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RESEARCH ON THE SOCIAL INFRASTRUCTURE: BIBLIOMETRIC ANALYSIS FROM 1990 – 2024

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Abstract: *Bibliometric studies have been utilized as analysis tools to explore publications and scientific research on the topic, from the novelty of scientific maps to the scheme of the bibliometric. Meanwhile, the systematic procedural explained in the series of bibliometrics, on the other hand, needs to be conducted by the researchers. However, the concise research procedure on bibliometric analysis is a valuable tool to project research gaps, tentative trends, co-occurrence, and authorship. The topic chosen is social infrastructure, which needs to be identified for bibliometric analysis. Consequently, the paper aims to conduct a comprehensive bibliometric of social infrastructure. Collected data from Scopus include 4,111 publications retrieved from the database. Moreover, bibliometrics has a couple of significant analyses of the domain (level of analysis) and knowledge structure. The results indicated a remarkable footprint for social infrastructure research involving authors, sources, and publications following this subject. Likewise, the nation and association produced significant efforts towards the subject. Consecutively, the science mapping approach was thoroughly confiscated, including social infrastructure-related research, intellectual research, and the structure of the topic. In-depth overviews and notions connected to social infrastructure are valid sources for study and practice.*

Keywords: *Bibliometric Analysis, Domain, Scientific Structure, Social Infrastructure.*

Abstrak: Studi bibliometrik telah digunakan sebagai alat analisis untuk mengeksplorasi publikasi dan penelitian ilmiah tentang topik, dari kebaruan peta ilmiah sesuai dengan skema bibliometrik. Sementara itu, prosedur sistematis yang dijelaskan dalam seri bibliometrik di sisi lain jarang dilakukan oleh para peneliti. Meskipun demikian, prosedur penelitian yang ringkas pada analisis bibliometrik menjadi alat yang berguna untuk memproyeksikan kesenjangan penelitian, tren sementara, ko-terjadinya, dan kepemilikan, dll. Topik yang dipilih adalah infrastruktur sosial yang jarang diidentifikasi untuk analisis bibliometrik. Oleh karena itu, makalah ini bertujuan untuk melakukan bibliometrik komprehensif tentang infrastruktur sosial. Data yang dikumpulkan dari Scopus mencakup 4.111 publikasi yang diambil dari database. Selain itu, bibliometrik memiliki beberapa analisis utama dari domain (tingkat analisis) dan struktur pengetahuan. Hasil yang ditunjukkan sebagai jejak yang luar biasa untuk penelitian infrastruktur sosial yang melibatkan penulis, sumber, dan publikasi sesuai dengan subjek ini. Demikian pula, negara dan asosiasi menghasilkan upaya yang signifikan terhadap subjek tersebut. Secara berurutan, pendekatan pemetaan ilmiah diambil dari penelitian terkait infrastruktur sosial, intelektual, dan struktur topik. Gambaran dan gagasan mendalam yang terkait dengan infrastruktur sosial, menjadi sumber yang valid untuk studi dan praktik.

Kata Kunci: Analisis Bibliometrik, Domain, Infrastruktur Sosial, Struktur Ilmiah.

I. Introduction

It is long and lasting thoughts that are acknowledged as social cohesion develops through repetitive human activities and joint participation in shared projects, not merely from a principled pledge to examine abstract values (Klinenberg, 2018: 16). The society and its environment are interconnected through social cohesion and the public realm, and vice versa. The public sphere significantly impacts individuals and society, encompassing the social infrastructure and its associated values (Luqman et al., 2021) , regarding how social infrastructure was present.

Social infrastructure is places that allow people to gather (Latham & Layton, 2022). Moreover, the ethos behind social infrastructure helps to construct inclusivity rather than satisfy instrumental needs (Iglesias-Pascual et al., 2023). Therefore, facilitating living matters such as physical home characteristics, proper neighborhoods, proximity to school, public transport, and sustainable development increases people's satisfaction with their real estate and affects their quality of life (Grum & Kobal Grum, 2020). Klinenberg' discovery of the underappreciated role of social infrastructure in modern society the backlash thoroughly the research only conducted for a limited range as the concept predominately on the research trend (Klinenberg, 2018; Latham & Layton, 2019; Layton & Latham, 2022). Meanwhile, science mapping appears scarce and is acknowledged as lacking in measurement.

Social infrastructure is a broader means of place and public institutions where people interact and foster humanity in their social community. Hereafter, the concept was not merely into the advanced ground of research development, but it did otherwise, which included "left-behind places." The social infrastructure emphasized empowering these places for society improvement and continuously rejuvenating public institutions that were untouched into more fruitful within their function (Tomaney et al., 2023). This urge matters with the wider range of understanding as the concept is not merely visioned about social interaction but more to develop and build a resilient community and the physical place (Pavan et al., 2022; Tomaney et al., 2023). Social Infrastructure must be in place early for community well-being to create opportunities for different social backgrounds, races, sexualities, and religions (Wai et al., 2013). Whereas robust community and infrastructure develop according to their neighborhood, people gather at some places, keep in touch, and persuade to talk to each other as critical factors which social infrastructure values lived in there.

Moreover, social infrastructure is the lost piece of the puzzle and a place for everyone to complete a fractured society (Klinenberg, 2018). In addition, for a diverse and complex society that requires large amounts of capital in terms of development itself, physical infrastructure alone wouldn't be enough to overcome various challenges due to a lack of understanding of social and human values.

On the other hand, social infrastructure challenged conventional logical experience from the only physical, which was named after oil and metal and consisted of the ingredients of infrastructure (Kerstetter et al., 2023). It went beyond reaching individuals and society who used physical infrastructure to improve living matter, as explained by numerous notions. Amount of extensive development in the urge to be projected beyond physical improvements, yet the city, rural, village, and hinterland areas are affected by social infrastructure spheres to make sure the enhancement is well implemented (Ekawati & Rahmawati, 2023; Maria et al., 2023; Saraswati et al., 2023).

The fundamentals and stances were sketched before being consecutively taken action by the government. However, as one of the providers, government action could be adequate to provide social infrastructure as a public service from their policy. Governments constantly acknowledge the need for better integration across social infrastructure (Australian Infrastructure Audit, 2019), which clarifies how the state reacted to the social infrastructure matter to whom it provided for their citizens afterwards. The strict social planning arranged by the set of policies holds responsibility for concentrated areas to uphold community, reduce crime, and the public services area to overcome serious problems before they happen (Hollis et al., 2023; Klinenberg, 2018). Social infrastructure is defined by the context of policy frameworks, substantial planning, and social issues measurement, which requires constitution-based formulation for its enforcement.

After that, social infrastructure is the balancing principle to overcome critical problems due to uncertainty of social problems, to whom society is inclined to be a 'safe place' for everyone. The instrument consisted of physical, government, private, and societal action within the social infrastructure. Hence, the broader perspectives emphasized public space with extensive human values (Klinenberg, 2018; Parker et al., 2023; Singh, 2022). It is a social Infrastructure sketched in communal capacity building to build an environment and study the spaces and places that support social life (Latham & Layton, 2022). This notion for research is inclined toward capacity, social life, and physical infrastructure utilities in terms of public

spaces. Social infrastructure repositions the public space perspective following the research of both social and engineering, upholding valuable spheres of the societal problem related to the physical solution (Baldwin & Stafford, 2019). According to Latham & Layton (2022), cooperation capacity will not arise without infrastructure provision. Infrastructure provision is one of the core elements of social infrastructure that replaces physically oriented limitations from maintenance and operation to further social participation and direct participation of the surrounding community. Hence, the growth and development of social infrastructure research, which incorporated social, humanity, science, and engineering projects, directly affected sustainable development drawn from these subjects (Qi et al., 2023). Many scholars have found that this collaborative effort effectively engages the capacities and development for social infrastructure creation and governance (Latham & Layton, 2022).

To set a research and scientific mapping across related literature, which would be pivotal, and the notion of social infrastructure research, with scientific matter, could use this paper as a guide on the subject. The review will address three specific goals, such:

(1) Obtain comprehensive knowledge and analyze the scientific progress of the output using the social infrastructure research concept;

(2) Investigate the different topics and changes in social infrastructure students over time; and

(3) Thoroughly analyze the core structure of social infrastructure research concerning relevant subjects.

II. Literature Review

Social Infrastructure Research Trend of 1990-2024

Prominently known as the fusion between physical and social value towards public infrastructure, social infrastructure compromises the structure of research and scientific understanding following function and development (Horton & Penny, 2023). Previous studies elaborated on what was known as the value of infrastructure for such post-disaster, public space, and public service institutions, such as schools, libraries, hospitals, and rural drainage. After that, it constructs what social infrastructure is (Fraser et al., 2024). Recent studies on the social infrastructure subject showing the indicated topic and most cited article from 1990-2024, accordingly showed in the table, for such:

Table 1. Most Cited Articles of "Social Infrastructure" publications

Rank	Document Title	Authors	Year	Citation	Source
1	Global Freshwater Resources: Soft-Path Solutions for the 21st Century	Gleick, Peter H.	2003	981	Science, 302(5650), pp. 1524–1528
2	A survey of urban climate change experiments in 100 cities	Castán Broto, Vanesa; Bulkeley, Harriet	2013	648	Global Environmental Change, 23(1), pp. 92–102
3	Spatial planning for multifunctional green infrastructure: Growing resilience in Detroit	Meerow, Sara; Newell, Joshua P.	2017	497	Landscape and Urban Planning, 159, pp. 62–75
4	From green to sustainability: Information Technology and an integrated sustainability framework	Dao, Viet; Langella, Ian; Carbo, Jerry	2011	496	Journal of Strategic Information Systems, 20(1), pp. 63–79
5	Can farmers' adaptation to climate change be explained by socio-economic household-level variables?	Below, Till B; Mutabazi, Khamaldin D; Kirschke, Dieter; Franke, Christian; Sieber, Stefan; Siebert, Rosemarie; Tscherning, Karen	2012	482	Global Environmental Change, 22(1), pp. 223–235
6	'Virtual' intimacies? Families communicating across transnational contexts	Wilding	2006	473	Global Networks, 6(2), pp. 125–142
7	Reconstruction of New Orleans after Hurricane Katrina: A research perspective	Kates R.W; Colten C.E; Laska S; Leatherman S.P	2006	467	Proceedings of the National Academy of Sciences of the United States of America, 103(40), pp. 14653–14660
8	The paths to social licence to operate: An integrative model explaining community acceptance of mining	Moffat, Kieren; Zhang, Airong	2014	465	Resources Policy, 39(1), pp. 61–70
9	Supplying urban ecosystem services through multifunctional green infrastructure in the United States	Lovell; Taylor	2013	449	Landscape Ecology, 28(8), pp. 1447–1463
10	Categorization of indicators for sustainable manufacturing	Joung, Che B; Carrell, John; Sarkar, Prabir; Feng, Shaw C	2013	409	Ecological Indicators, 24, pp. 148–157

The writers conducted a literature review highlighting the most cited articles in this social infrastructure sphere. The results are apparent, with significant inventions ranging from 2003 to 2017, with approximately the lowest cited being 409 and the highest being 981 of the total users who cited these articles—following the top 10 articles with various topics such as drainage, urban infrastructure, disaster relief measures, spatial urban planning, climate change, and mining infrastructure. Hence, it is well-known that the social infrastructure model evolved with the ever-simplest daily infrastructure to the upper-level disaster relief, in some instances, the advancement of social value which required transformative approaches among the related cases (DeVerteuil et al., 2022; Klinenberg, 2018). This invention might correlate with various topics since social infrastructure is a robust and multidisciplinary research.

III. Research Methodologies

This bibliometric review examines the documents linked to social infrastructure research indexed in the Scopus database. Scopus provides superior and comprehensive coverage of journals. It is widely recognized as a reliable and reputable source for bibliometric studies (Annahar et al., 2023; Falagas et al., 2008). Furthermore, the search technique was designed explicitly with restricted parameters, including English language publications, a time frame from 1990 to 2022, and documents within the topic areas of Social Science, Arts and Humanities, Mathematics, Decision Science, and Multidisciplinary. Furthermore, the writer restricted the keywords to Infrastructure, Sustainable Development, Decision Making, Infrastructural Development, and Social Infrastructure. Table 2 summarises document discovery and search data.

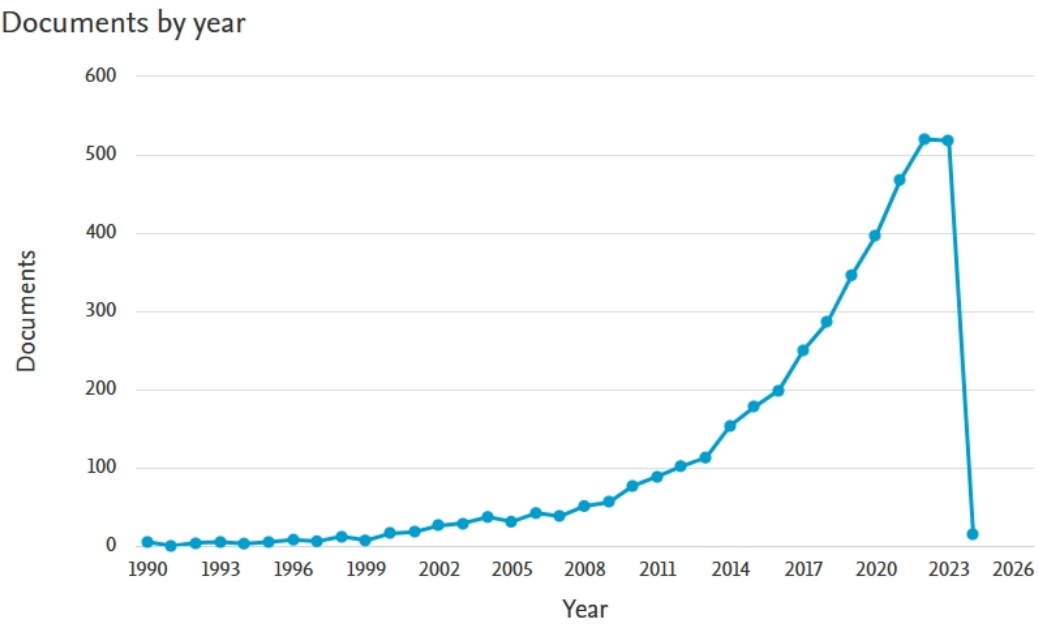
Table 2. Set of Retrieval Procedure of Scopus Database

Number	Procedure	Output
1	Publication retrieved with keyword *Social Infrastructure*	57,727 publications
2	Publication retrieved with keyword *Social Infrastructure*. English publication only	54,400 publications
3	Publication retrieved with keyword *Social Infrastructure*. English publications and subject, keywords, and year limitation (1990 – 2024).	4,111 publications
Amount of Publication (1990 – 2024)		4,111 publications

The data and publications retrieving procedure was carried out on 23rd December 2023. The retrieving procedure utilized extensive coverage to identify publications under the keyword "Social Infrastructure" composed of title, abstract, and keywords. The study of bibliometric review was conducted and resulted in the amount of 4,111 publications. After that, data analysis was conducted and arranged from VOSviewer (1.6.19 version) to identify documents regarding social infrastructure and which concepts were within the scope of research on social infrastructure. Also featured are Scopus-produced calculations and other related tools to analyze the growth and scientific geography of publication distribution towards social infrastructure from 1990 to 2024.

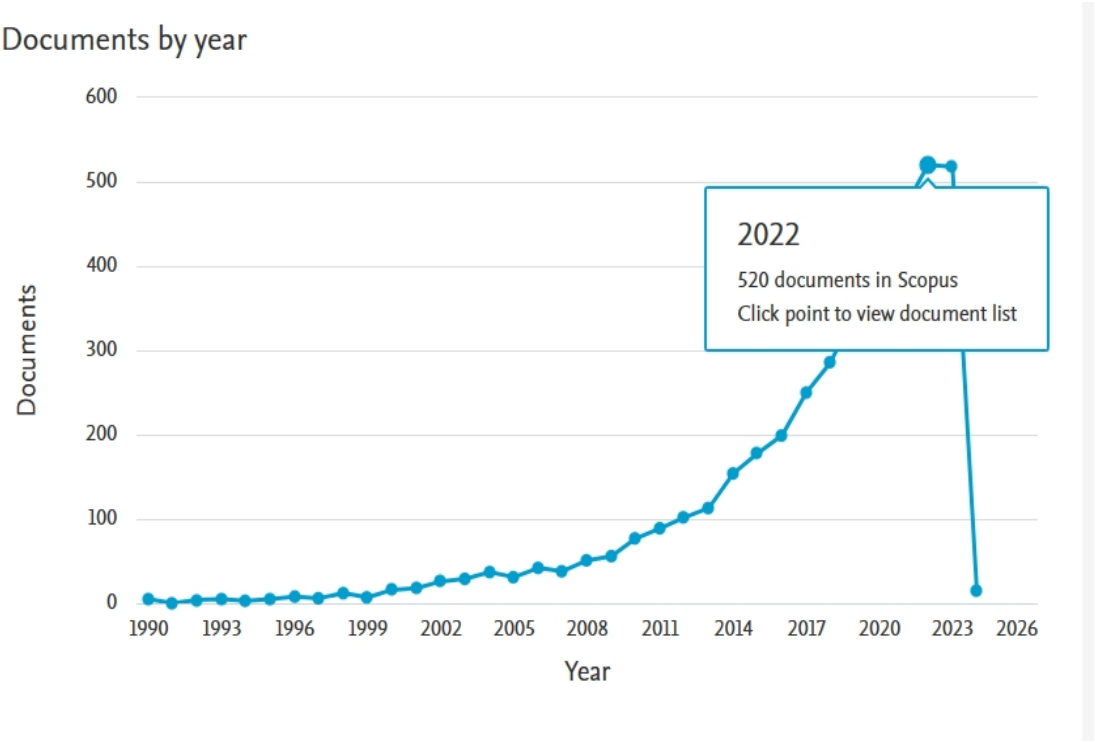
IV. Result and Discussion

Research Discovery (1990 – 2024)



Picture 1. Social Infrastructure Research Trend (1990 – 2024)

Social infrastructure, according to the indicated affluent but increasing number of publications produced between 1990 – 2024, peaked in 2020 – 2022. Periodically, the research towards identical topics had the potential to reach the highest number of 520 in 2022.



Picture 2. Highest Research on Social Infrastructure by The Year (2022)

The data produced meaningful insight into social infrastructure research, and following the analysis conducted by the writer, it gives precious consideration to related research matters. Moreover, according to the most cited articles in order, the writer will provide the top 10 articles in 2022 which gave the highest number of productions.

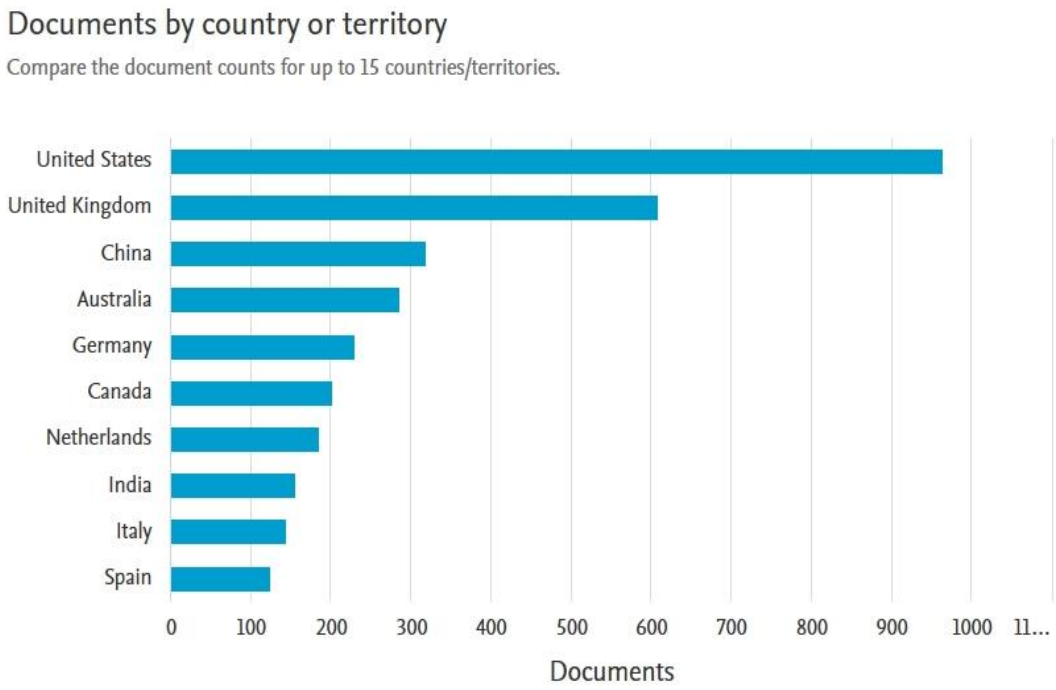
Table 3. Most Cited Articles of "Social Infrastructure" Publications in 2022

Rank	Document Title	Authors	Citation	Source
1	2	3	4	5
1	A Review on Global E-Waste Management: Urban Mining towards a Sustainable Future and Circular Economy	Murthy, Venkatesha; Ramakrishna, Seeram	72	Sustainability (Switzerland), 14(2), 647
2	How does telecommunications infrastructure affect eco-efficiency? Evidence from a quasi-natural experiment in China	Tang, Chang; Xue, Yan; Wu, Haitao; Irfan, Muhammad; Hao, Yu	62	Technology in Society, 69, 101963
3	A theory of digital technology advancement to address the grand challenges of sustainable development	Popkova, Elena G; De Bernardi, Paola; Tyurina, Yuliya G; Sergi, Bruno S	48	Technology in Society, 68, 101831

1	2	3	4	5
4	Sustainability and the Digital Transition: A Literature Review	Rosário, Albérico Travassos; Dias, Joana Carmo	44	Sustainability (Switzerland), 14(7), 4072
5	Using a digital twin to explore water infrastructure impacts during the COVID-19 pandemic	Pesantez, Jorge E; Alghamdi, Faisal; Sabu, Shreya; Mahinthakumar G; Berglund, Emily Zechman	40	Sustainable Cities and Society, 77, 103520
6	The evaluation and obstacle analysis of urban resilience from the multidimensional perspective in Chinese cities	Zhao, Ruidong; Fang, Chuanglin; Liu, Jing; Zhang, Lifang	38	Sustainable Cities and Society, 86, 104160
7	Extracting the Planning Elements for Sustainable Urban Regeneration in Dubai with AHP (Analytic Hierarchy Process)	Awad, Jihad; Jung, Chuloh	37	Sustainable Cities and Society, 76, 103496
8	Inclusive infrastructure development, green innovation, and sustainable resource management: Evidence from China's trade-adjusted material footprints	Razzaq, Asif; Sharif, Arshian; Ozturk, Ilhan; Skare, Marinko	35	Resources Policy, 79, 103076
9	'Murderous energy' in Oaxaca, Mexico: wind factories, territorial struggle and social warfare	Dunlap, Alexander; Arce, Martín Correa	33	Journal of Peasant Studies, 49(2), pp. 455–480
10	Conflicted transitions: Exploring the actors, tactics, and outcomes of social opposition against energy infrastructure	Sovacool, Benjamin K; Hess, David J; Cantoni, Roberto; Lee, Dasom; Claire Brisbois, Marie; Jakob Walnum, Hans; Freng Dale, Ragnhild; Johnsen Rygg, Bente; Korsnes, Marius; Goswami, Anandajit; Kedia, Shailly; Goel, Shubhi	31	Global Environmental Change, 73, 102473

Hence, with robust and extensive social infrastructure studies, the researcher has discovered recent trends in research-related subjects produced by the country/territory

worldwide. This part below provides the list of countries and territories that produced the result of data and those of participating parties in the research scope.



Picture 3. Document Resulted by Country or Territory

The United States of America dominated the research scope on social infrastructure, among the procedure's limitations, as previously described. Scopus database has discovered that social infrastructure keywords lead to the numerous countries and territories in which the parties enhance their effort to the research scope and the several documents outside the article, book, or conference paper. However, the sphere of scientific documents included in the Scopus databases has verified the source. Therefore, the United States of America produced the 964 documents, separately from the fixed amount of the document. The data is presented in the table below:

Table 4. Varieties of Document from The United States of America on "Social Infrastructure" related as the most productive country

No	Document	Amount
1	2	3
1	Article	782
2	Conference Paper	80
3	Review	58
4	Book Chapter	23
5	Editorial	9
6	Note	7

1	2	3
7	Short Survey	2
8	Letter	1
9	Data Paper	1
10	Book	1

Evolution of Social Infrastructure Studies

For a decade, which acknowledged social infrastructure programs as city development, the research focused on the urban schemes and public institutions in the urban sphere or sub-urban area, mainly but not limited to the population and density (Fiorentino, 2023). The central and local government launched their initiative through policies which concise its natural development into urban living, whilst the rural included as the potential issues for their agricultural as well as quantifying empty spaces (Li et al., 2022). The driving factor of social infrastructure is instrumented by the government or private, for instance, their struggle to build an ideal neighbourhood across the nation. Shared community space in the city, technology and internet infrastructure, libraries and even prisons are potential social initiatives (Casady & Geddes, 2020; Klinenberg, 2018). Moreover, technical means of physical infrastructure further away flew into the perception according to its social infrastructure roots; surprisingly, people paid attention to social value afterwards. Physical issues could not end the problem in existing society, with social infrastructure evolving as the conscience of the research, which included fixed perspectives (Fraser et al., 2022) , following the research limitation revealed from the '90s that social infrastructure discovered the finding in the scope of functional infrastructure neither urban nor rural as the city physical public goods for instance.

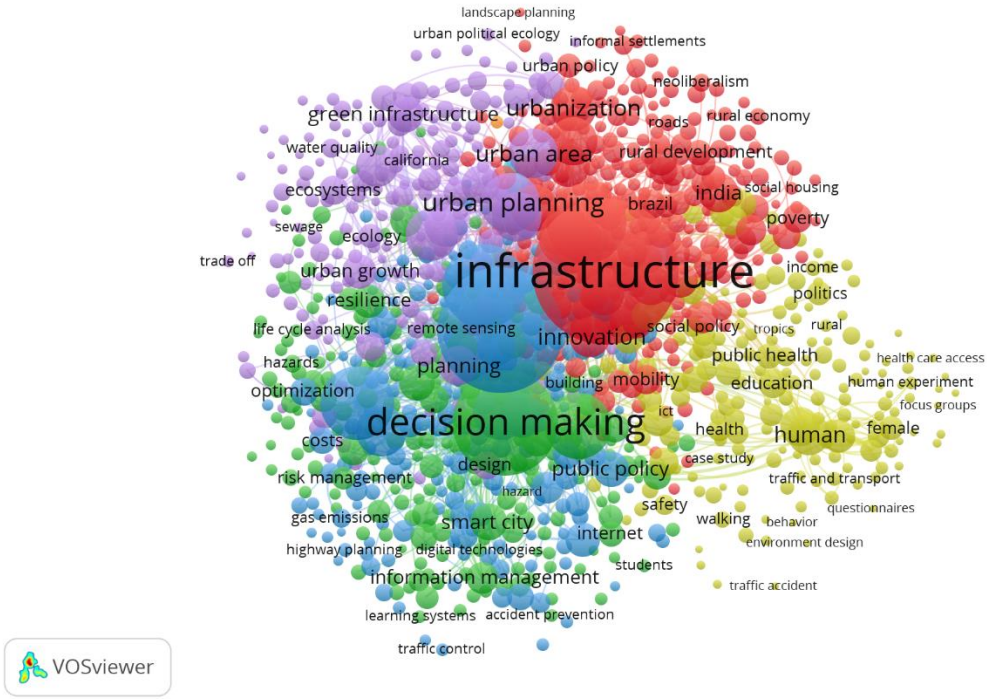
Hence, the flagship in which social infrastructure is a prominent consideration to develop cities and countryside. Enormous areas such as infrastructural development could be packed neatly into continuous human matters intermingled with livelihood matters regarding physical and social roles to its technical guidance (Yang et al., 2023). Through the meta-analysis, the writer identified numerous publications towards social infrastructure research that directly addressed disaster relief and management, post-disaster measurements, and consecutively joined in the rescue and post-disaster development from 2004 to 2020, in the particular scope of the COVID-19 pandemic. Neither social nor physical should people be aware of their surroundings to learn and live fully cognizant of technical and engineering issues placed into human livelihood (Cunha et al., 2024). The recognized sphere of social infrastructure ran by no limited means as genuine physical engineering, yet on the occasional

based, it took the social and moral value instrumented to constructing public facilities and utilizing the goods. Unlike conventional construction terms, social infrastructure is the newest set from the 21st century, and it maintains social function in engineering. Likewise, this sphere has raised brand-new humanity (Rao, 2023).

The edge of capacity included the so-called anthropocentric and massive development, which the sphere directly explained as the idea. There is nothing in between the social relationship between conventional walls of buildings and moral values (Fortun et al., 2021). The research of social infrastructure grew as the engineering domain, yet by human value and their living matter on this planet.

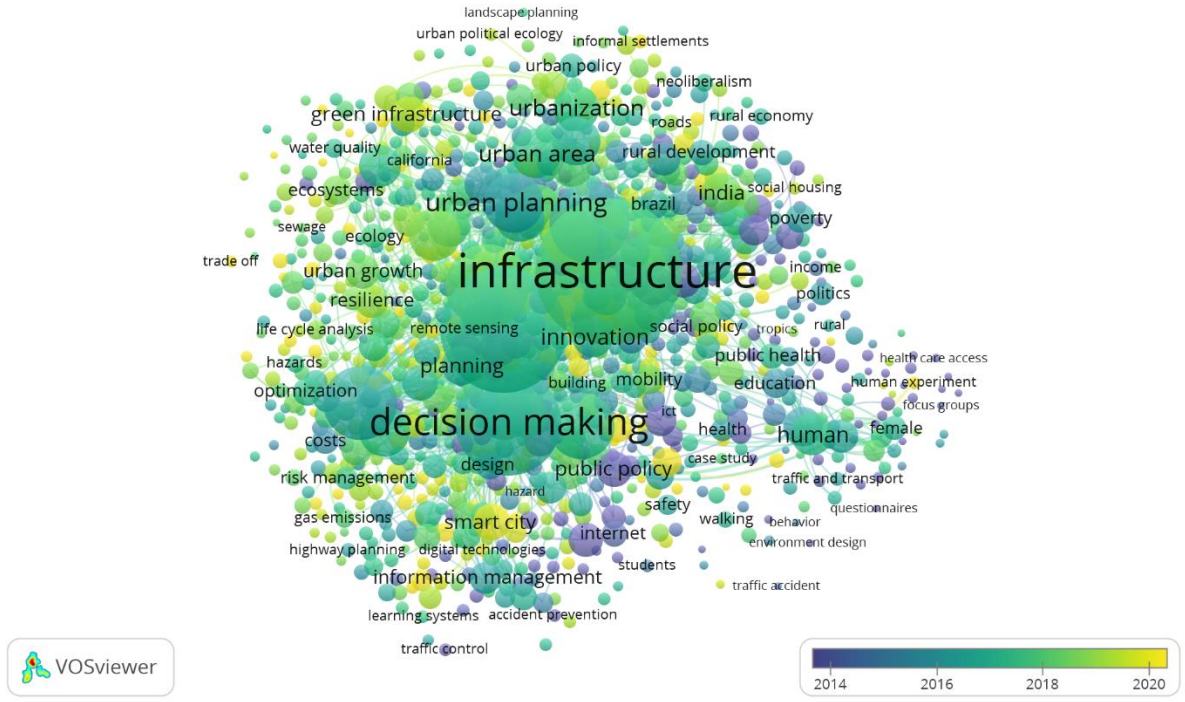
Social Infrastructure Research Projection and Gaps

Following the whole research of social infrastructure, the researchers conducted the geographical projection that was afterwards presented in VOSviewer data. At first look, the density of research and the connected subject are included in the data acquired by the researcher using the set criteria. A set of projections is delivered in three forms: (1) Co-occurrence projection with distinctive colour between nodes indicating different subjects. Moreover, to specify the names of the subjects, they were written, followed by item analyses with high frequency in each. (2) Overlay projection draws a tentative trend of overlay projection and the average publication presented in node colour throughout the years. (3) Density projection draws the frequency by the nodes that reveal which one of the subjects with higher and most produced the research of social infrastructure-related items and the less frequency informed numerous subjects in which informed their less related research in the scope of social infrastructure and related items.



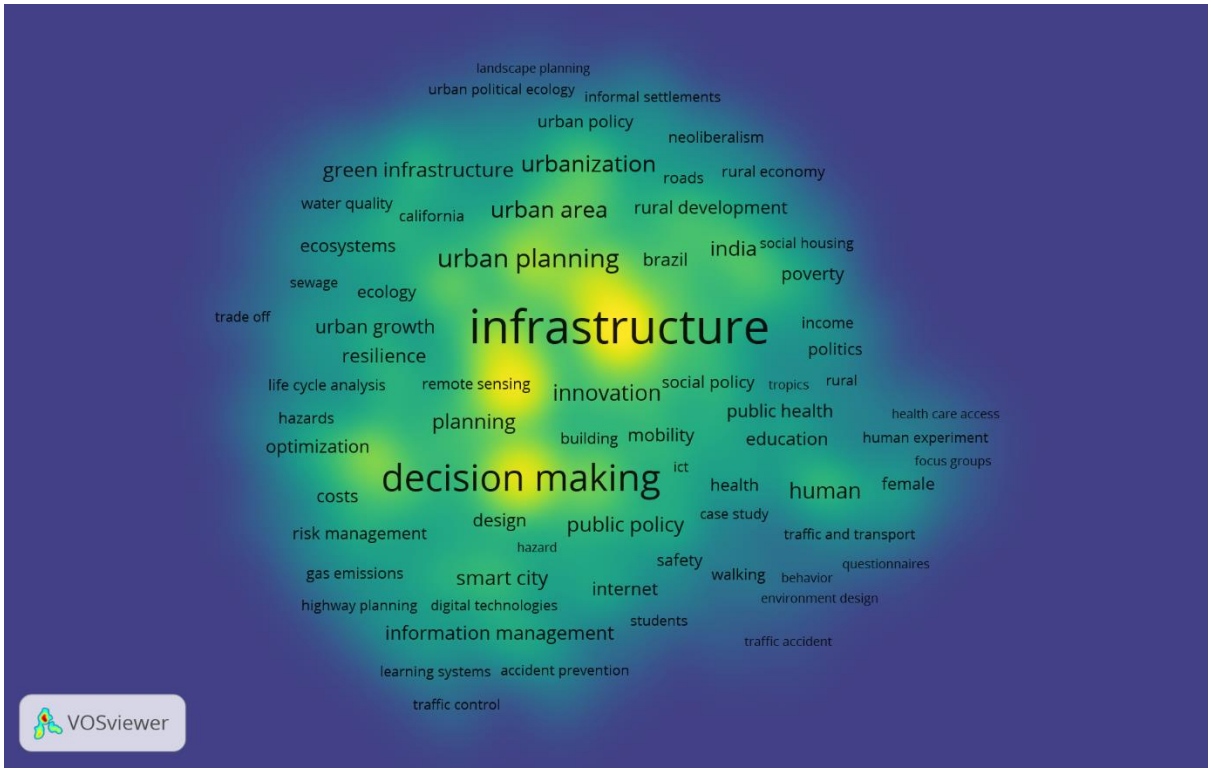
Picture 4. Keyword Co-occurrence Network Projection of Social Infrastructure

Network projection has been presented as the constituent base of the research topic and co-occurrence among connected nodes that informed the numerous subjects related to such infrastructure: urban planning, decision making, and urban area. Thus, this can be reflected in the research sphere of social infrastructure. The database retracted from Scopus has ensured the citation and research trend to act accordingly by the search limitation that had been mentioned in the research procedure beforehand. With the bibliometric analysis, scientific papers would be easily recognised considering the arrangement of the research information and confirmed and validated research articles (Widianingsih et al., 2021).



Picture 5. Keyword Overlay Network Projection of Social Infrastructure

The overlay, likewise, is the research order to observe the kind of topic and its presence from time to time. The projection retracted from the database concluded the research trend of social infrastructure, with the most productive period reaching its peak from 2018-2020, per the database, which no longer uses the most excellent overlay density in the infrastructure area. The greener part indicates that the period is highly productive, and the less productive ones are based on keywords that show the same function as the green node, except the colour is changed to yellow (Tigre et al., 2023; Yao et al., 2023). The research trend projection by the overlay network visualization broadly gives a reciprocal period in which the subject and its matter evolve around time and are acknowledged in the bibliometric analysis procedure (Agarwal et al., 2022). The projection showed a tentative trend of the projection scheme and the regular periods through the node colour (Lee et al., 2023).



Picture 6. Keywords Density Network Projection of Social Infrastructure

Further projection, in order, is shown as the density of several research studies related to social infrastructure as the keywords. Despite the crowded subject of such infrastructure, decision-making, and planning, There is scarce density with the less crowded subject, which is as vital as the crowded one to ensure the research on social infrastructure goes beyond one discipline. From the projection that has been presented, high-frequency nodes tend to be related to social infrastructure research, both physical infrastructure and planning. Therefore, the less frequent social infrastructure-related subject also indicates the exact meaning of research for humans, intelligent cities, and public policy.

Picture 7. Keywords Co-Authorship Projection Network of Social Infrastructure

Co-authorship is the projection that describes research participation according to authors who put forth their efforts and sustainable development of this scope afterwards. The projection beforehand analyses network-based nodes with several colours, as shown in the picture above. Authorship identification and the expanding network that had the position with special marking and identity, it is well known that differences recorded (McCambridge & Golder, 2024). Moreover, this invention also represented which author that his/her publication built the social infrastructure research as robust as possible.

V. Conclusion

For 34 years, social infrastructure research and other related subjects have developed as a robust entity which promotes human, government, and physical infrastructure. Those can proceed and move along with each other, for such development, policy, and social issues ultimately existed in the people and civilizations that lived among them. Likewise, the research limitation on social infrastructure research only applied for 34 years, with further steps that need to be taken. This apparent research for further studies also fills the research gap and ensures abundant research; it can be implied that the recommendation should be positioning social infrastructure with contemporary issues, placing the number of multidisciplinary

subjects with aligned policy research and international development. These identified measures will hold a trace of research and serve as guidance for concise understanding yet precision on the research matter. Thus, it can be reflected as one of ongoing research according to bibliometric discovery, and this will be a further guide on future research, as well as the identified research gap, trends, and implications toward the social infrastructure scope of academic invention.

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