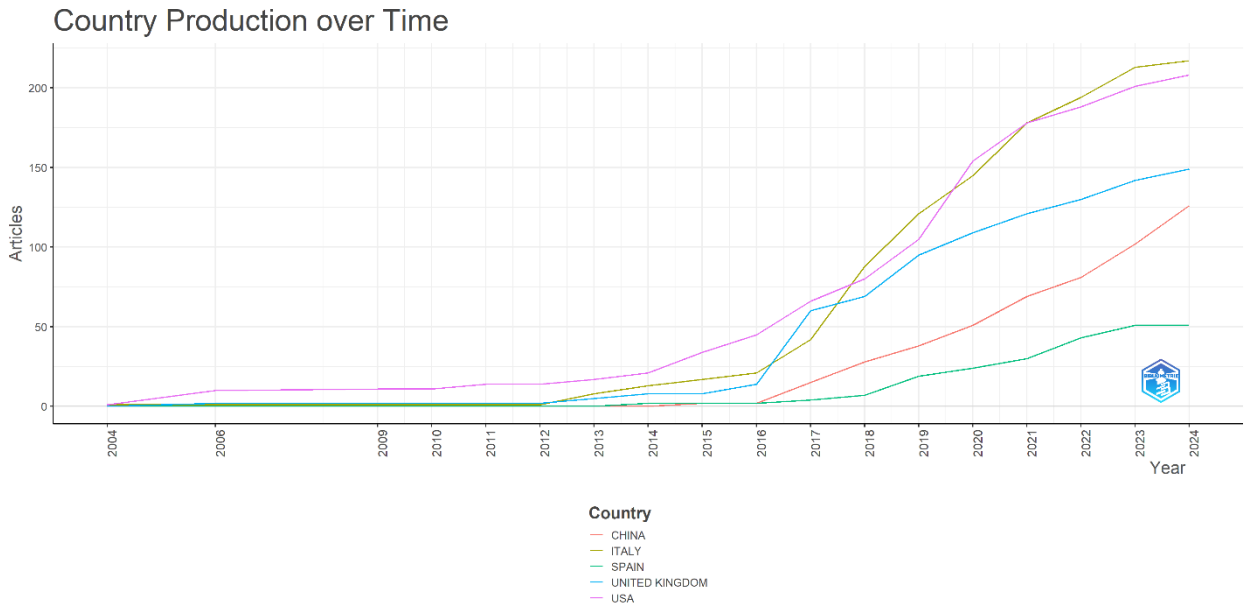

Figure 15. *Documents Production by Countries Over Time.*

Figure 16 shows the countries that receive the most citations among the publication-producing countries. Accordingly, the USA ranks first with 353 citations. United Kingdom ranks next with 223, Australia 172, Italy 162, and China 71 citations.

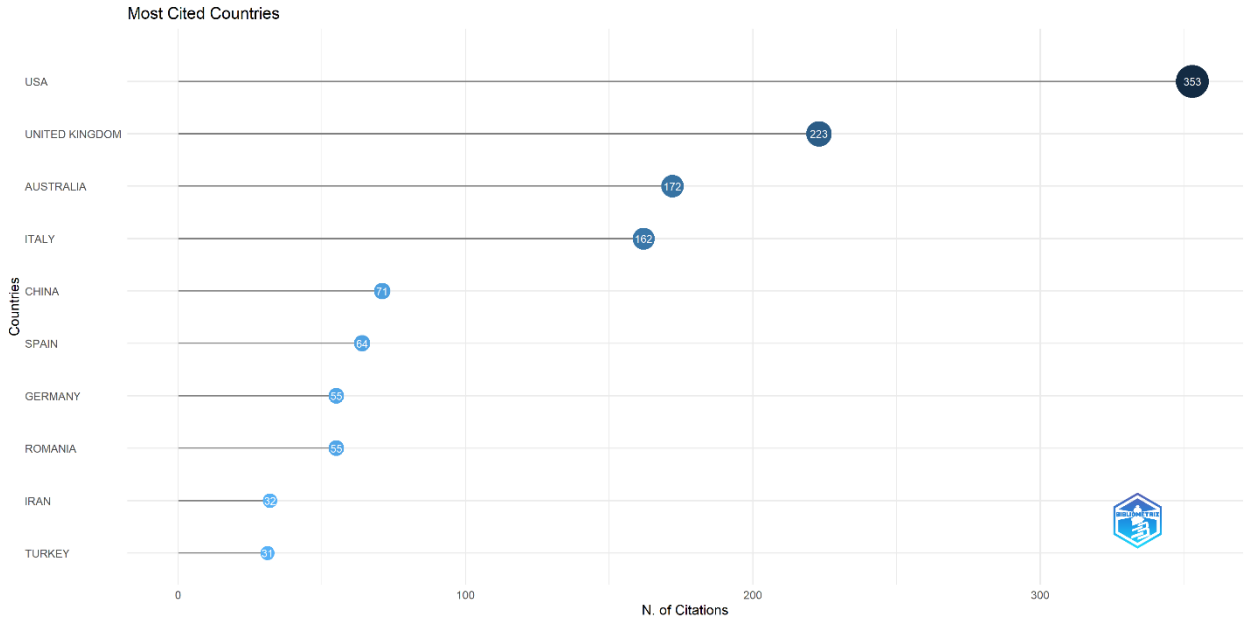

Figure 16. *Most Cited Countries.*

Figure 17 shows the countries that cooperate in document production. The world map uses the color blue, and the darker the blue, the more documents are produced. The thickness of the connection line between the countries also shows greater cooperation.

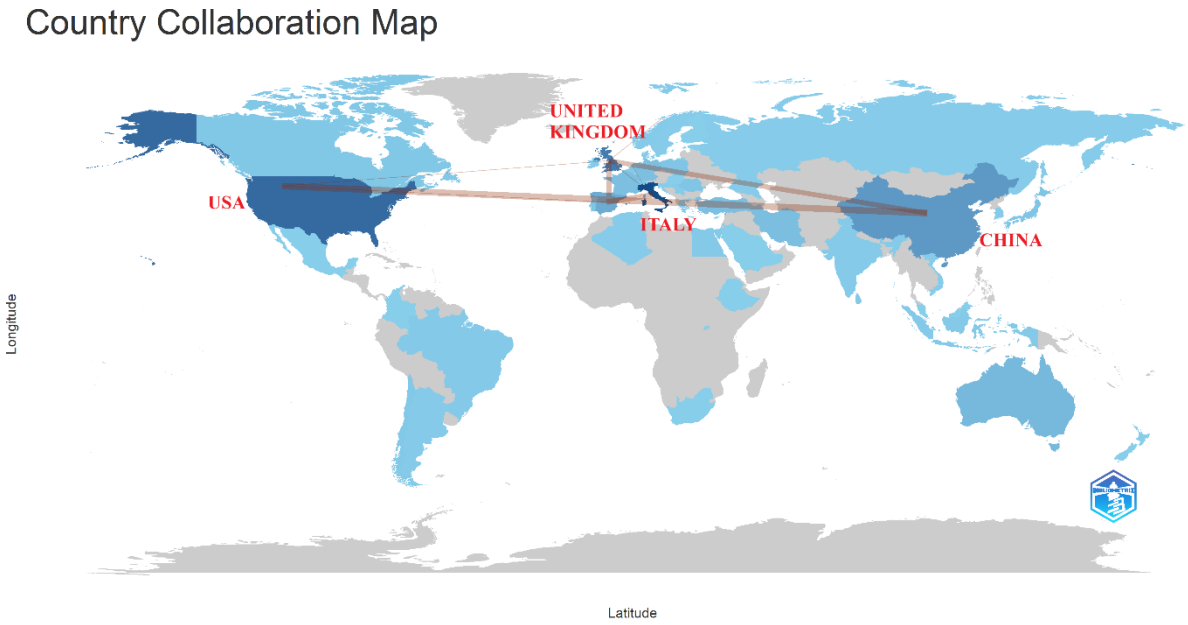

Figure 17. *Countries Collaborating in Document Production.*

A search of the Web of Science (WOS) database on 01.11.2024 to identify studies on resilience in architecture found 419 documents. The keywords used in these documents are listed in Figure 18.

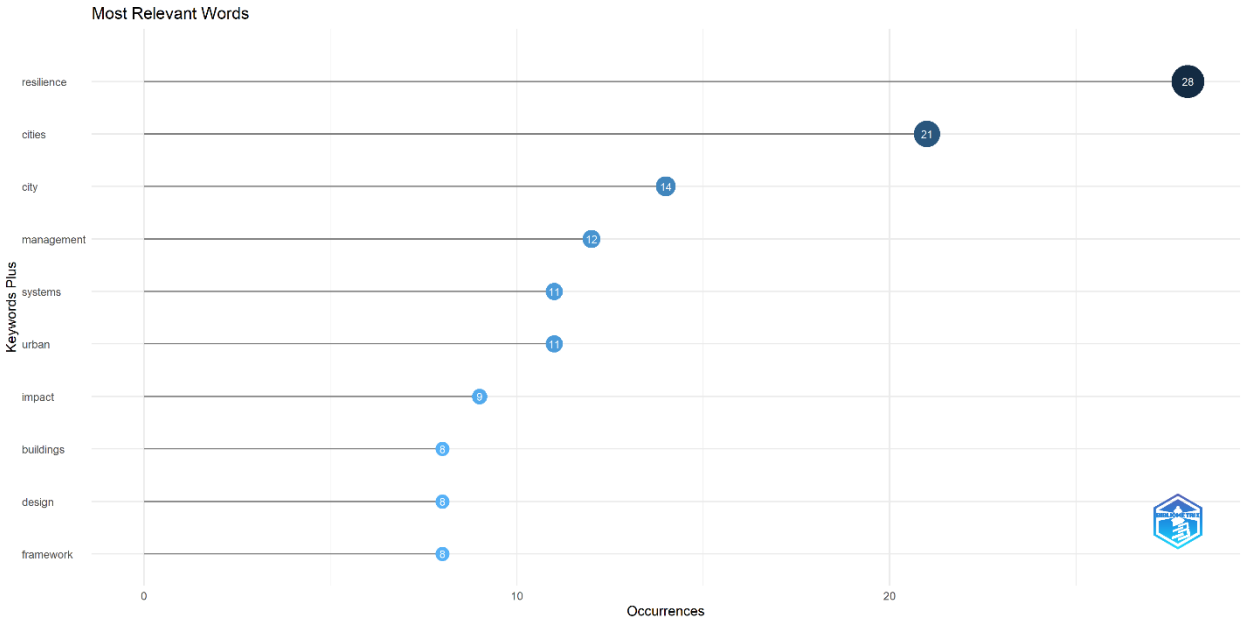

Figure 18. *Most Frequently Used Words.*

When Figure 18 is examined, “resilience”, also the subject of this research article, ranks first among the most frequently used words with 28 uses. “Cities” is used 21 times, “city” 14 times, and “management” 12 times in the documents. The authors' keywords (a), keywords plus (b), word clouds in titles (c) and abstracts (d) for keywords frequently used in studies on resilience in the field of architecture are shown in Figure 19.

Figure 19. *Word Clouds Related to Documents.*

A word cloud is a data visualisation technique used to represent the keywords of published documents, in which the size of each word indicates its frequency or importance. The term "author's keywords" is used to denote the topical and contextual inclinations of researchers in a given study [70, 71]. The "Keywords Plus" keyword structure is created by an automatic computer algorithm and consists of words that are frequently seen in the reference titles of a study [72]. It is worth noting that the keywords in the "Keywords Plus" structure do not necessarily have to be in the title of the study or in the keywords determined by the author. These keywords make it easier to capture the content of an article with more depth and variety [72]. Accordingly, it is seen that frequently used words are expressed in larger fonts than others, and the less frequently repeated words are expressed in smaller fonts. The word clouds are designed on the 50 most frequently repeated words in the studies produced. Word clouds with four different variables are shown in Figure 19. When Figure 19 (a) “authors’ keywords” are evaluated, “resilience” (101) ranks first as a keyword in the studies on resilience in the field of architecture. It is then seen that the frequently used keywords are “urban resilience”, “climate change”, “sustainability” and “landscape”. Figure 19 (b) “keywords plus” is evaluated, “resilience” is in the first rank with 28, and the keywords “cities”, “city”, “management” and “systems” are frequently used, respectively. Figure 19 (c) shows the keywords frequently used in the titles of the produced studies. Accordingly, “urban” is first (166), followed by “resilience” and “design”. Figure 19 (d) shows which words are frequently used in the abstarcts of the produced documents. In this word cloud, the word “urban” is first (961) followed by “resilience”, “design”, and “city”. As can be understood from these word clouds, city, sustainability, design and climate change are frequently used in urban resilience research. It is seen that the negativities experienced in cities due to climate change are also reflected in academic studies and that the city must have resilient systems on the path to sustainable development. Figure 20 shows the change and frequency of the words used in the field of architecture to describe resilience to the changing world and conditions, starting from the first study produced to the present day.

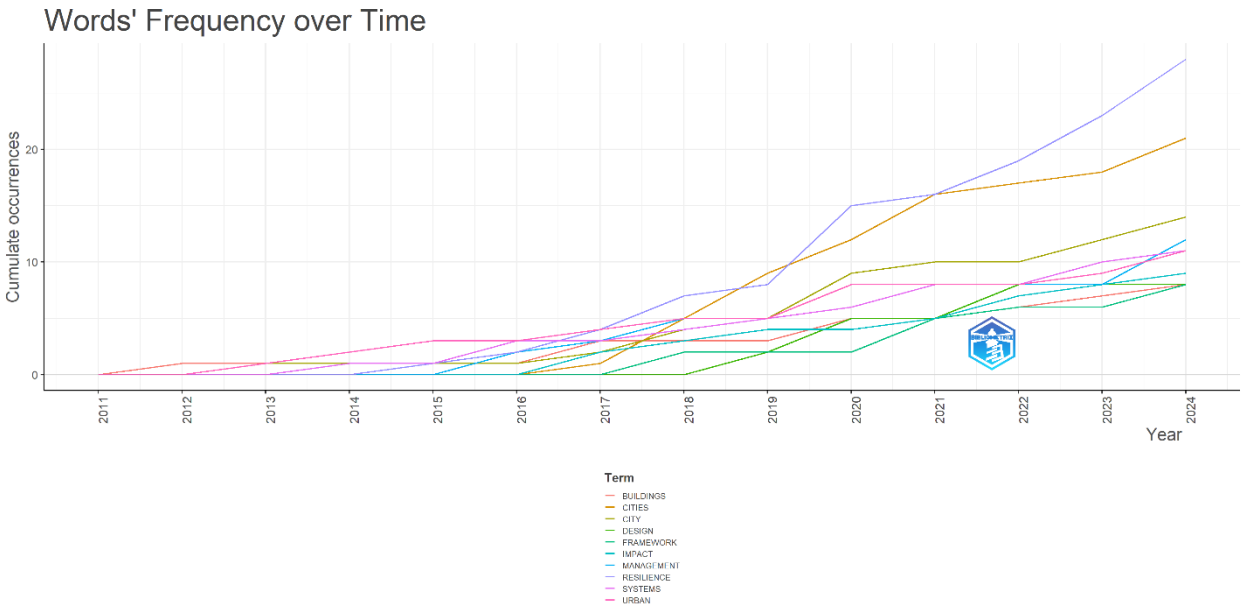

Figure 20. *Change in the Frequency of Use of Words Over Time.*

The trend status of the keywords used in the historical process is shown in Figure 21.

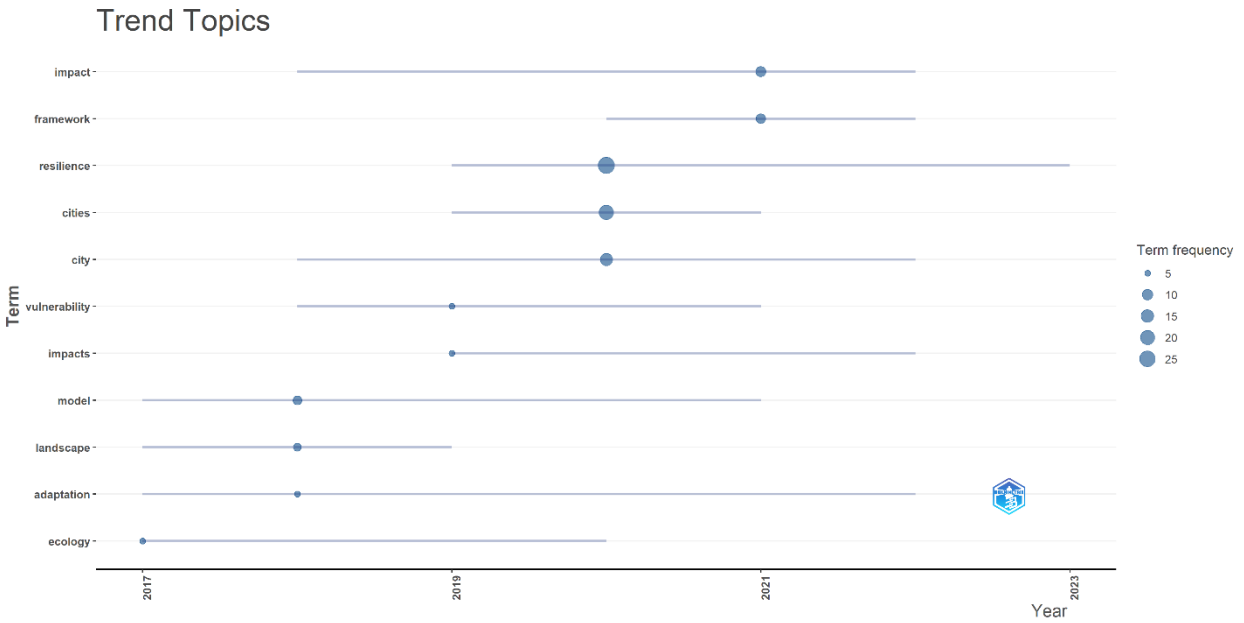

Figure 21. *Trend Keywords Over Time.*

The size of the circles in Figure 21 shows the frequency of use and the trend status. Accordingly, the word “resilience” became a trend in 2020. The network map in Figure 22 shows the frequently used and trending keywords as authors' keywords.

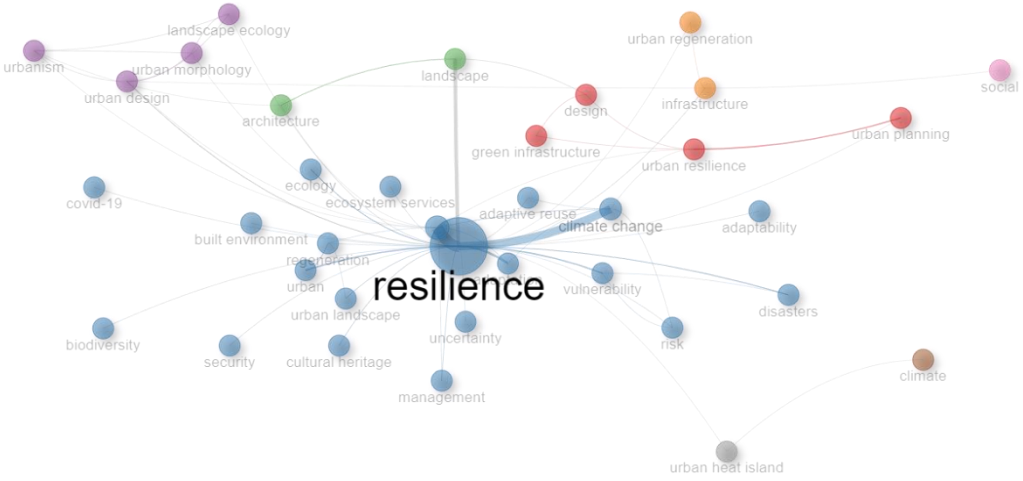

Figure 22. *Use of Keywords Together.*

When the use of authors' keywords are analyzed through the network map, it is seen that the word "resilience" is closely and directly related to keywords such as "climate change", "adaption", "urban" and indirectly related to words such as "design", "social", "urban regeneration" and "urban heat ısland". A Thematic map of the keywords used by the authors was created with the "biblioshiny for bibliometrix" software tool. Figure 23 shows the thematic map of the keywords used by the authors.

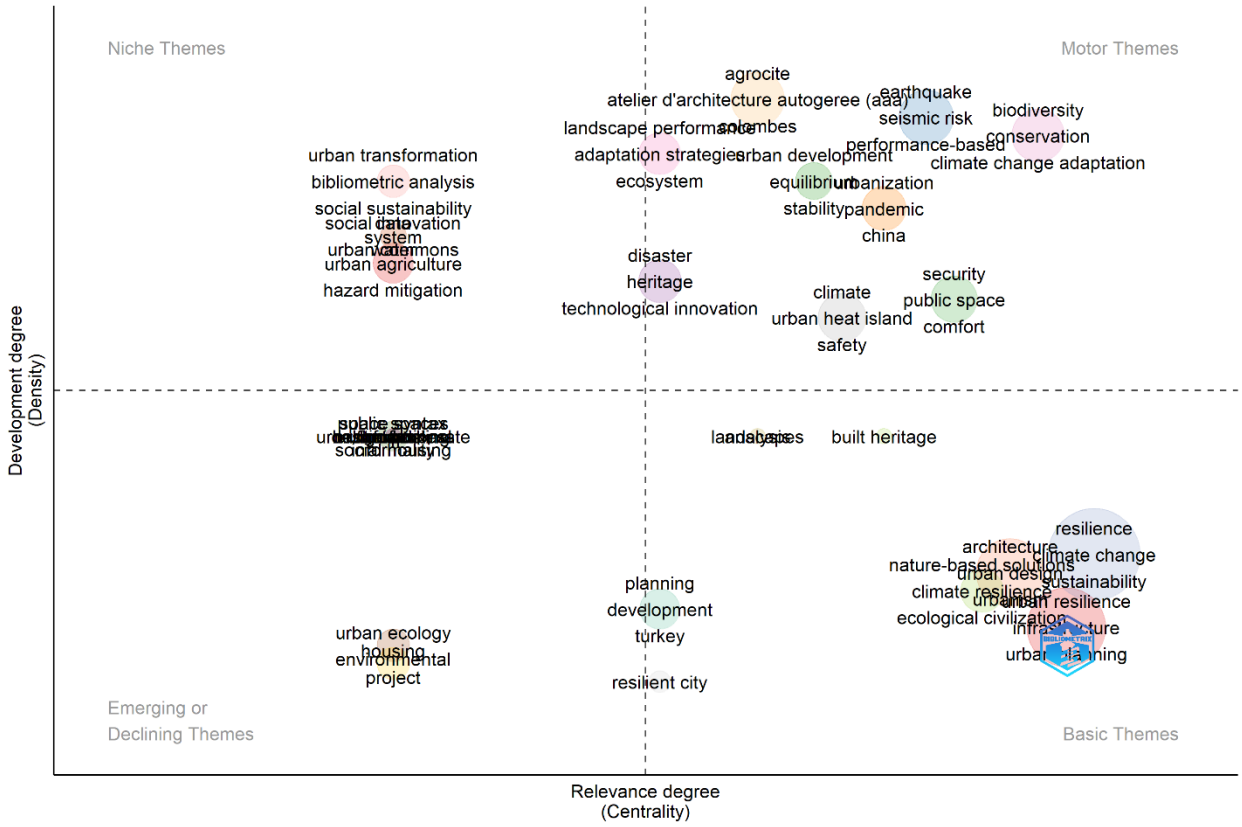

Figure 23. *Thematic Map Showing the Keywords Used by the Authors.*

Thematic map was used to analyze the importance and periodic development of the research theme. Thematic map was first used by Callon and his colleagues [73]. Thematic map is a coordinate system consisting of centrality (x-axis) and density (y-axis). Centrality measures the importance of the selected theme, and density measures the development of the selected theme [74, 70]. The centrality measure for a

given cluster is the density of its connections to other clusters. The more and stronger these connections are, the more this cluster determines a series of research problems that are vital to the scientific or technological community [73]. Density characterizes the strength of the connections that connect the words that make up the cluster. The stronger these connections are, the more coherent and integrated the research problems corresponding to the cluster are. Therefore, a research topic can be classified into 4 quadrants according to these two values, each representing a specific theme module, and thus the research topic can analyze where the keyword is and display its bibliographic data with a relevant keyword. This method is a necessary method for interpreting the thematic map and therefore research topics [73, 75, 76]. The thematic map is divided into four quadrants [74, 70]. In this thematic map, the degree of centrality is shown on the horizontal axis, and the degree of density is shown on the vertical axis. Accordingly, those close to the centre represent the keywords most used in the documents included in the analysis. In terms of density, the higher the keyword is, the more it is used. The keywords in the Basic Themes section are the most used critical keywords in all studies. The Motor Themes section shows the trending keywords in the studies produced in recent years. The Emerging or Declining Themes section represents the keywords that are not used much in the studies produced or that have newly emerged. These keywords either disappear or progress towards becoming a trend over time. The Niche Themes section shows that more work needs to be done on the keywords in this theme in studies on resilience; in other words, there is a gap and potential in the literature. From this thematic map, it becomes clear that in studies on resilience in the field of architecture, the keywords in the Basic Themes section should be scanned, the trending keywords in the Motor Themes section should be used in the studies produced, and the potential of the keywords in the Niche Themes section should also be evaluated.

5. CONCLUSION

In this research article, a bibliometric analysis of studies on resilience in architecture was conducted using the Web of Science (WOS) database. The "biblioshiny for bibliometrix" software tool was selected for the bibliometric analysis of the data belonging to these documents. The data from the documents were transferred to this software tool, and the visuals belonging to the analysis were obtained. According to the results of the analysis, general information about the documents was given first. According to the data obtained within the scope of the article, the documents produced on resilience in architecture were analyzed under five headings. First, the overview analysis included general information, annual document production, annual citation count, and analysis using the Sankey Diagram and triple area graph. Secondly, in the Source/journals analysis, the most productive source, the most cited source, source/journals impact and the analysis of the change in document production of the sources over time were included. Thirdly, in the author analysis, the most productive author, the most cited author and the countries of the responsible author/authors of the documents were analyzed. Fourthly, the countries cited the most, the countries that cooperate in document production and the change in the document production of the countries over time, are shown in the country analysis. Finally, the fifth analysis, the word analysis, includes the most used keywords, word cloud, words together, the change in the words used over time, trend topics and thematic map. As a result of the analysis, it was determined that there were 419 documents, the first document on the subject in the relevant field was produced in 2004, and the annual documents production rate was 14.31%. Although document production peaked in 2019 and there was a partial decrease in the following years, the interest in the subject in the field is constantly increasing. The prominent authors are Petrisor A.I., Romice O. and Bahrami F., the keywords "resilience", "climate change", and "urban resilience" are frequently used; the source "Landscape Architecture Frontiers" is the most preferred, "Landscape and Urban Planning" stands out with its number of citations, and the source " Landscape Journal" has the highest H-index impact value. It is seen that Italy ranks first among countries with 85 publications and that the interest in publications on resilience in the field of architecture in the USA and Italy have increased over time. It is seen that the keyword “resilience” is the most used keyword with 28 uses and that it is closely and directly related to keywords such as “climate change”, “adaption”, “urban” and indirectly related to words such as “design”, “social”, “urban regeneration” and “urban heat ısland”. The keywords “cities”, “city”, “sustainability” and “management” are frequently used in urban resilience research. It is seen that the negativities experienced in cities due to climate change are also reflected in academic studies and that the city must have resilient systems on the path to sustainable development. When the studies produced on resilience in the field of architecture are analyzed, it is seen that there are

only 11 documents from Turkey. Compared to other countries, it is seen that there has yet to be interest in resilience research in the field of architecture in Turkey. Increasing urban population and needs threaten critical systems in cities.

In some cases, these critical systems may be inadequate. With the increasing population, access to basic needs such as education and health, especially housing problems, becomes more difficult. Segregation in society, the stigma of poverty, isolation, low social harmony and dissatisfaction directly affect social sustainability. The negativities experienced due to climate change and global warming, the adverse effects of which are now more tangibly felt worldwide, directly and threaten cities. Cities are both the source of these negativities and also suffer from their consequences. The increase in urban population and the decrease in rural population lead to a food crisis, as agricultural production decreases. In this case, people migrate to cities more intensively to access food and employment. In this case, the building stock increases and global warming is experienced due to buildings. This spiral relationship continues in a cycle. Steps that will stop this cycle or reduce the intensity of the relationship should be taken by local governments and central government. Intensive migration is predicted only to occur if people are provided equal opportunities for employment and housing in their settlements. Local governments, the closest administrative unit to the people, should act with the principle of partnership and participation and include the individual in critical systems without separating from society. Since resilience is defined as the ability of critical systems in a city to respond to sudden shocks and stresses, the importance of the resilience of critical systems in a city becomes evident in a sudden disaster. These natural disasters have historically caused migrations, epidemics, housing problems and food crises. For this reason, for a city's critical systems to be sustainable, it must have a primarily resilient structure. Academically, more emphasis should be placed on resilience studies, especially in the field of architecture.

REFERENCES

[1] URL-1. *UNDRR*. https://www.undrr.org/terminology/critical-infrastructure Last Accessed: 01.10.2024

[2] Rathnayaka, B., Robert, D., Siriwardana, C., Adikariwattage, V.V., Pasindu, H.R., Setunge, S. & Amaratunga, D. (2023). Identifying and prioritizing climate change adaptation measures in the context of electricity, transportation and water infrastructure: a case study, Int. J. *Disaster Risk Reduc. 99*, 104093, https://doi.org/10.1016/J.IJDRR.2023.104093

[3] Rajapaksha, D., Rathnayaka, B. Siriwardana, C. & L. Rajapakse (2023). A Systematic Literature Review on Climate Change Adaptation Measures for Coastal Built Environment, *Springer Nature*, Singapore, https://doi.org/10.1007/978-981-99-3471-3_44

[4] Pasindu, D., Rathnayaka B., Rajapaksha, D., Siriwardana, C. & Rajapaskse, L. (2023). The Role of Professionals Involved in the Built Environment in Contributing to Climate Change Adaptation in Sri Lanka, *Springer Nature*, Singapore, https://doi.org/10.1007/978-981-99-3471-3_43

[5] Guo, D., Shan, M. & Owusu, E.K. (2021). Resilience assessment frameworks of critical infrastructures: state-of-the-art review, *Build 11* (10)464, https://doi.org/10.3390/buildings11100464

[6] Ouyang, M. (2014). Review on modeling and simulation of interdependent critical infrastructure systems, *Reliab. Eng. Syst. Saf. 121*, 43–60, https://doi.org/10.1016/j.ress.2013.06.040

[7] Tachaudomdach, S., Upayokin, A., Kronprasert, N. & Arunotayanun, K. (2021). Quantifying road-network robustness toward flood-resilient transportation systems, *Sustain. Times 13* (6), 3172, https://doi.org/10.3390/SU13063172

[8] Perera, U.S., Siriwardana, C. & Pitigala Liyana Arachchi, I.S. (2022). Development of critical infrastructure resilience index for cities in Sri Lanka, Int. J. Disaster Resil. *Built Environ.*, https://doi.org/10.1108/IJDRBE-01-2022-0007

[9] Yang, Z., Barroca, B., Weppe, A., Bony-Dandrieux, A., Laffréchine, K., Daclin, N., November, V., Omrane, K., Kamissoko, D., Benaben, F., Dolidon, H., Tixier, J. & Chapurlat,V. (2023). Indicator-based resilience assessment for critical infrastructures – a review, *Saf. Sci. 160* 106049, https://doi.org/10.1016/J. SSCI.2022.106049

[10] Rehak, D., Senovsky, P., Hromada, M. & Lovecek, T. (2019). Complex approach to assessing resilience of critical infrastructure elements, Int. J. Crit. *Infrastruct. Prot. 25*, 125–138, https://doi.org/10.1016/J.IJCIP.2019.03.003

[11] Flynnova, L., Paulus, F. & Valasek, J. (2022). Threats and resilience: methodology in the area of railway infrastructure, *in: 2022 IEEE International Carnahan Conference on Security Technology, ICCST 2022*, Vsb - Technical University of Ostrava, Faculty of Safety Engineering, Ostrava, Czech Republic, Institute of Electrical and Electronics Engineers Inc., https://doi.org/10.1109/ICCST52959.2022.9896580

[12] Rehak, D., Hromada, M. & Ristvej, J. (2017). Indication of critical infrastructure resilience failure, *in: 27th European Safety and Reliability Conference*, ESREL 2017, C. M. And B. R., Eds., Faculty of Safety Engineering, VSB-Technical ˇ University of Ostrava, Ostrava, Czech Republic, CRC Press/Balkema, pp. 963–970, https://doi.org/10.1201/9781315210469-124

[13] Sharifi, A. (2023). Resilience of urban social-ecological-technological systems (SETS): a review, *Sustain. Cities Soc. 99*, 104910, https://doi.org/10.1016/J. SCS.2023.104910

[14] Chen, X., Yu, L., Lin, W., Yang, F., Li, Y., Tao, J. & Cheng, S. (2023). Urban resilience assessment from the multidimensional perspective using dynamic Bayesian network: a case study of Fujian Province, China, *Reliab. Eng. Syst. Saf.*, 109469, https://doi.org/10.1016/J.RESS.2023.109469

[15] Ribeiro, P.J.G. & Pena Jardim Gonçalves, L.A. (2019). Urban resilience: a conceptual framework, *Sustain. Cities Soc. 50*, 101625, https://doi.org/10.1016/J. SCS.2019.101625

[16] Escorcia Hernandez, J.R., Torabi Moghadam, S., Sharifi, A. & Lombardi, P. (2023). Cities in the times of COVID-19: trends, impacts, and challenges for urban sustainability and resilience, *J. Clean. Prod. 432*, 139735, https://doi.org/10.1016/J.JCLEPRO.2023.139735

[17] Sathurshan, M., Saja, A., Thamboo, J., Haraguchi, M. & Navaratnam, S. (2022). Resilience of critical infrastructure systems: a systematic literature review of measurement frameworks, *Infrastructures 7* (5), https://doi.org/10.3390/infrastructures7050067

[18] Hosseini S., Barker, K. & Ramirez-Marquez, J.E. (2016). A review of definitions and measures of system resilience, *Reliab. Eng. Syst. Saf. 145*, 47–61, http://dx.doi.org/10.1016/j.ress.2015.08.006

[19] Shamsipour, A., Johanshahi, A., Mousavi, S.S., Shoja, F., Golenji, R. A., Tayebi, S., Alavi, S. A. & Sharifı, A. (2024). Assessing and mapping urban ecological resilience using the loss-gain approach: a case study of Tehran, Iran, *Sustain. Cities Soc. 103*, 105252, https://doi.org/10.1016/J.SCS.2024.105252

[20] Sharifi, A. & Yamagata, Y. (2017). Towards an integrated approach to urban resilience assessment, *APN Sci. Bull. 7* (1), https://doi.org/10.30852/sb.2017.182

[21] Cutter, S. L., Ahearn, J. A., Amadei, B., Crawford, P., Eide, E. A., Galloway, G. E., Goodchild, M. F., Kunreuther, H. C., Li-Vollmer, M., Schoch-Spana, M., Scrimshaw, S. C., Stanley, E. M., Whitney, G., & Zoback, M. L. (2013). Disaster resilience: A national imperative. *Environment, 55(*2), 25-29. https://doi.org/10.1080/00139157.2013.768076

[22] Rathnayaka, B., Siriwardana, C. S. A., Robert, D., Amaratunga, D., & Setunge, S. (2022). Improving the resilience of critical infrastructures: Evidence-based insights from a systematic literature review. *International Journal of Disaster Risk Reduction, 78*, [103123]. https://doi.org/10.1016/j.ijdrr.2022.103123

[23] Bocchini, P., Frangopol, D.M., Ummenhofer, T. & Zinke, T. (2014). Resilience and sustainability of civil infrastructure: toward a unified approach, *J. Infrastruct. Syst. 20* (2), 04014004, https://doi.org/10.1061/(ASCE)IS.1943-555X.0000177

[24] Argyroudis, S. A., Mitoulis, S. A., Hofer, L., Zanini, M. A., Tubaldi, E., & Frangopol, D. M. (2020). Resilience assessment framework for critical infrastructure in a multi-hazard environment: Case study on transport assets. The Science of the total environment, 714, 136854. https://doi.org/10.1016/j.scitotenv.2020.136854

[25] Yang, Z., Barroca, B., Bony-Dandrieux, A., & Dolidon, H. (2022). Resilience Indicator of Urban Transport Infrastructure: A Review on Current Approaches. Infrastructures, 7(3), 33. https://doi.org/10.3390/infrastructures7030033

[26] Imani, M., & Hajializadeh, D. (2020). A resilience assessment framework for critical infrastructure networks' interdependencies. Water science and technology : a journal of the International Association on Water Pollution Research, 81(7), 1420–1431. https://doi.org/10.2166/wst.2019.367

[27] Panda, A. & Ramos, J.N. (2020). Making Critical Infrastructure Resilient: Ensuring Continuity of Service Policy and Regulations in Europe and Central Asia, www.undrr.org

[28] URL-2. *Climate And Disaster Resilient Infrastructure : Building Resilience To Future Uncertainties.* *https://knowledge.unasiapacific.org/our-work/knowledge-resources/climate-and-disaster-resilient-infrastructure-building-resilience* Last Accessed: 01.11.2024

[29] URL-3. *Global Assessment Report on Disaster Risk Reduction*. https://gar.undrr.org/sites/default/files/reports/2019-05/full_gar_ report.pdf Last Accessed: 25.10.2024

[30] Amantini, A., Chora´s, M., D'Antonio, S., Egozcue, E., Germanus, D. & Hutter, R. (2012). The human role in tools for improving robustness and resilience of critical infrastructures, Cognit. *Technol. Work 14* (2), 143–155, https://doi.org/10.1007/s10111-010-0171-2

[31] Heglund, J., Hopkinson, K. M., & Tran, H. T. (2021). Social sensing: towards social media as a sensor for resilience in power systems and other critical infrastructures. Sustainable and Resilient Infrastructure, 6(1-2), 94-106. https://doi.org/10.1080/23789689.2020.1719728

[32] URL-4. *Sendai Framework for Disaster Risk Reduction 2015 – 2030.* https://www.undrr.org/publication/sendai-framework-disaster-risk-reduction-2015-2030 Last Accessed: 23.10.2024

[33] Ashrafi, B., Naseri, M. & Barabady, J. (2022). Resilience of a transportation network: importance of vulnerable nodes, *in: 16th International Conference on Probabilistic Safety Assessment and Management, PSAM 2022,* UiT, the Arctic University of Norway, Tromsø, Norway: International Association for Probablistic Safety Assessment and Management (IAPSAM).

[34] Wang, J., Zuo, W., Rhode-Barbarigos, L., Lu, X., Wang, J., & Lin, Y. (2019). Literature review on modeling and simulation of energy infrastructures from a resilience perspective. Reliability Engineering and System Safety, 183, 360-373. https://doi.org/10.1016/j.ress.2018.11.029

[35] Osei-Kyei, R., Almeida, L. M., Ampratwum, G., & Tam, V. (2022). Systematic review of critical infrastructure resilience indicators. Construction Innovation, 1210-1231. https://doi.org/10.1108/CI-03-2021-0047

[36] Øien, K., Bodsberg, L.& Jovanovi´c, A. (2018). Resilience assessment of smart critical infrastructures based on indicators, in: G.C.H.S.B.A.V.J.E. van, T. K (Eds.), *28th International European Safety and Reliability Conference, ESREL 2018*, SINTEF Technology and Society, CRC Press/Balkema, Trondheim, Norway, pp. 1269–1278.

[37] Raoufi, H. & Vahidinasab, V. (2021). Power system resilience assessment considering critical infrastructure resilience approaches and government policymaker criteria, IET Gener. *Transm. Distrib. 15* (20), 2819–2834, https://doi.org/10.1049/gtd2.12218

[38] Ouyang, M. (2014). Review on modeling and simulation of interdependent critical infrastructure systems, *Reliab. Eng. Syst. Saf. 121*, 43–60, https://doi. org/10.1016/J.RESS.2013.06.040

[39] Sharifi, A. (2020). Urban resilience assessment: mapping knowledge structure and trends, *Sustain. Times 12* (15), 5918, https://doi.org/10.3390/SU12155918

[40] Rus, K., Kilar, V. & Koren, D. (2018). Resilience assessment of complex urban systems to natural disasters: a new literature review, *Int. J. Disaster Risk Reduc. 31*, 311–330, https://doi.org/10.1016/J.IJDRR.2018.05.015

[41] Holling, C. S. (1973). Resilience and Stability of Ecological Systems. *Annual Review of Ecology and Systematics*, *4*, 1–23. http://www.jstor.org/stable/2096802

[42] Alberti, M. (1999). Urban Patterns and Environmental Performance: What Do We Know? *Journal of Planning Education and Research, 19,* 151 – 163, https://doi.org/10.1177/0739456X9901900205

[43] Sharifi, A., Yamagata, Y. (2016). Urban Resilience Assessment: Multiple Dimensions, Criteria, and Indicators. In: Yamagata, Y., Maruyama, H. (eds) Urban Resilience. *Advanced Sciences and Technologies for Security Applications. Springer*, Cham. https://doi.org/10.1007/978-3-319-39812-9_13

[44] Tong, P. (2021). Characteristics, dimensions and methods of current assessment for urban resilience to climate-related disasters: a systematic review of the literature, *Int. J. Disaster Risk Reduc.*, 102276, https://doi.org/10.1016/j.ijdrr.2021.102276

[45] Meerow, S., Newell, J. P., & Stults, M. (2016). Defining urban resilience: A review. Landscape and Urban Planning, 147, 38-49. https://doi.org/10.1016/j.landurbplan.2015.11.011

[46] Sharifi, A. (2016). A Critical Review of Selected Tools for Assessing Community Resilience. *Ecological Indicators, 69,* 629-647. https://doi.org/10.1016/j.ecolind.2016.05.023

[47] URL-5. *OECD. Organisation for Economic Co-Operation and Development.* https://www.oecd.org/cfe/regionaldevelopment/resilient-cities.htm Last Accessed: 23.10.2024

[48] Alyami, S. H., Abd El Aal, A. K., Alqahtany, A., Aldossary, N. A., Jamil, R., Almohassen, A., Alzenifeer, B. M., Kamh, H. M., Fenais, A. S., & Alsalem, A. H. (2023). Developing a Holistic Resilience Framework for Critical Infrastructure Networks of Buildings and Communities in Saudi Arabia. Buildings, 13(1), 179. https://doi.org/10.3390/buildings13010179

[49] Molarius, R., Keränen, J., Kekki, T., & Jukarainen, P. (2022). Developing Indicators to Improve Safety and Security of Citizens in Case of Disruption of Critical Infrastructures Due to Natural Hazards—Case of a Snowstorm in Finland. Safety, 8(3), 60. https://doi.org/10.3390/safety8030060

[50] Shehara, P. L. A. I., Siriwardana, C. S. A., Amaratunga, D., & Haigh, R. (2021). Development of a Framework to Examine the Transportation Infrastructure Resilience: Sri Lankan Context. In R. Dissanayake, P. Mendis, K. Weerasekera, S. De Silva, & S. Fernando (Eds.), ICSBE 2020 - Proceedings of the 11th International Conference on Sustainable Built Environment (Vol. 174, pp. 235-258). (Lecture Notes in Civil Engineering; Vol. 174). Springer Singapore. https://doi.org/10.1007/978-981-16-4412-2_18

[51] Roe, E. & Schulman, P.R. (2012). Toward a comparative framework for measuring resilience in critical infrastructure systems, *J. Comp. Policy Anal. Res. Pract. 14 (2),* 114–125, https://doi.org/10.1080/13876988.2012.664687

[52] Rahi, K. (2018). Indicators to assess organizational resilience – a review of empirical literature, *International Journal of Disaster Resilience in the Built Environment,* Vol. 10 No. 2/3, pp. 85-98. https://doi.org/10.1108/IJDRBE-11-2018-0046

[53] Yang, Z., Barroca, B., Weppe, A., Bony-Dandrieux, A., Laffréchine, K., Daclin, N., November, V., Omrane, K., Kamissoko, D., Benaben, F., Dolidon, H., Tixier, J., & Chapurlat, V. (2023). Indicator-based resilience assessment for critical infrastructures – *a review, Saf. Sci. 160,* https://doi.org/10.1016/j.ssci.2022.106049

[54] Dhar, T.K. & Khirfan, L. (2017). A multi-scale and multi-dimensional framework for enhancing the resilience of urban form to climate change, *Urban Clim. 19*, 72–91, https://doi.org/10.1016/J.UCLIM.2016.12.004

[55] Petrun Sayers, E. L., Anthony, K. E., Tom, A., Kim, A. Y., & Armstrong, C. (2022). 'We will rise no matter what': community perspectives of disaster resilience following Hurricanes Irma and Maria in Puerto Rico. Journal of Applied Communication Research, 51(2), 126–145. https://doi.org/10.1080/00909882.2022.2069473

[56] Kaluarachchi, Y. (2018). Building community resilience in the Re-settlement of displaced communities, Procedia Eng. 212, 443–450, https://doi.org/10.1016/j.proeng.2018.01.057

[57] Jayasiri, G. P., Siriwardena, C., Hettiarachchi, S., Dissanayake, P., & Bandara, C. (2018). Evaluation of Community Resilience Aspects of Sri Lankan Coastal Districts. International Journal on Advanced Science, Engineering and Information Technology, 8(5), 2161–2167. https://doi.org/10.18517/ijaseit.8.5.7095

[58] Koliou, M., van de Lindt, J. W., McAllister, T. P., Ellingwood, B. R., Dillard, M., & Cutler, H. (2018). State of the research in community resilience: progress and challenges. Sustainable and resilient infrastructure, No Volume, 10.1080/23789689.2017.1418547. https://doi.org/10.1080/23789689.2017.1418547

[59] Wells, E.M., Boden, M., Tseytlin, I., & Linkov, I. (2022). Modeling critical infrastructure resilience under compounding threats: A systematic literature review. Progress in Disaster Science. https://doi.org/10.1016/j.pdisas.2022.100244

[60] Dobie, S., Schneider, J. & Szafranski, A. (2019). Going beyond the Waffle House index: using food systems as an indicator of community health and sustainability, *in: 2019 IEEE International Symposium on Technologies for Homeland Security, HST 2019*, A. Alfred Taubman College of Architecture and Urban Planning, University of Michigan, Ann Arbor, MI, United States: Institute of Electrical and Electronics Engineers Inc., https://doi.org/10.1109/HST47167.2019.9032922

[61] Narieswari, L., Sitorus, S.R., Hardjomidjojo, H., & Putri, E.I. (2021). Assessment of disaster resilience in Semarang City. IOP Conference Series: Earth and Environmental Science, 771. https://doi.org/10.1088/1755-1315/771/1/012026

[62] Kusumastuti, R. D., Viverita, Husodo, Z. A., Suardi, L., & Danarsari, D. N. (2014). Developing a resilience index towards natural disasters in Indonesia. International Journal of Disaster Risk Reduction, 10(PA), 327-340. https://doi.org/10.1016/j.ijdrr.2014.10.007

[63] Cimellaro, G. P. (2016). *Urban Resilience for Emergency Response and Recovery:* Fundamental Concepts and Applications. Springer International Publishing: Imprint: Springer. https://doi.org/10.1007/978-3-319-30656-8

[64] Pritchard, A. (1969). *Statistical bibliography or bibliometrics.* Journal of Documentation, 25(4), 348-349.

[65] Ruhanen, L., Weiler, B., Moyle, B. D., & McLennan, C. lee J. (2015). Trends and patterns in sustainable tourism research: a 25-year bibliometric analysis. Journal of Sustainable Tourism, 23(4), 517–535. https://doi.org/10.1080/09669582.2014.978790

[66] URL-6. *Web of Science.* https://www.webofscience.com/WoS/WoScc/basic-search Last Accessed: 01.11.2024

[67] Wang, J., & Liu, Z. (2014). A Bibliometric Analysis on Rural Studies in Human Geography and Related Disciplines. Scientometrics, 101, 39-59. http://dx.doi.org/10.1007/s11192-014-1388-2

[68] Kiriyama, E., & Kajikawa, Y. (2014). A multilayered analysis of energy security research and the energy supply process. *Appl Energy*, *123*, 415–423. https://doi.org/10.1016/j.apenergy.2014.01.026.

[69] Aria, M. and Cuccurullo, C. (2017) Bibliometrix: An R-tool for Comprehensive Science Mapping Analysis. *Journal of Informetrics*, *11*, 959-975. https://doi.org/10.1016/j.joi.2017.08.007

[70] Nasir, A., Shaukat, K., Hameed, I. A., Luo, S., Alam, T. M., & Iqbal, F. (2020). A bibliometric analysis of corona pandemic in social sciences: A review of influential aspects and conceptual structure. *IEEE Access*, 8, 133377–133402.

[71] Wang, J., & Zhang, S. (2022). Cross-Cultural Learning: A visualized bibliometric analysis based on bibliometrix from 2002 to 2021. *Mobile Information Systems*, 1– 11.

[72] Zhang, J., Yu, Q., Zheng, F., Long, C., Lu, Z., & Duan, Z. (2016). Comparing keywords plus of WOS and author keywords: A case study of patient adherence research. *Journal of the Association for Information Science and Technology*, 67(4), 967-972.,

[73] Callon, M., Courtial, J. P., & Laville, F. (1991). Co-word Analysis as a Tool for Describing the Network of Interactions Between Basic and Technological Research: The Case of Polymer Chemsitry. *Scientometrics*, 22(1), 155-205.

[74] Cobo, M. J., López-Herrera, A. G., Herrera-Viedma, E., & Herrera, F. (2011). Science Mapping Software Tools: Review, Analysis, and Cooperative Study Among Tools. *Journal of the American Society for Information Science and Technology*, 62(7), 1382-1402.

[75] Yu, J., & Muñoz-Justicia, J. (2020). A Bibliometric Overview of Twitter-Related Studies Indexed in Web of Science. *Future Internet*, 12(5), 91.

[76] Seyhan, F. ve Özzeybek Taş, M. (2021). Sağlık Turizmi Konusunda Yapılan Çalışmaların "R Tabanlı" Bibliyometrix Analizi. *International Social Sciences Studies Journal*, 7(81), 1569-1586.