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Infrastructure Projects as a Sustainable Tool for Ukraine's Recovery and Development: A Bibliometric Perspective

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Abstract. In the current realities of a full-scale war, economic, political, and environmental crises in Ukraine, the issue of post-war recovery and further sustainable economic development is of paramount importance. The path to sustainable recovery depends significantly on the end of the war, successful implementation of infrastructure projects, and continued international support. However, any process should begin with a thorough analysis of its theoretical implications and a comprehensive evaluation of its concept. The aim of the research is to investigate the evolution of research on “infrastructure projects” within the context of sustainable development. Research methods involve bibliometric analysis, data extraction, keyword analysis, network analysis, and data visualization. The article explores the theoretical principles of infrastructure projects as a driver for the sustainable development of Ukraine. Within the scope of this research, a bibliometric analysis of the essence of the terms “infrastructure project” and "sustainable infrastructure project” was conducted. It revealed a dynamic evolution in the scholarly discourse surrounding “infrastructure projects”. While the term “infrastructure project” has been present in academic literature since 1979, a significant surge in research activity is evident from the early 2000s onwards. This surge reflects a growing recognition of the critical role infrastructure plays in economic and social development, alongside the escalating concerns surrounding environmental sustainability and climate change. The emergence and rapid growth of research on “sustainable infrastructure projects” is a notable trend. This indicates a relatively recent but rapidly evolving area of scholarly inquiry, reflecting the increasing emphasis on environmental, social, and economic sustainability in infrastructure development. These findings provide a foundation for understanding the evolving discourse on sustainable infrastructure and its potential role in Ukraine's post-war recovery.

Keywords: bibliometric analysis, infrastructure project, sustainable infrastructure project, sustainable development.

JEL Code: Q01, F63.

Pateikta / **Submitted** on 09.12.2024

Introduction

Ukraine considers infrastructure to be one of the key drivers of effective economic growth, which contributes to the welfare of the population, and therefore infrastructure facilities have become the main target of attacks by the aggressor. According to the “Report on direct damage to infrastructure from destruction as a result of russia`s military aggression against Ukraine as of the beginning of 2024” (KSE Institute,… 2024), since the beginning of hostilities, the total amount of direct losses from damage and destruction of transport infrastructure is $ 36.8 billion; 25.4 thousand km of roads and 344 bridges were destroyed, which is estimated at $ 26.7 billion in losses in the road sector and $ 2.6 billion in bridge infrastructure; direct losses in the railway industry amount to $ 4.3 billion, approximately $ 2.04 billion in the aviation sector, $ 0.85 billion in the port sector; among telecom operators - $ 510 million, in addition to the damage in the energy sector - $ 9 billion.

The reconstruction of such facilities through the implementation of infrastructure projects is not just a task but an important mission and one of the strategic directions of economic development, new opportunities for regional development, energy independence, social well-being of the country and the population, strengthening of the state, and thus further sustainable and stable development of Ukraine. This is a significant opportunity to create a modern, inclusive, and sustainable infrastructure that will meet the needs of people in the 21st century and the challenges of the modern world, which will contribute to the country's better integration into the international community.

To understand the full scope of this challenge, it is crucial to define “infrastructure project” comprehensively. These projects play a pivotal role in economic growth, social development, and environmental sustainability. By carefully analyzing the concept of “infrastructure project” and its relationship with sustainability, policymakers and stakeholders can make informed decisions that will contribute to a successful and equitable recovery and reconstruction of Ukraine.

Analyzing the concept of “infrastructure project” within the context of post-conflict reconstruction is essential for a clear understanding of the types of infrastructure projects needed for recovery and development is crucial for effective resource allocation and prioritization of investments. Also, it plays a significant role in evaluating the environmental, social, and economic sustainability of different infrastructure projects is critical to ensure long-term resilience and avoid creating new vulnerabilities. Moreover, effective and sustainable infrastructure development requires meaningful engagement with local communities to ensure that projects meet their needs and address their concerns. Investing in resilient infrastructure, such as those that can withstand natural disasters and other shocks, is crucial for long-term recovery and sustainable development in the face of future challenges.

The complexity and interdisciplinary nature of the concept of an “infrastructure project” makes the implementation of such projects even more complex. Besides modern trends and requirements set additional aspects for evaluation. Considering that an “infrastructure project” covers a wide range of activities, its interpretation can be analyzed from different perspectives. The purpose of the research is to investigate the evolution of research on “infrastructure projects” and “sustainable infrastructure project” within the context of sustainable development by analyzing bibliometric data, identifying key research themes, and identifying prominent scholars and institutions contributing to this field. The research object is a set of publications for the query “infrastructure project” and “sustainable infrastructure project” in the Scopus database.

The main objectives of the research are to identify key research themes and sub-fields within the broader domain of sustainable infrastructure projects; to analyze the evolution of research on “infrastructure projects” and “sustainable infrastructure projects” over time; to explore the relationship between research on “infrastructure projects” and “sustainable infrastructure projects” and the broader discourse on sustainable development.

The research methods are bibliometric analysis, data extraction, keyword analysis, network analysis, and data visualization.

“Infrastructure projects” constitute a cornerstone of economic and social development, encompassing a diverse range of undertakings from transportation networks and energy systems to digital infrastructure and social amenities. Defining this multifaceted concept is crucial for a comprehensive understanding of its role in sustainable development.

1. Analysis of the concept of an infrastructure project

According to Kharchuk and Ivanychenko (2019) an “infrastructure project” is a “large investment and construction project involving public authorities and management, various companies, including foreign ones, with a developed system of logistics supply and sales of products, which makes it necessary to take into account the external environment of the project”.

Smentina and Klevtsevych (2016) consider an “infrastructure project” as “a set of actions and their sequence for the creation and (or) reconstruction of a specific object or technological complex of infrastructure, their subsequent use (operation), implemented on the basis of a project agreement”.

At the legislative level, according to the Law of Ukraine “On amendments to some legislative acts of Ukraine to simplify the attraction of investments and the introduction of new financial instruments” (Verkhovna Rada of Ukraine, 2020), the concept of an “infrastructure project” is interpreted as “a project for the construction (reconstruction, repair) of facilities in the areas of transport infrastructure (roads, bridges, crossings, etc.) and gas pipelines, in the areas of social and cultural purposes (healthcare, education, social purposes) and/or housing and communal services (water supply and sewage facilities, heat and power supply systems, etc.)”.

Onalaja et al. (2018) believe that an “infrastructure project” is dynamic and complex, as it involves a significant number of risks. The duration and scale that characterize the implementation of infrastructure projects, as well as the involvement of different parties in dynamic relationships with many interdependencies, make it more vulnerable to risks.

Infrastructure projects play a vital role in the areas of transport infrastructure, social and cultural facilities, and housing and utilities. However, conventional infrastructure approaches often have a negative impact on the environment, contributing to pollution, climate change, loss of biodiversity, in addition to a range of socio-economic and cultural impacts. So, the analysis of an infrastructure projects should involve the aspect of sustainability and its impact on the overall environment.

The implementation of sustainable infrastructure projects is a key step in addressing several challenges. The concept of sustainability has become paramount in the 21st century, particularly within the context of infrastructure development. Recognizing the urgent need to mitigate climate change, enhance environmental quality, and ensure social equity, there is a growing consensus that infrastructure development must be carried out in a way that minimizes negative environmental impacts, increases resilience, improves quality of life, and stimulates economic development. This approach aims to ensure a more sustainable, equitable, and prosperous future for people and the planet. This perspective is supported by numerous scholarly and policy documents, such as those published by the United Nations, the World Bank, and the International Energy Agency, which emphasize the critical role of sustainable infrastructure in achieving the Sustainable Development Goals (SDGs) (United Nations, 2015)

In modern scientific the concept of “sustainable infrastructure projects” is only becoming a field of research for domestic scientists, which leads to the lack of a comprehensive interpretation of this term. Analyzing the concept of “sustainable infrastructure” according to the International Institute for Sustainable Development (2024), we can note that sustainable infrastructure involves the development of roads, buildings, energy, and water infrastructure, taking into account economic, social and environmental impacts. Sustainable infrastructure is also defined by the United Nations Environment Program (UNEP, 2023) as an infrastructure system that is strategically planned, designed, constructed, operated and decommissioned in a way that ensures long-term sustainability in economic, financial, social, environmental and institutional dimensions throughout the entire life cycle of the infrastructure.

For a more detailed study, we conducted a bibliometric analysis, which is a common form of meta-analytical research and a statistical method that finds qualitative and quantitative changes in a specific research topic, in order to study the bibliographic material, identify the main scientific areas in the field of study, the relationships between them, as well as the evolutionary dynamics of a particular field of the two concepts of “infrastructure project” and “sustainable infrastructure project”.

2. Research process and results

For further research, we used the built-in analysis tools of the Scopus database (2024). The first stage of the analysis was the identification of a sample of 9,481 scientific publications for the query “infrastructure project” and 55 scientific publications for “sustainable infrastructure project” in the search field with a search filter in article titles, abstracts, keywords, which was carried out using the built-in tools of the Scopus database (Scopus, 2024). Only publications written in English, totaling 9,995 and 54 scientific papers, respectively, were selected for further consideration. The decision to include only publications written in English was made to ensure consistency and comparability across the dataset. English has become the dominant language of scientific communication, with a significant majority of scientific literature published in this language. Figure 1 presents the dynamics of the number of publications by the keywords “infrastructure project” (A) and “sustainable infrastructure project” (B).

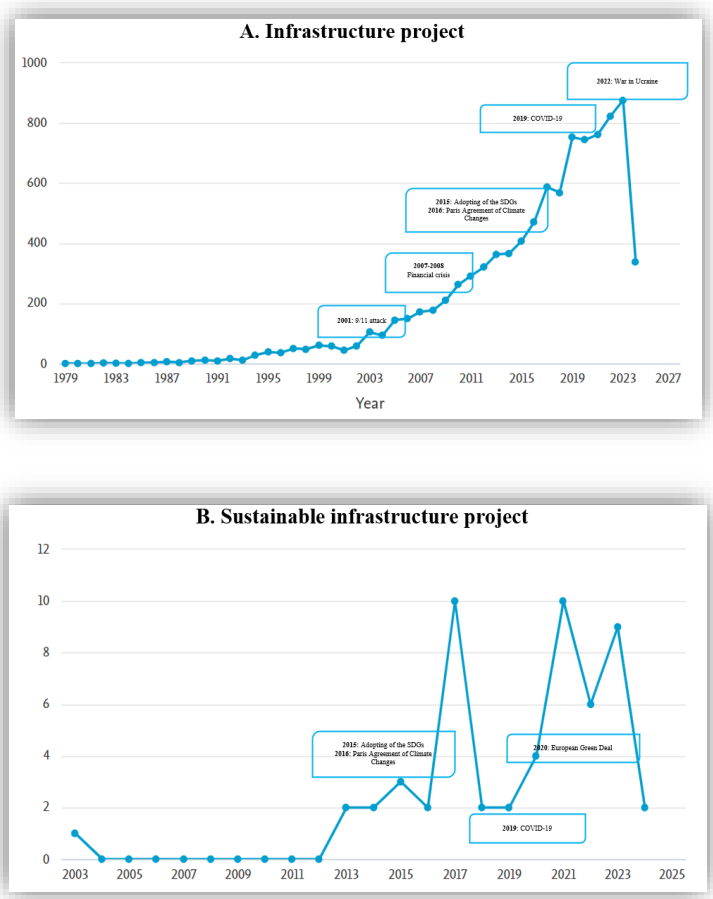

Fig. 1. **Dynamics of the number of publications by the keywords “infrastructure project” (A) and “sustainable infrastructure project” (B) (May 2024)**

Source: developed by the author based on Scopus database (2024)

The Scopus database reveals that scholarly discourse on “infrastructure projects” has a relatively long history, with the first mentions appearing in 1979 (see Figure 1). However, a significant surge in research activity surrounding this term is observed from the early 2000s onwards, indicating a growing academic interest in this domain. In contrast, the concept of “sustainable infrastructure project” emerged more recently, with the first mentions appearing in Scopus in 2003. While initial publications on this topic were scarce, research activity on "sustainable infrastructure projects" has gained significant momentum since 2013, reflecting its growing importance within the academic and policy discourse.

Until 2000-year publications on infrastructure projects were mostly technical in nature. Since the beginning of the 21st century, the number of scientific papers has increased due to digitalisation, open databases, new tools, and methods of analysis. Growing concerns about environmental issues have led to research on sustainable infrastructure projects since 2002, and the activity of publications on this topic has increased significantly since 2012.

In the 21st century, the development of infrastructure projects has been influenced by social, political, and economic events. The 2001 terrorist attack in New York highlighted the importance of infrastructure security. The global financial crisis of 2007-2008 changed approaches to project financing, focusing on infrastructure investment to stimulate the economy. The adoption of the UN's new 2030 Agenda and the Paris Agreement in 2016 have promoted research into sustainable infrastructure projects. The COVID-19 pandemic and the European Green Deal in 2020 also had a significant impact on infrastructure project research. The military conflicts in Ukraine since 2014 and war since 2022 have highlighted the importance of restoring and developing resilient infrastructure.

Figure 2 shows the countries of the world with a gradient distribution of publication activity on the issue of “infrastructure project”. According to Scopus data, the top 10 countries for research on this issue are the United States - 1,800 publications (14.9% of all publications), the United Kingdom - 9.1% (1,093 publications), Australia - 7% (839 publications), China - 6.8 per cent (822 publications), India - 4.2 per cent (511 publications), Germany - 3.4 % (419 publications), Canada - 3.2 per cent (388 publications), the Netherlands - 2.9 % (345 publications), Russia - 2.1 % (252 publications) and Sweden - 1.8 % (218 publications). In Ukraine, only 48 publications are indexed in the Scopus database, which is only 0.4% of all publications in the period from 1979 to 2024.

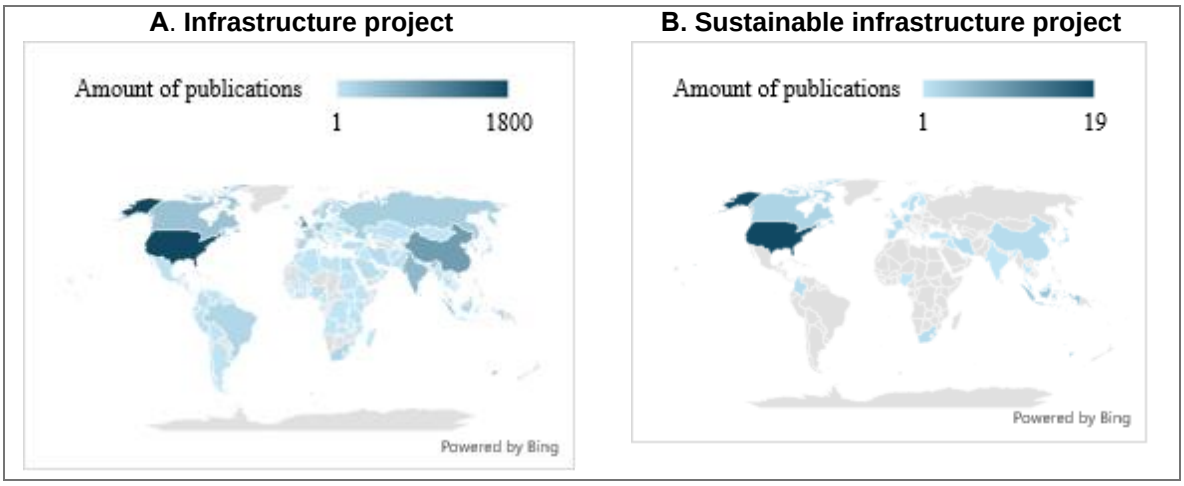

Fig. 2. **Territorial distribution of the number of publications by the keyword “infrastructure project” (A) and “sustainable infrastructure project” (B) in the period from 1979 to 2024 (May, 2024)**

Source: developed by the author based on Scopus database (2024)

As for the concept of “sustainable infrastructure project”, the top 10 countries have the following distribution: The United States - 19 publications (26.8% of all publications), Indonesia - 7% (5

publications), Australia - 5.6% (4 publications), Canada - 4.2% (3 publications), India - 4.2% (511 publications), Germany, Greece, Hong Kong - 2.8% (2 publications in each country). Unfortunately, in Ukraine, the Scopus database does not index studies on the concept of “sustainable infrastructure projects” in the period from 1979 to 2024.

A significant part of publications in these top countries, in particular in the United States, the United Kingdom, Australia, and China, is primarily due to significant investments in research activities, significant work and development of research universities, organisations, and centers that are globally recognised and promote close international cooperation. In addition, in terms of investment projects, these countries have the experience of a highly developed infrastructure, which makes it easy to conduct several studies on the introduction of the latest technologies in this area. There is also effective cooperation and knowledge transfer between academia and representatives of various industries.

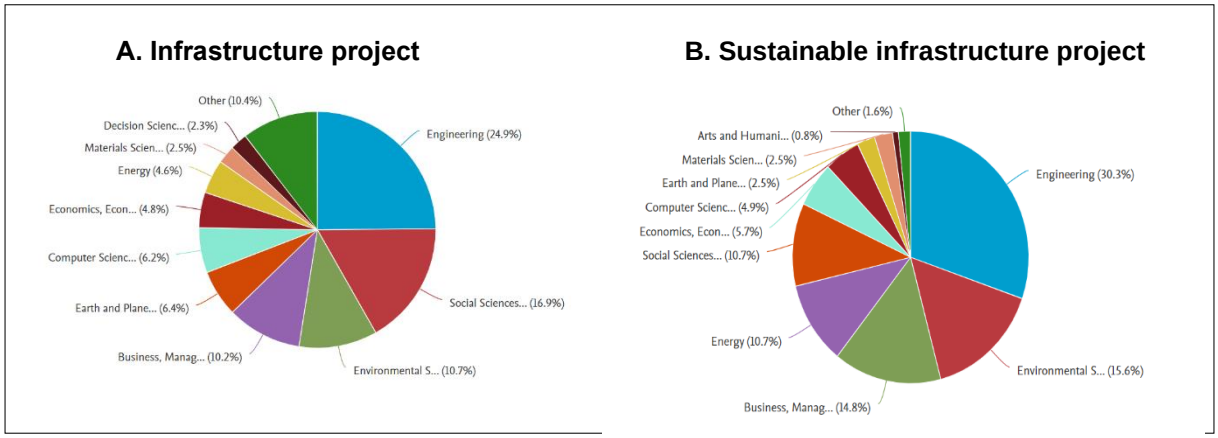

Fig. 3. **Analysis of research areas on the concept of “infrastructure concept” (A) and “sustainable infrastructure project” (B)**

Source: developed by the author based on Scopus database (2024)

The study of publications by industry has the following results (see Figure 3): 25-30% of publications for both concepts are in the field of Engineering, as any implementation of infrastructure projects requires knowledge of engineering principles, design methodology, and construction technologies to ensure the safety, functionality, and sustainability of infrastructure. Research on infrastructure projects goes beyond engineering and covers various aspects of the natural sciences: 10.7% (infrastructure projects) and 15.6% (sustainable infrastructure projects). Such an interdisciplinary approach is essential for creating environmentally responsible and resilient infrastructure systems that contribute to a sustainable future. There is also a link with the social sciences to understand the social and cultural aspects of infrastructure development to ensure that these projects are not only technically sound and environmentally responsible but also socially inclusive, equitable, and responsive to the needs and aspirations of the population. A significant proportion of publications in Business, Management and Accounting examine projects in terms of their financial viability and effective management and planning.

The second stage of the study was a deeper analysis of the concept of “infrastructure project” using the VosViewer 1.6.20 software (VosViewer Official Website, 2024) to build keyword relationships with further visualisation and clustering separately for each keyword. Using the software, 35,239 keywords related to the concept of “infrastructure project” were generated, but only 568 keywords with a total frequency of use of at least twenty-five were selected for further analysis and accurate cluster formation.

As a result, 6 clusters of interdisciplinary areas were formed (see Figure 4), related to the key research of the “infrastructure project”:

- Cluster 1 - concepts of project management, the construction industry and construction projects, their life cycle;
- Cluster 2 - investments, public-private partnerships, risk management and assessment;
- Cluster 3 - decision-making, planning, transport industry, costs, cost-benefit analysis;
- Cluster 4 - infrastructure, infrastructure development and planning, sustainability, environmental impact and climate change;
- Cluster 5 - sustainable development, economic and social impact, sustainable infrastructure;
- Cluster 6 - rail transport, bridges, tunnels, large-scale infrastructure.

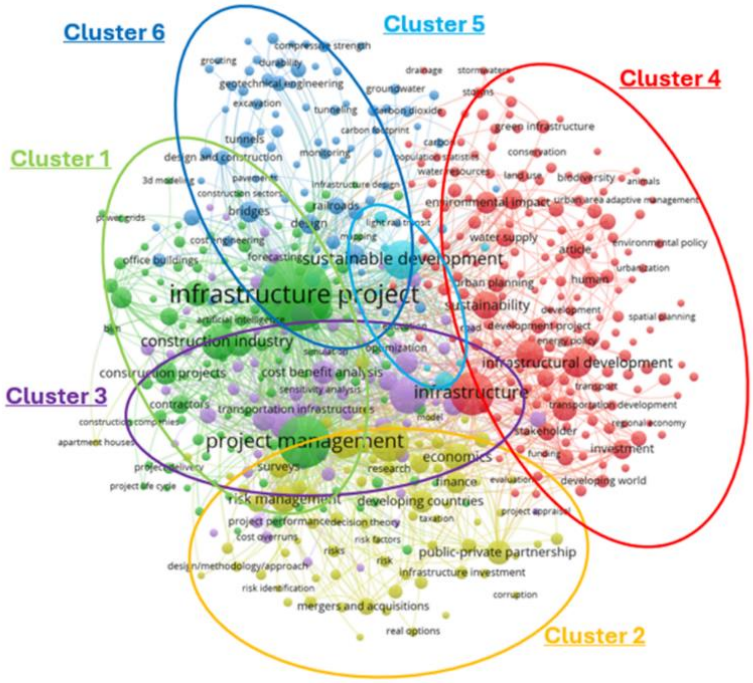

Fig. 4. **Visualisation and clustering of key concepts related to infrastructure projects**

Source: developed by the author with the help of VosViewer software based on Scopus database (2024)

In the case of the concept of “sustainable infrastructure project”, 392 keywords and 6 clusters were generated (see Figure 5).

- Cluster 1 (7 keywords) - cost-benefit analysis, design, detection method, forecasting, infrastructure, investment, planning, risk assessment, seismic design, sustainable development, water supply;
- Cluster 2 (9 keywords) - built environment, decision-making process, decision support system, environmental management, greenhouse gases; infrastructure project, knowledge management, sustainable development, sustainable infrastructure;
- Cluster 3 (6 keywords) - assessment, construction industry, construction projects, environmental impact, finance, waste management;
- Cluster 4 (5 keywords) - construction education, engineering education, preliminary planning, project management, rating system;
- Cluster 5 (5 keywords) - climate change, comparative research, environmental sustainability, green bonds, green finance;
- Cluster 6 (2 keywords) - life cycle, sustainable project.

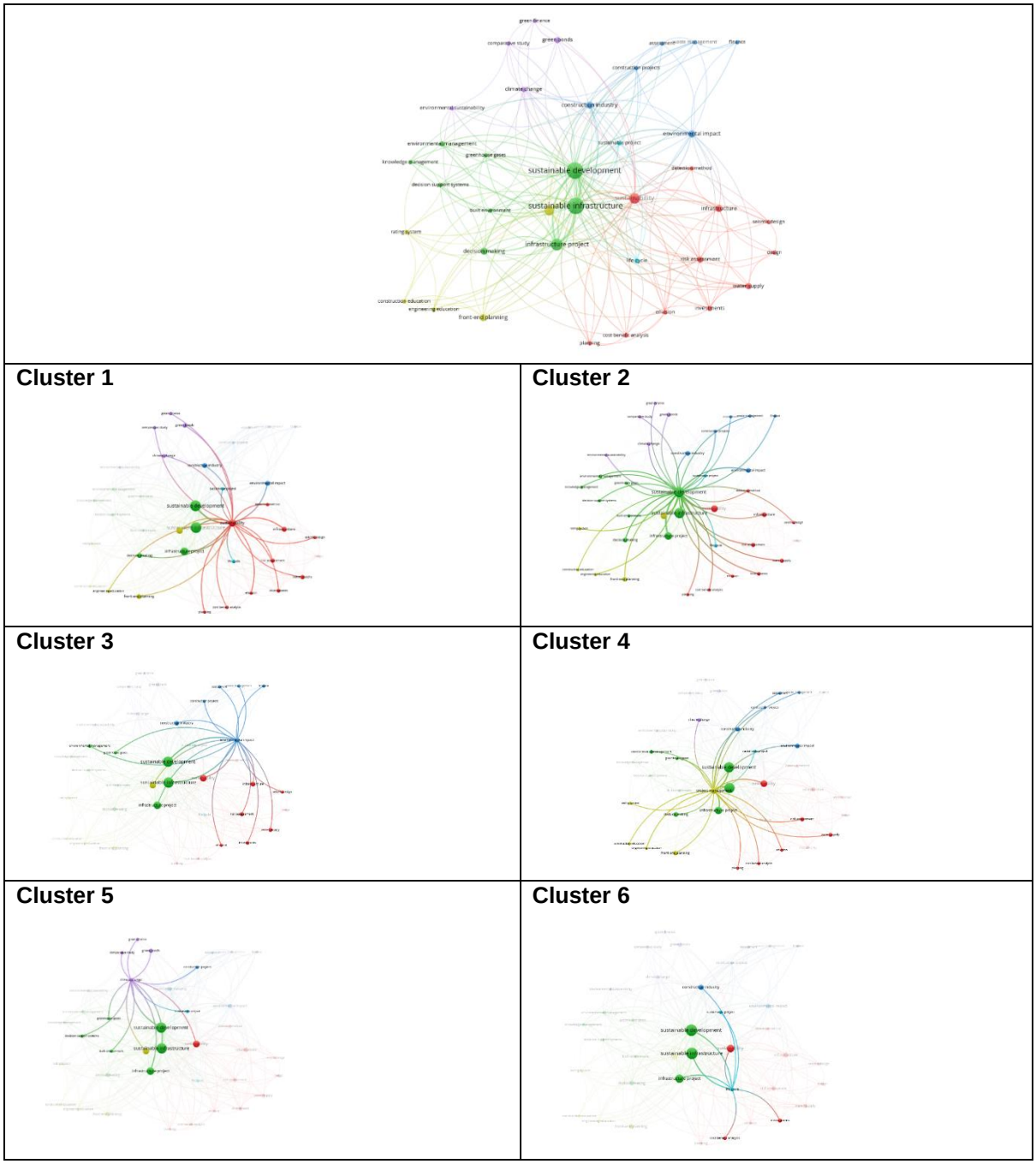

Fig. 5. Visualisation and clustering of key concepts related to the concept of "sustainable infrastructure project" (May, 2024)

Source: developed by the author with the help of VosViewer software based on Scopus database (2024)

Summarizing the results of the content-contextual block bibliometric analysis, it was noted that the bulk of scientific research is focused on identifying the interconnections of sustainable infrastructure projects with sustainable development (cluster 1), sustainable infrastructure (cluster 2), environmental impact (cluster 3), project management (cluster 4), climate change (cluster 5), and project life cycle (cluster 6) (Figure 6). The gradient from pale yellow to bright yellow indicates the increasing density of connections between the concepts in the study.

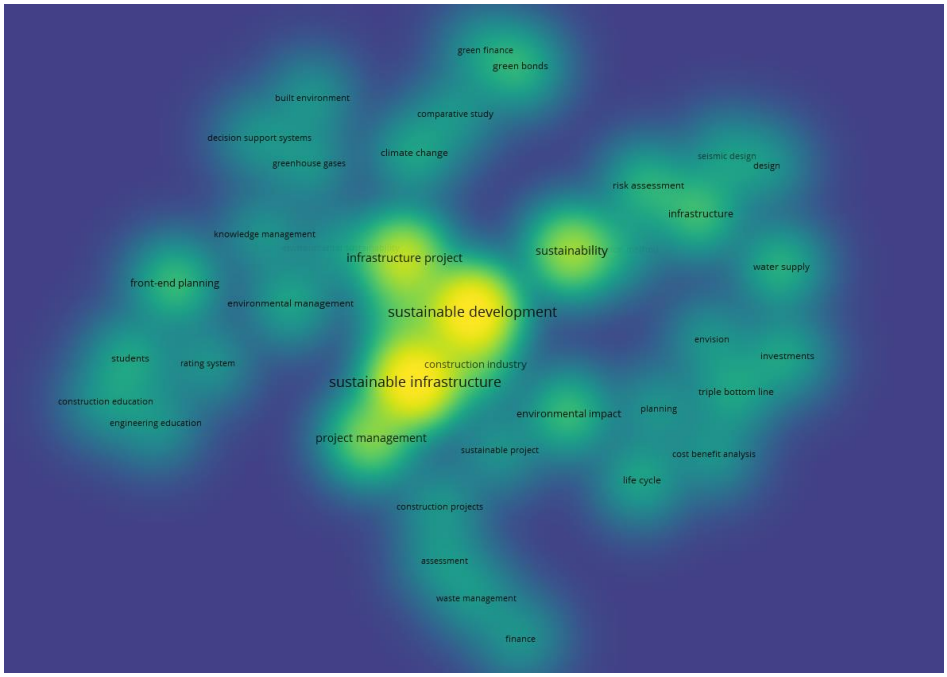

Fig. 6**. Map of the density of connections between concepts in the context of research on sustainable infrastructure projects based on publications in the Scopus database**

Source: developed by the author with the help of VosViewer software based on Scopus database (2024).

The strong links with these key concepts can be explained by the fact that a sustainable infrastructure project must meet the goals of sustainable development and be designed with the principles of sustainable development in mind, minimising negative environmental impacts, mitigating their consequences and withstanding the impacts of climate change, while managing potential environmental and social risks at all stages of the project life cycle. Thus, a sustainable infrastructure project is a comprehensive initiative that considers not only the technical aspects of construction, but also the long-term impacts on the environment, society, and economy.

The bibliometric analysis revealed a significant increase in scholarly attention towards “infrastructure projects” since the early 2000s, with the concept of “sustainable infrastructure projects” emerging as a distinct area of research in recent years. This analysis underscores the growing recognition of the critical role of infrastructure in sustainable development.

Key findings include a strong emphasis on research themes related to environmental sustainability, social equity, and economic resilience within the context of infrastructure development. The findings of this study have significant implications for policymakers and practitioners. Understanding the evolution of research on "sustainable infrastructure projects" can inform the development of more effective policies and strategies for planning, financing, and implementing sustainable infrastructure projects.

In the context of the ongoing conflict in Ukraine, this research has particular relevance. The widespread destruction of critical infrastructure in Ukraine highlights the urgent need for comprehensive and sustainable reconstruction efforts. Analyzing the existing body of knowledge on sustainable infrastructure can provide valuable insights into best practices for reconstruction, ensuring that the rebuilding process prioritizes sustainability, resilience, and long-term development.

Conclusions

This research has employed bibliometric analysis to investigate the evolution of scholarly discourse on "infrastructure projects" and "sustainable infrastructure projects" within the context of sustainable development. The bibliometric analysis of the term "infrastructure project" within the context of sustainable development demonstrates a significant evolution in research focus over the past two decades. Initially dominated by technical aspects, the field has increasingly embraced interdisciplinary approaches driven by digitalization, open data, and advanced analytical methods. So, the term “infrastructure project” could be explained as a complex undertaking involving the creation, upgrading, or maintenance of physical assets essential for societal and economic functioning, which involves stakeholders of different levels in dynamic interaction. Environmental concerns have shifted attention towards sustainable infrastructure, with notable growth in related publications since 2012. Key global events, including the 2001 terrorist attacks, the 2007-2008 financial crisis, and the adoption of the UN's Sustainable Development Goals and the Paris Agreement, have profoundly influenced research trends. Recent challenges, such as the COVID-19 pandemic and conflicts in Ukraine, further underscore the importance of resilient and sustainable infrastructure development. In these conditions, the term “sustainable infrastructure project” could be identified as a planned and executed undertaking that goes beyond traditional infrastructure development by integrating principles of environmental sustainability, social equity, and economic viability. This analysis highlights the dynamic and multifaceted nature of infrastructure project research in the context of sustainable development, pointing to a continued integration of sustainability principles in future studies.

According to the results obtained with the help of the VosViewer software, the relevance and necessity of a more detailed and thorough further study of infrastructure projects with regard to the concept of project management, analysis of the country's investment activity, and review of public-private partnership as a form of project financing, research into the main decision-making approaches and planning, analysis of the infrastructure sector and sustainable infrastructure projects, their social and economic impact, as well as features of sustainable development in terms of the implementation of infrastructure projects for environmental and climate change.

References

International Institute of Sustainable Development (2024). *What is sustainable infrastructure?* Retrieved from https://www.iisd.org/savi/faq/what-is-sustainable-infrastructure-2/

Kharchuk, O., & Ivanychenko, V. (2019). Infrastructure projects: essence, types and their significance for the transport industry of Ukraine. In *Collection Scientific Eorks of the State University of Infrastructure and Technologies. Series: Economics and management,* 43–44, 42–51. Retrieved from https://em.duit.in.ua/index.php/home/issue/view/11

KSE Institute; The Office of the President of Ukraine; the Ministry of Economy of Ukraine; the Ministry for the Restoration of Community Development, Territory and Infrastructure of Ukraine; the Ministry for Temporarily Occupied Territories and Internally Displaced Persons of Ukraine (2024, April). *Report on direct damage to infrastructure from the destruction caused by Russia's military aggression against Ukraine as of the beginning of 2024*. Retrieved from https://kse.ua/wp-content/uploads/2024/04/01.01.24_Damages_Report.pdf

Onalaja, A., Cheung, W.M., & Samwinga, V. (2018). Identifying infrastructure project uncertainties during project initiation using system thinking. In *Proceedings of the Creative Construction Conference 2018,* 537–543. https://doi.org/10.3311/CCC2018-071

Scopus Database (2024). Retrieved from https://www.scopus.com

Smentina, N., & Klevtsevych, N. (2016). *Infrastructure Project Management*. Odesa: ONEU.

UNEP (2023, February). *Annual Report 2022*. Retrieved from https://www.unep.org/resources/annual-report-2022

United Nations (2015). *The 17 Goals*. Retrieved from: https://sdgs.un.org/goals

Verkhovna Rada of Ukraine (2020). *On amendments to some legislative acts of Ukraine to simplify the attraction of investments and the introduction of new financial instruments.* Act No. 738-IX, June 19. Retrieved from https://zakon.rada.gov.ua/laws/show/738-20#Text

VosViewer Official Website (2024). Retrieved from https://www.vosviewer.com

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