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Artificial Intelligence in the Digital Transformation of Smart City Governance: A Bibliometric Analysis

Sultan A. Zhubanazarov[a]*, Gulnur S. Tapenova[a], Sairan N. Ulakov[a], Bauyrzhan A. Zhunusov[b], Desislava I. Yordanova[c]

[a] Karaganda University of Kazpotrebsoyuz, 9 st. Academic, Karaganda, Kazakhstan; [b] Aktobe Regional University named after K.Zhubanov, 34 Aliya Moldagulova ave., Aktobe, Kazakhstan; [c] Sofia University "St Kliment Ohridski"; 15 bul.Tsar Osvoboditel, Sofia, Bulgaria

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ABSTRACT

The rapid introduction of artificial intelligence into smart city management systems is changing approaches to urban planning, public service provision, and management decision-making, but scientific research in this area remains thematically and disciplinarily fragmented. The primary aim of this study is to systematically map the scientific literature on the role of artificial intelligence in the digital transformation of smart city governance. The paper uses methods of bibliometric and network analysis, including analyses of publication and citation dynamics, co-authorship, bibliographic coupling among organizations, and the co-occurrence of keywords. The selection of publications was conducted in accordance with the PRISMA 2020 guidelines, and the construction and visualization of bibliometric networks were performed using the VOSviewer program. The initial data was obtained from the Scopus database on October 5, 2025. An initial search revealed 34,548 documents. After applying the criteria of the subject area, publication period, document type, and language, the final sample included 1,865 English-language journal articles published in 2015-2025. The largest number of publications is in China — 236 articles (12.7%), Great Britain — 230 (12.3%), and the USA — 216 (11.6%). Kazakhstan ranks 54th with nine publications. The most productive journal is Sustainability, with 254 articles, followed by Sustainable Cities and Society with 134 and Cities with 122. The results show a steady increase in scientific interest in the topic after 2019 and, at the same time, indicate a lack of development in interregional scientific cooperation and research on the ethical, institutional, and societal aspects of the use of artificial intelligence in urban governance.

KEYWORDS: Smart City, Urban Planning, Urban Economy, Artificial Intelligence, Digital Transformation, Bibliometric Analysis, Network Analysis

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*** Corresponding author: Zhubanazarov S.A.** – PhD candidate, Karaganda University of Kazpotrebsoyuz, 9 st. Academic, Karaganda, Kazakhstan, 87767970228, email: szhubanazar@gmail.com

Искусственный интеллект в цифровой трансформации управления умными городами: библиометрический анализ

Жұбаназаров С.А.[a]*, Тапенова Г.С.[a], Улаков С.Н.[a], Жунусов Б.А.[b], Йорданова Д.И.[c]

[a]Карагандинский университет Казпотребсоюза, ул. Академическая 9, Караганда, Казахстан; [b]Актюбинский региональный университет имени К.Жубанова, пр. А. Молдагулова 34, Актобе, Казахстан; [c]Софийский университет "Св. Климент Охридского", бул. "Цар Освободител" 15, София, Болгария

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АННОТАЦИЯ

Стремительное внедрение искусственного интеллекта в системы управления умными городами меняет подходы к городскому планированию, предоставлению общественных услуг и принятию управленческих решений, однако научные исследования в этой области остаются тематически и дисциплинарно разрозненными. Цель настоящего исследования систематизировать научную литературу о роли искусственного интеллекта в цифровой трансформации управления умными городами. В работе применены методы библиометрического и сетевого анализа, включая анализ динамики публикаций и цитирования, соавторства, библиографического сопряжения организаций и совместной встречаемости ключевых слов. Отбор публикаций осуществлялся в соответствии с принципами PRISMA 2020, а построение и визуализация библиометрических сетей — с использованием программы VOSviewer. Исходные данные получены из базы Scopus 5 октября 2025 года. Первоначальный поиск выявил 34 548 документов. После применения критериев предметной области, периода публикации, типа документа и языка в итоговую выборку вошли 1 865 англоязычных журнальных статей, опубликованных в 2015–2025 годах. Наибольшее количество публикаций приходится на Китай — 236 статей (12.7%), Великобританию — 230 (12.3%) и США — 216 (11.6%). Казахстан занимает 54-е место с девятью публикациями. Наиболее продуктивным журналом является Sustainability — 254 статьи, за ним следуют Sustainable Cities and Society — 134 и Cities — 122 статьи. Результаты показывают устойчивый рост научного интереса к теме после 2019 года и одновременно свидетельствуют о недостаточной развитости межрегионального научного сотрудничества и исследований этических, институциональных и общественных аспектов применения искусственного интеллекта в городском управлении.

КЛЮЧЕВЫЕ СЛОВА: умный город, городское планирование, городская экономика, искусственный интеллект, цифровая трансформация, библиометрический анализ, сетевой анализ

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*** Корреспондирующий автор: Жұбаназаров С.А.** – PhD докторант, Карагандинский университет Казпотребсоюза, ул. Академическая 9, Караганда, Казахстан, 87767970228, email: szhubanazar@gmail.com

INTRODUCTION

Over the past decade, digital technologies have been rapidly integrated into urban governance systems. Artificial intelligence (hereinafter – AI) has attracted increasing attention because of its potential to transform smart city development and management. AI offers numerous opportunities to improve quality of life, increase service efficiency, enhance infrastructure reliability, and support effective urban administration (Albino et al., 2015). It is now used not only to anticipate and prevent infrastructure failures but also to improve public services and promote sustainable development.

AI can support the integration of the core dimensions of smart city development, including the economy, human capital, governance, mobility, the environment, and quality of life (Albino et al., 2015). This integration is enabled by real-time data processing, predictive analytics, automated decision support systems, and coordination among different urban services. In transportation, AI can optimize traffic flows, public transport routes, and mobility planning. In environmental management, it can support the monitoring of energy consumption, emissions, waste, and other indicators of urban sustainability. AI can also facilitate economic development by improving resource allocation, supporting innovation, and increasing the efficiency of urban infrastructure. In public administration, it can strengthen evidence-based planning, automate routine administrative processes, improve public service delivery, and enable authorities to respond more rapidly to citizens' needs. When combined with the Internet of Things, big data, and other digital technologies, AI provides urban authorities with new tools for identifying emerging problems, evaluating alternative policy scenarios, and addressing complex urban development challenges. However, the effectiveness of these applications depends on data quality, institutional capacity, system interoperability, and the responsible governance of AI technologies.

Nevertheless, the body of knowledge on the application of AI in smart city management remains dispersed across various disciplines. The ethical application of AI, protecting privacy, and minimizing potential abuse of AI are among the key concerns that must be addressed in this nascent domain. These concerns have been considered in the current paper through a bibliometric study. The application of bibliometrics, which involves quantitative approaches in the assessment of scientific literature, is an objective way to analyse new domains and draw the contours of their development.

The primary aim of this study is to systematically map scientific literature on AI's role in the digital transformation of smart city governance. Specifically, the study identifies the major thematic clusters, influential authors, institutions, countries, journals and publications, international collaboration patterns, and existing research gaps. To achieve this aim, Scopus-indexed publications are examined using bibliometric techniques within a systematic literature-selection framework. The study addresses the following research questions:

RQ1: What major themes and research clusters characterize the literature on AI and the digital transformation of smart city governance?

RQ2: Which authors, institutions, countries, journals, and publications have had the greatest influence on the development of this research field?

RQ3: What research gaps and promising directions for future studies emerge from the bibliometric analysis?

LITERATURE REVIEW

In the context of smart cities, urban governance encompasses the institutional arrangements, decision-making processes, and stakeholder relationships through which public policies and urban services are designed, implemented, and evaluated (Meijer & Bolívar, 2016). Effective governance can strengthen urban competitiveness by improving institutional coordination, supporting innovation, and enabling cities to respond more efficiently to social, economic, and environmental challenges (Sgambati & Gargiulo, 2022). Smart city governance therefore extends beyond the digital provision of public services. It also includes citizen participation, evidence-based policymaking, institutional transparency, and the co-production of urban solutions by public authorities, businesses, civil society organisations, and local communities.

Scholl and AlAwadhi (2016) identify several governance challenges associated with smart city initiatives. These include coordinating complex partnerships among public, private, and civic actors, integrating data from different administrative

systems, managing large-scale data infrastructures, and maintaining democratic accountability in an increasingly algorithmic environment. The growing use of AI adds another layer to these challenges because algorithmic outputs can influence policy priorities, resource allocation, access to public services, and administrative decision-making. Consequently, the adoption of AI in urban governance requires not only appropriate technological infrastructure but also institutional rules that determine how data and algorithmic recommendations are produced, interpreted, and used.

The digital transformation of public administration entails the radical reshaping of governmental systems, functions, and relationships through the intelligent use of digital technologies (Mergel et al., 2019). Unlike e-government development, which emphasizes continuous improvement, digital transformation entails reconsidering how values are created, organizational cultures are shaped, and state-citizen relations are formed. According to the literature, digital transformation is the most prominent form of technological change in government administration. Public sector studies have shifted toward an emphasis on data analytics and AI (Sun & Medaglia, 2019). However, public institutions may lack the regulatory capacity, specialised expertise, and organisational flexibility required to adapt governance frameworks to rapidly developing AI capabilities (Wirtz & Weyerer, 2023). Moreover, the public value of digital transformation depends not only on administrative efficiency but also on citizen trust, acceptance, accessibility, and the perceived legitimacy of technology-based decisions (Twizeyimana & Andersson, 2019).

The use of AI in urban governance has broad scope and spans various areas. According to Yigitcanlar and Cugurullo (2020), there is an extensive overview of AI technology for urban development, with machine learning as the main component. This paper finds a vast disparity between the technological aspects of AI and the preparedness of institutions in local governance settings. On the other hand, theoretical research into the new science of cities has postulated that the digital flow of information is transforming urban systems into complex adaptive systems that require new computational models for governance. Such theoretical knowledge has led to a growing body of research on the role of AI in improving human decision-making in urban governance. On the other hand, the value-related aspects of governance, including fairness, accountability, and political legitimacy, cannot be captured solely by technical approaches (Cocchia, 2014).

However, despite the growing body of studies conducted in both fields, important gaps remain. Firstly, the knowledge structure of literature on the use of AI in smart city governance has yet to be systematically mapped through bibliometric analysis. Secondly, few cross-country comparisons have been made on the use of AI in governance practices. The third gap concerns the ethical and accountability aspects of AI in smart city management, including transparency and citizen involvement. The fourth gap concerns the absence of a temporal analysis to demonstrate the evolution of research priorities in response to new policies and technologies. This study fills these gaps by providing an empirical basis for further research.

Bibliometric analysis is well-suited to addressing these gaps because it enables quantitative examination of publication trends, citation impact, collaboration networks, influential contributors, and relationships among research topics (Donthu et al., 2021). Previous research has demonstrated the increasing relevance of digital public administration for sustainable development and data-driven governance (Burlacu et al., 2021). However, an integrated mapping of AI research within the specific context of smart city governance remains necessary. Accordingly, the present study analyses Scopus-indexed publications to identify the intellectual structure, thematic clusters, influential contributors, collaboration patterns, and future research directions in this field.

RESEARCH METHODS

Bibliometrics is an established methodology that uses quantitative approaches to assess trends in scientific literature (Donthu et al., 2021). In this regard, a bibliometric analysis of scientific literature on the role of AI in the digital transformation of smart city governance in the Scopus database was performed, with a particular focus on the volume of literature and citation rate, collaboration networks among authors, and thematic clusters of keywords. The advantage of using a bibliometric

approach lies in its capability to analyse large sets of literature at once, reveal structural patterns, and offer a methodological foundation for intellectual developments.

Scopus was selected as the sole bibliographic data source because it provides broad multidisciplinary coverage and structured metadata required for bibliometric analysis, including author information, institutional affiliations, citation data, author keywords, and cited references. The publication identification, screening, and selection procedure was reported in accordance with the PRISMA 2020 framework, adapted to the context of a bibliometric review (Page et al., 2021). PRISMA was used to document the number of records identified, excluded, screened, and retained for the final bibliometric analysis. Figure 1 presents the corresponding study-selection flow diagram.

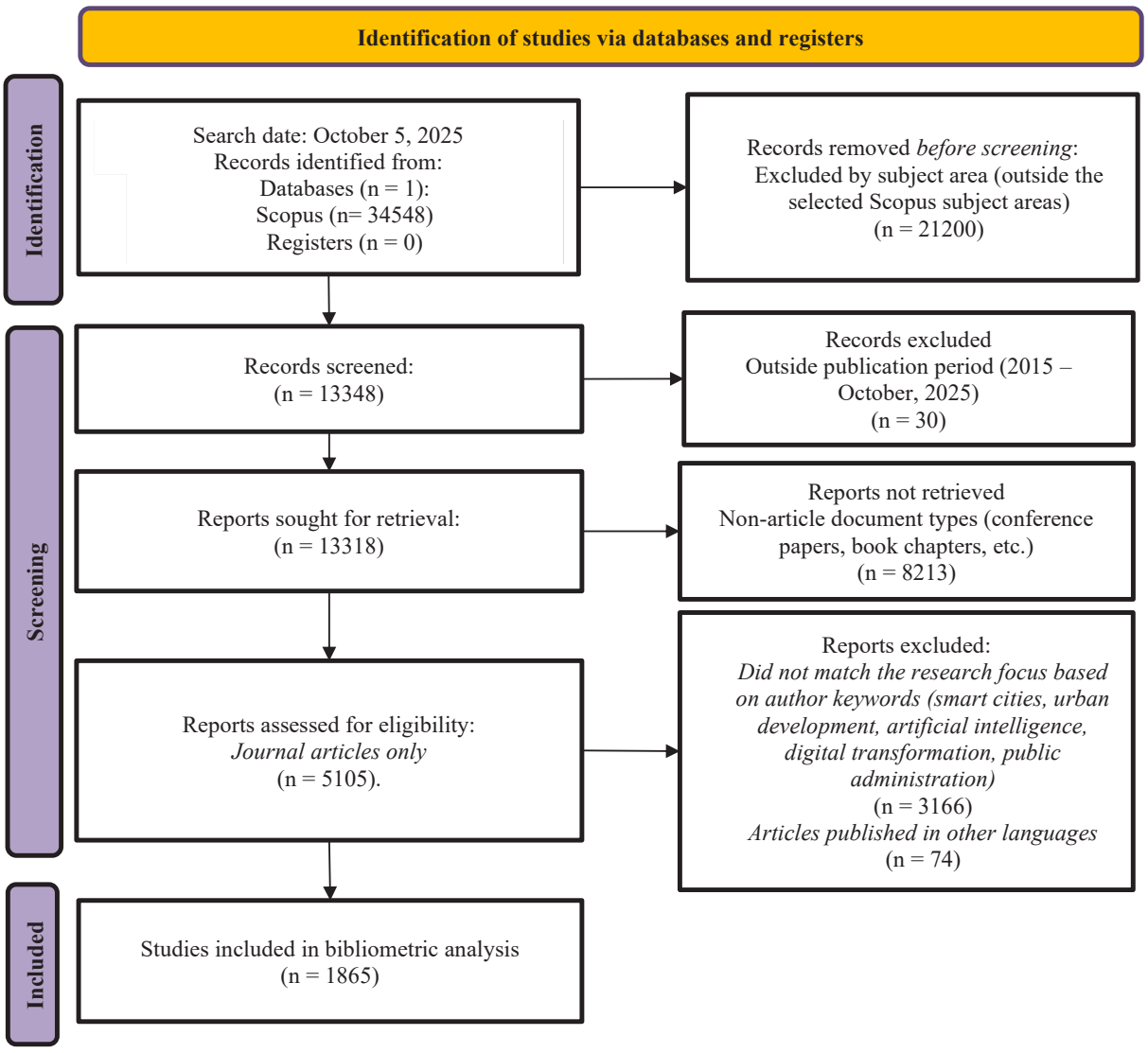


Figure 1. PRISMA 2020 flow diagram of the study selection process

Bibliometric data were retrieved exclusively from the Scopus database on 5 October 2025. The search was conducted in the TITLE-ABS-KEY field using three conceptual groups representing smart cities, artificial intelligence, and urban governance: TITLE-ABS-KEY (“smart city” OR “smart cities”) AND TITLE-ABS-KEY (“artificial intelligence” OR “machine learning” OR “deep learning”) AND TITLE-ABS-KEY (“urban governance” OR “smart governance” OR “public administration” OR “digital government” OR “digital transformation” OR “urban management”). This search structure

ensured that every retrieved publication addressed all three core components of the study: the smart city context, artificial intelligence technologies, and governance or public administration. The acronym "AI" was not used as an independent search term because it may retrieve records in which the same abbreviation has a different meaning.

The initial search returned 34,548 records. Following the PRISMA 2020 guidelines, publications outside the selected subject areas (Social Sciences, Decision Sciences, Business, Management and Accounting) were excluded (n = 21,200), leaving 13,348 records for screening. Restricting the publication period to 2015-2025 (October) excluded 30 records, resulting in 13,318 publications. Subsequently, only journal articles were retained, excluding conference papers, reviews, book chapters, editorials, and other non-article document types (n = 8,213). This resulted in 5,105 journal articles eligible for further assessment.

The bibliographic records were exported from Scopus in CSV format. The exported data included complete citation information, abstracts, author affiliations, author keywords, index keywords, funding information, and cited references. Before analysis, author names, institutional affiliations, country names, and synonymous keywords were standardised. A thesaurus file was used to merge equivalent terms, such as "AI" and "artificial intelligence", "smart city" and "smart cities", and "IoT" and "Internet of Things".

The remaining 1,939 publications were further restricted to English-language articles, excluding 74 non-English publications. Consequently, a final dataset of 1,865 publications was retained for bibliometric analysis. The inclusion criteria comprised peer-reviewed journal articles indexed in Scopus that satisfied the predefined search query, subject area, publication period, author keyword filters, and English-language criteria.

The bibliographic records were exported in CSV format and included complete bibliographic information, author affiliations, abstracts, author keywords, and cited references for subsequent bibliometric analysis using VOSviewer. To identify collaboration networks and thematic research clusters, network analysis was conducted using VOSviewer based on co-authorship relationships and keyword co-occurrence. In the resulting maps, the colours represent clusters identified using the VOSviewer clustering algorithm (Van Eck & Waltman, 2010).

RESULTS

Within the framework of the bibliometric analysis, the study examined research on the role of AI in public administration and urban development by analysing journals, highly cited publications, authors, and keywords in the dataset. This approach enabled the construction of bibliometric maps and provided the analytical basis for answering the research questions.

The dataset used in this study comprises 1,865 scholarly papers published in 687 journals, primarily covering the fields of Social Sciences, Business, Management and Accounting, and Decision Sciences. These papers were authored by 5,350 researchers affiliated with 3,443 organisations in 102 countries and received a total of 74,421 citations.

The annual number of publications demonstrates an overall upward trend during the period under consideration. From 2015 to 2018, scientific output remained relatively low, reflecting the early development of this interdisciplinary research field. A notable increase occurred in 2019, when the number of publications reached 139. Although some fluctuations were observed between 2020 and 2022, a clear upward trend emerged after 2023. During the first ten months of 2025, the annual number of publications exceeded 287. Overall, these findings demonstrate a gradual increase in scientific activity in this field.

Citation counts for these years are expected to increase over time (Figure 2).

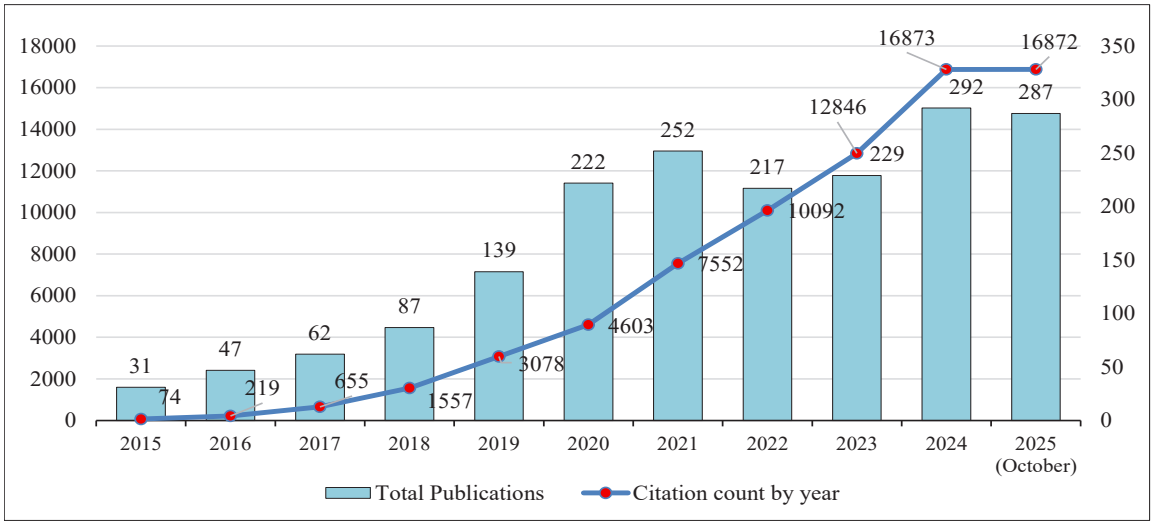


Figure 2. Annual publication and citation index

Regarding citation dynamics, the publications received between 74 and 655 citations per year from 2015 to 2017. The number of citations increased sharply to 1,557 in 2018, possibly due to the influence of one or more highly cited studies. From 2019 onwards, citation counts continued to increase, reaching 3,078. The highest citation activity was observed during the 2020–2025 period, indicating the growing visibility and academic influence of publications in this field. Citation data for 2024 and 2025 remain incomplete because recent publications have had less time to accumulate citations, and the 2025 data cover only through October.

Figure 3 presents the international co-authorship network by country, illustrating collaborative relationships among countries engaged in smart city research.

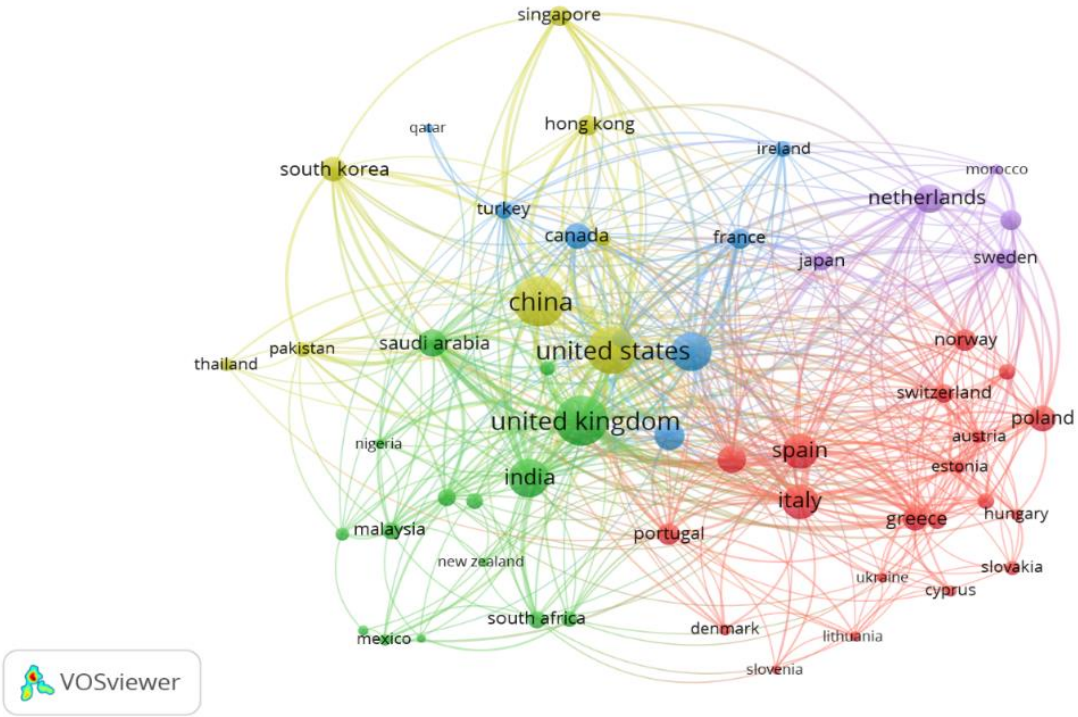


Figure 3. International co-authorship network by country

The network revealed several densely connected international collaboration clusters, with the United States, China, and the United Kingdom occupying central positions and maintaining strong collaborative links with numerous countries. These findings demonstrate that international scientific cooperation plays an important role in the development of smart city research. China had the highest publication output (n = 236; 12.7% of all publications), followed by the United Kingdom (n = 230; 12.3%), the United States (n = 216; 11.6%), India (n = 144; 7.7%), Australia (n = 137; 7.3%), Italy (n = 119; 6.4%), and Spain (n = 118; 6.3%). Although China led in publication output, the citation analysis showed that publications from the United States had the highest citation impact per document (CPD = 22.7), followed by those from the United Kingdom (CPD = 19.7). Kazakhstan ranked 54th with 9 publications, indicating a relatively limited contribution to global scientific output in this field.

The bibliographic coupling network of organizations generated using VOSviewer illustrates the intellectual similarity among research institutions based on the references cited in their publications (Figure 4).

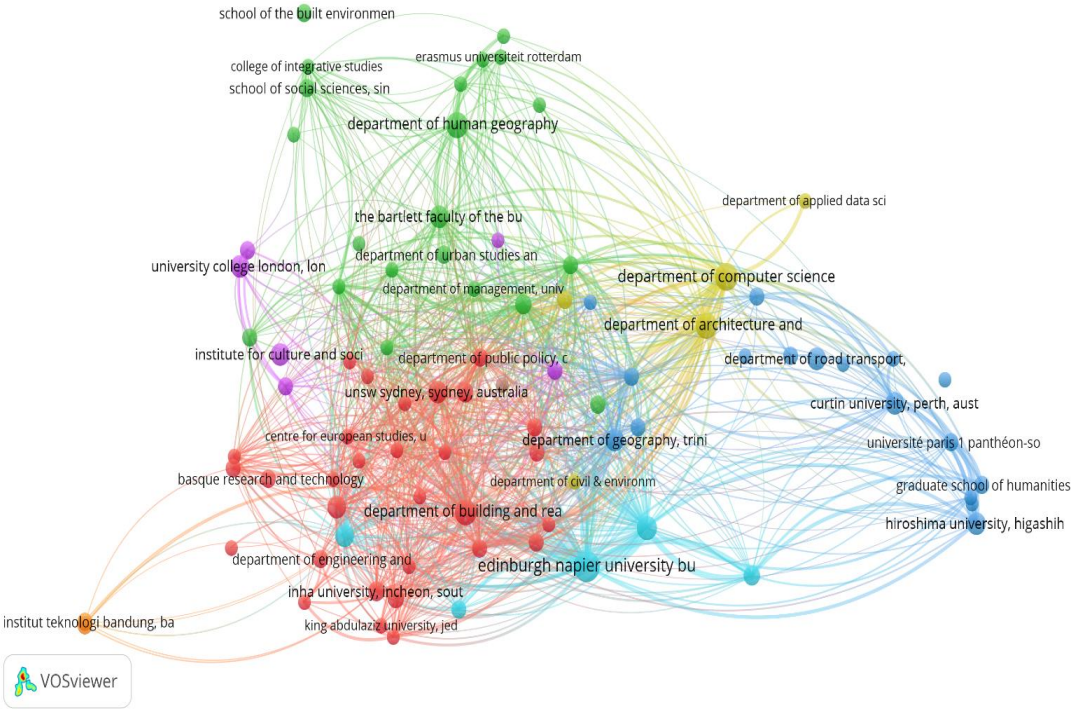


Figure 4. Bibliographic coupling of organizations

The network identifies several densely connected institutional clusters, indicating organizations that share similar knowledge bases and research interests rather than direct collaborative relationships. The clustering patterns reflect thematic proximity in smart city research and demonstrate the existence of distinct research communities. Among the most influential organizations, Queensland University of Technology (n = 25) and UNSW Sydney (n = 25) exhibit the highest publication output. UNSW Sydney occupies a central position within the network and demonstrates strong bibliographic links with organizations across multiple thematic clusters, reflecting the broad interdisciplinary scope of its research. Edinburgh Napier University (n = 21) also represents a prominent organization, connecting several institutional clusters through shared citation patterns in smart city and urban planning research. The National University of Singapore (n = 20) forms the core of the Asian institutional cluster, showing strong bibliographic coupling with organizations from Southeast Asia, particularly Institut Teknologi Bandung (Indonesia). University College London (n = 18) occupies a central position within the United Kingdom-Europe cluster and demonstrates high intellectual similarity with institutions

engaged in theoretical and conceptual research. Norges Teknisk-Naturvitenskapelige Universitet (n = 17) represents the Scandinavian research community and exhibits strong bibliographic links with organizations focusing on engineering and urban technology. Overall, the bibliographic coupling network indicates that organizations tend to form geographically and thematically coherent clusters based on shared citation patterns. While the Australian, United Kingdom, European, and Asian clusters demonstrate strong internal bibliographic similarity, the links between these clusters are comparatively weaker. Organizations such as UNSW Sydney and Edinburgh Napier University occupy central positions connecting multiple thematic clusters, reflecting their broad research portfolios and extensive intellectual influence within the smart city research domain.

Co-authorship networks of scholars show how scientists work together to develop and contribute to the field of research. In the case study at hand, the co-authorship network comprises 5,350 scholars whose interactions were examined with a minimum publication threshold of 5, yielding 6 clusters comprising 24 authors (Figure 5).

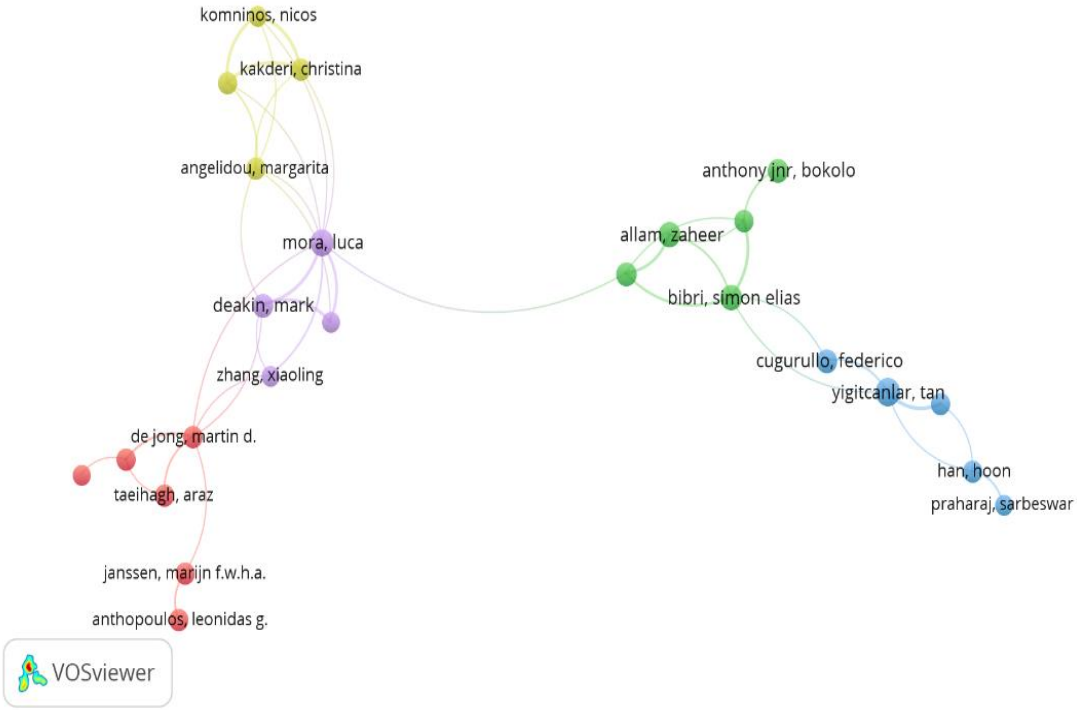


Figure 5. Co-authorship network among authors

The formation of clusters in the network indicates that each group consists of authors with relatively strong collaborative ties. These clusters are characterized by high levels of internal connectivity and comparatively limited links with other clusters. Larger nodes represent authors with greater weight in the co-authorship network, while extensive links with other researchers indicate their potential role in connecting different research directions.

The largest author cluster is centered on Tan Yigitcanlar and includes researchers from Australia, Ireland, and Asia. The map shows that this cluster is strongly connected to Zaheer Allam and Simon Elias Bibri, reflecting collaboration among scholars working on smart-city sustainability and green-infrastructure development. Another cluster comprises Greek researchers, including Margarita Angelidou, Christina Kakderi, Nicos Komninos, and Anastasia Panori, whose research focuses on smart city innovation and regional development. The network also reveals links among Mark Deakin, Luca Mora, Alasdair Reid, and Xiaoling Zhang, indicating collaboration between researchers from Europe and Asia. Luca Mora occupies a central position in the network and appears to act as a bridge between several research clusters.

The co-authorship visualization helps identify existing collaboration patterns and the formation of scientific communities within the multidisciplinary field of smart city governance. Although cross-regional links are present, they remain less developed than collaboration within individual geographical and thematic clusters. This pattern demonstrates the international scope of smart city research and underscores the need to strengthen cooperation among researchers across regions.

As shown in Figure 6, studies on the digital transformation of urban governance are concentrated in several core journals.

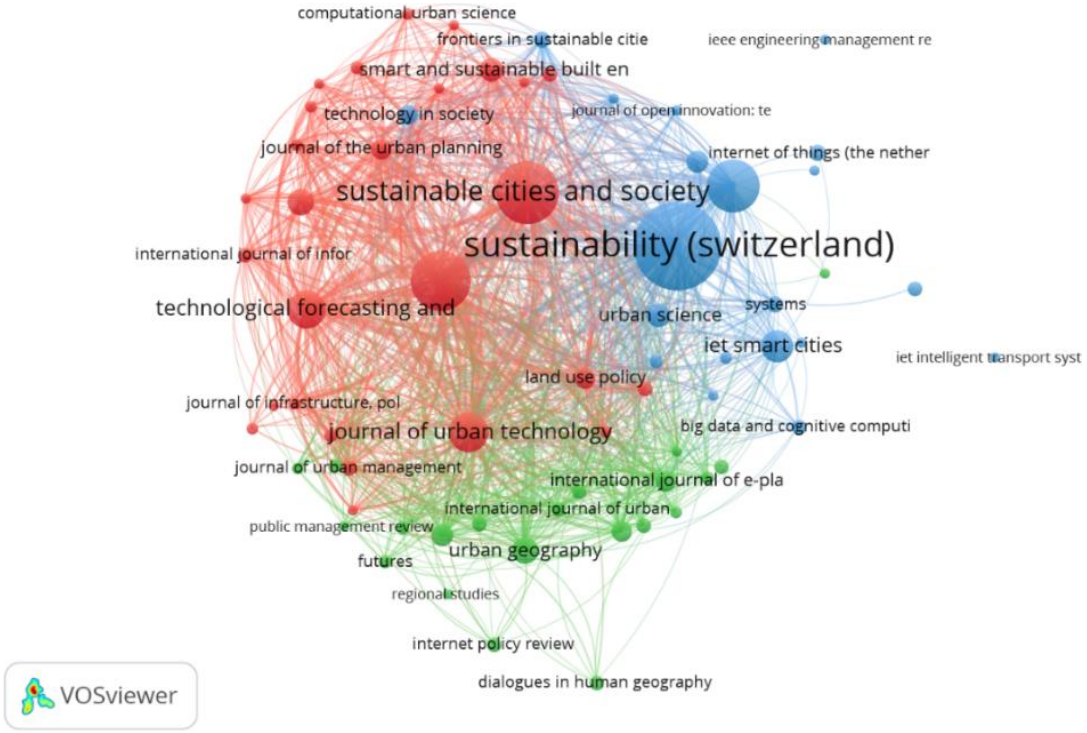


Figure 6. Bibliometric map of international scientific journals

The review revealed that many studies regarding digital transformation in urban governance are available in specific core journals. When it comes to journal impact, the largest number of papers (n = 254) is found in Sustainability (Switzerland), a journal attributed to its interdisciplinary nature and open-access policy. Sustainable Cities and Society is another key journal in the field, ranking second (n = 134). Another noteworthy journal in the field is Cities (n = 122), one of the most authoritative sources in the study of AI and smart-city governance. Other impactful journals include Smart Cities (n = 92), Journal of Urban Technology (n = 53), Technological Forecasting and Social Change (n = 48), and IET Smart Cities (n = 35)

The ten most highly cited scientific papers are presented in Table 1.

Table 1. Top ten most cited publications

Author (year)	Title	Journal and No.	Citations
Albino et al. (2015)	Smart cities: Definitions, dimensions, performance, and initiatives	Journal of Urban Technology, 22(1), pp. 3–21	2,636
Moreno et al. (2021)	Introducing the “15-minute city”: Sustainability, resilience and place identity in future post-pandemic cities	Smart Cities, 4(1), pp. 93–111	1,210
Ahvenniemi et al. (2017)	What are the differences between sustainable and smart cities?	Cities, 60, pp. 234–245	1,089
Allam & Dhunny (2019)	On big data, AI and smart cities	Cities, 89, pp. 80–91	881
De Jong et al. (2015)	Sustainable-smart-resilient-low carbon-eco-knowledge cities; Making sense of a multitude of concepts promoting sustainable urbanization	Journal of Cleaner Production, 109, pp. 25–38	874
Dagher et al. (2018)	Ancile: Privacy-preserving framework for access control and interoperability of electronic health records using blockchain technology	Sustainable Cities and Society, 39, pp. 283–297	773
Angelidou (2015)	Smart cities: A conjuncture of four forces	Cities, 47, pp. 95–106	691
Shelton et al. (2015)	The 'actually existing smart city'	Cambridge Journal of Regions Economy and Society, 8(1), pp. 13–25	676
Appio et al. (2019)	Understanding Smart Cities: Innovation ecosystems, technological advancements, and societal challenges	Technological Forecasting and Social Change, 142, pp. 1–14	528
Ahad et al. (2020)	Enabling technologies and sustainable smart cities	Sustainable Cities and Society, 61, 102301	503

Note: compiled by the authors

The criterion for selecting publications is the number of citations, starting at 500. The leader is the publication of Albino, V., Berardi, U., and Dangelico, R.M., entitled “smart cities: definitions, dimensions, performance, and initiatives”, dated 2015 and published in the Journal of Urban Technology. It has been cited 2,636 times. Second is the paper of Moreno, C., Allam, Z., Chabaud, D., Gall, C., and Pratlong, F. “Introducing the ‘15-minute city’: Sustainability, resilience and place identity in future post-pandemic cities” (1,210 citations). The study by Ahvenniemi, H., Huovila, A., Pinto-Seppä, I., and Airaksinen, M., entitled “What are the differences between sustainable and smart cities?”, has also provided significant insights into policy issues in smart city governance. It is worth noting that the papers discussed touch on key aspects of digital transformation and urban governance. In turn, it should be noted that highly cited publications generally require time to gain widespread recognition, as citation counts are often considered an indicator of their impact.

Keyword co-occurrence analysis is a widely used bibliometric technique for identifying the conceptual structure and major research themes within a scientific field. It examines the frequency of author keywords and their co-occurrence relations across publications. A keyword co-occurrence map enables researchers to identify the principal research themes and conceptual relationships in the literature on digital transformation in urban governance. In the present study, keyword co-occurrence analysis was performed using author keywords extracted from the selected publications. A total of 9,174 author keywords were identified across the 1,865 articles. To improve the interpretability of the network, a minimum occurrence threshold of 10 was applied. Consequently, 307 keywords met the threshold and were included in the co-occurrence network. Using the VOSviewer modularity optimization algorithm, the keyword co-occurrence network was partitioned into four thematic clusters (Figure 7).

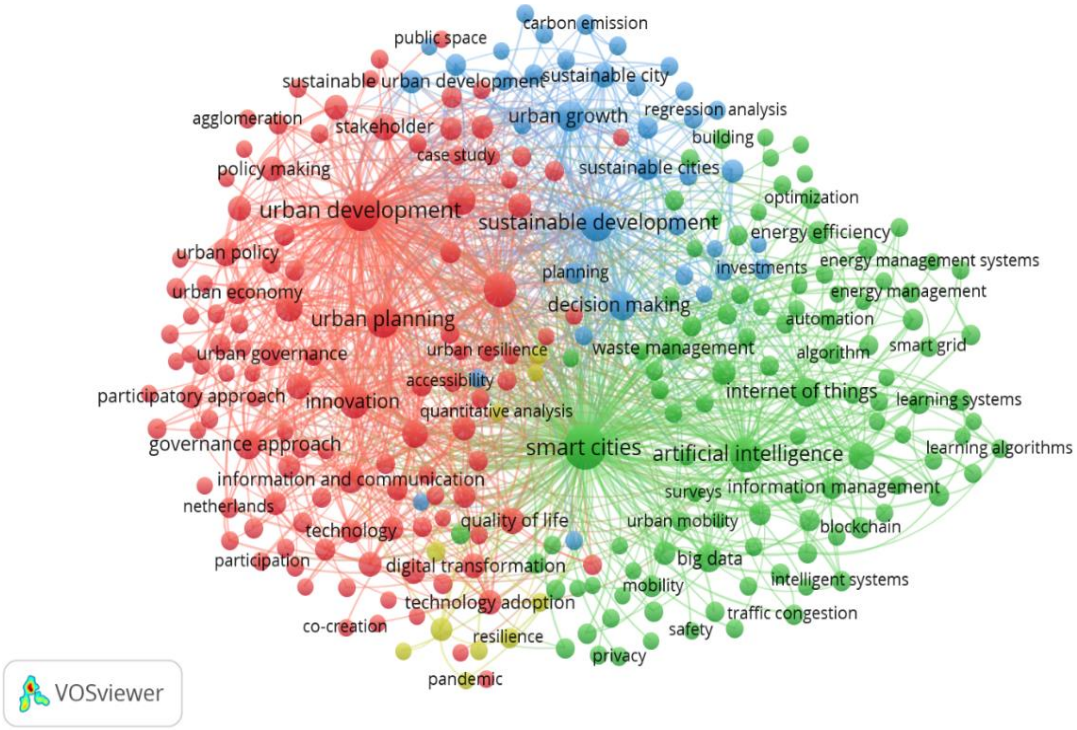


Figure 7. Co-occurrence keyword network

According to the keyword co-occurrence analysis, the keyword "smart cities" had the highest occurrence frequency (n = 1,106) and the highest total link strength (TLS = 4,951), indicating that it represents the most influential and strongly connected node within the network and serves as the central hub linking the identified thematic clusters. Other frequently occurring keywords included urban development (n = 657), sustainability (n = 303), artificial intelligence (n = 288), innovation (n = 173), internet of things (n = 125), decision making (n = 122), and big data (n = 90). The proximity of the "artificial intelligence" node to the central "smart cities" node indicates a strong thematic relationship between these concepts within the keyword co-occurrence network. Overall, the network reveals the principal thematic directions of smart city research and highlights the increasing importance of AI in the digital transformation of urban systems.

Firstly, the cluster marked in green (technological) primarily focuses on the keywords "smart cities" and "artificial intelligence". In the network map, this cluster has a high number of connections among the nodes, which are related to terms such as "internet of things", "urban mobility", "big data", "information management", and "blockchain". The formation of this group of keywords shows their interdependency and interrelatedness. The scientific importance of this cluster lies in its potential to create the technological infrastructure for the effective implementation of big data and ICT by integrating AI into the sustainable development of smart cities. AI plays an important role in innovation that relies on big data and IoT, providing opportunities for data analysis and prediction. The authors Akgün et al. (2024) stress the necessity of using digital communication channels between citizens and authorities to ensure the city's adaptation to the digital age. According to Cardona-Arenas and Campuzano (2024), this cluster creates a technological basis for implementing "a collaborative society that tackles urban problems thanks to citizen participation".

The second cluster, shown in red (governance), revolves around the keywords "urban development" and "urban planning". This cluster has the most nodes and spans a wide area on the left side of the network. This cluster consists of ideas such as "innovation", "information and communication", "participation", "urban governance", "urban economy", and "digital transformation". The scientific contribution of this cluster is evident

in the network model through the need for interaction and cooperation between citizens and local authorities in urban planning, as well as the principle of transparency in public administration. While the technological base introduced in the first cluster (big data, IoT) operates as an intermediary node, contributing to the accomplishment of goals in "urban planning" and "urban governance", it connects the two clusters. In particular, as Han et al. (2024) point out, when local governments follow the principles of openness in data collection, it becomes easier to disseminate information about urban planning among citizens. Furthermore, Kong and Chen (2025) emphasize that the agency for transformation exercised by local governments is essential for increasing urban efficiency. This is directly related to the open community participation mentioned in the first cluster.

Thirdly, the blue cluster ("sustainability") focuses on keywords such as "sustainable development" and "urban growth". This cluster incorporates concepts including "decision-making", "sustainable cities", "sustainable urban development", "carbon emission", "building", "regression analysis", and "planning". Its position within the network indicates strong thematic connections with both the technological and governance clusters. The inclusion of regression analysis reflects the widespread use of empirical methods to examine relationships among urban growth, environmental sustainability, and carbon emissions. Villani et al. (2025) demonstrate that Digital Twin technology, when supported by sensor-distributed networks and predictive capabilities, can enhance sustainable urban management, urban resilience, and data-driven decision-making. Similarly, Kireyeva et al. (2022) emphasize that regional digital readiness and ICT development constitute essential prerequisites for implementing smart city initiatives and supporting regional digital transformation.

Fourthly, the yellow cluster (economic development) focuses on "economic development,", "investments," "regional development," "smart grid," "energy management," and "optimization" and related topics. The proximity of this cluster to the green (technological) one illustrates that, at the level of the network itself, AI's influence on the economy and automation more broadly is evident, as AI algorithms directly affect economic outcomes. Moreover, the cluster in question relies on the results from the first three clusters but focuses more on the investment and economic growth aspects of digital transformation in urban governance. Therefore, it can be viewed as a bridge between theoretical insights and practical economic/administrative decision-making in urban settings. According to Alrasbi and Ariaratnam (2026), digital transformation within the public sector occurs by creating particular "smart city" strategies, which highlights the importance of the cluster in question. Political and economic specifics of each region are highly relevant for overcoming issues associated with smart city development.

In terms of science, the innovation is the systematic mapping of four interrelated aspects of urban governance during the process of digital transformation, using a keyword co-occurrence network, and the interrelations among them are empirically demonstrated by the density of network connections. The introduction of AI and other technological innovations in the public sector improves mechanisms for interaction and cooperation in urban governance and positively impacts citizens' well-being. In particular, the application of AI to data analysis and decision-making optimization improves the efficiency of these mechanisms.

DISCUSSION

The bibliometric analysis results reveal that the field under study is marked by high dynamics, increased diversity, and fragmentation.

The keyword co-occurrence analysis identified four major thematic clusters representing the intellectual structure of the field: (1) technological, (2) governance, (3) sustainability, and (4) economic development. The technological cluster emphasizes AI, the IoT, big data, and digital infrastructure. The governance cluster focuses on urban governance, public administration, citizen participation, urban planning, and digital transformation. The sustainability cluster highlights environmentally sustainable urban development, carbon neutrality, and smart sustainable cities, whereas the economic development cluster addresses investment, regional development, energy management, and smart-city economic strategies. Together, these four clusters illustrate the multidisciplinary structure of AI research in smart city governance.

The significant increase in publications starting in 2019 is explained by the evolution of AI methodologies and the intensification of international policies promoting smart city development.

The visibility of AI-based approaches in the network, expressed in terms of node size, connection intensity, and number of publications, reflects the nature of the field, which is predominantly concerned with showcasing technical feasibility and operational advantages that result from implementing AI. Such a state of affairs aligns with the general tendency noted by Wirtz and Weyerer (2023), in which the implementation of AI in public administration outpaced the development of the necessary theoretical and normative apparatus to manage its social impact.

The bibliometric analysis confirms the need for an in-depth discussion of AI's influence on the digital transformation of smart cities. The findings are consistent with previous studies (Almulhim, 2025; Rouky et al., 2025; Gil et al., 2026), demonstrating that AI contributes to urban infrastructure optimization, energy management, traffic control, and data-driven decision-making. At the same time, smart city research continues to be driven primarily by technological infrastructure, while governance-oriented studies are becoming increasingly prominent. Although China and the United States dominate publication output, European institutions remain particularly influential in governance-oriented research.

From a theoretical point of view, the research will make an additional contribution to the development of knowledge about the use of AI, which should be treated not only as a technological element in smart city infrastructure but also as a central element of governance.

From a practical perspective, the study's results have several implications for action. For policymakers and the urban public sector, these results demonstrate the necessity of designing AI governance models that are developed together with citizens through transparent mechanisms. The lack of studies dedicated to the ethics of AI reveals the increasing need to prepare AI technologies that are designed to be accountable by default. Researchers, in turn, should be aware of the low levels of international cooperation in studies on AI governance in smart cities.

CONCLUSION

The study aimed to analyse the influence of AI on the digital transformation of smart city governance and to examine the intellectual structure and collaboration patterns of the scientific literature using bibliometric methods. The bibliometric analysis of 1,865 Scopus-indexed publications from 2015 to October 2025 yielded several significant findings.

First, the research field has experienced a significant increase in publications since 2019. Although publication output fluctuated between 2020 and 2022, sustained growth resumed after 2023. This trend can be attributed to the increasing maturity of AI technologies and the growing interest of policymakers in their implementation within smart cities. Second, China, the United Kingdom, and the United States stand out as the most active contributors to research. Third, the keyword co-occurrence analysis identified four major thematic clusters representing the intellectual structure of the field: technological, governance, sustainability, and economic development. Together, these clusters indicate that AI research in smart city governance has evolved into a multidisciplinary field integrating technological innovation, governance mechanisms, sustainable urban development, and economic transformation. Fourth, the interaction between citizens and local authorities demonstrates the growing significance of data-driven policymaking. In this sense, the effective exploitation of data through AI and digital transformation technologies becomes a vital part of efficient urban planning and policymaking. Finally, collaboration networks exhibit strong regional cohesion, whereas interregional collaboration remains comparatively limited. The theoretical contributions made between 2015 and 2018 continue to inform the intellectual structure of the field, complemented by an emerging citation layer tied to studies in AI for governance.

Such findings bring a number of additions to the current literature. Methodologically speaking, the use of bibliometric analysis enables researchers to understand the current state of the field and to draw the first-ever map of the topics that constitute it and their relations. Generally, these data provide insight into the structural fragmentation of the research area, which is important for the field itself, and allow for the suggestion of ideas for future

research. Empirically, the research reveals certain communities of researchers, prominent authors, and knowledge brokers who could contribute to the faster and more effective integration of technological and governance perspectives on digital transformations. Therefore, this study provides a solid foundation for future research on the adoption and impact of AI technologies in smart cities.

Some areas for future research are outlined below. Researchers in public administration could investigate the impact of implementing AI governance on urban governance, particularly regarding transparency and intersectoral collaboration. Longitudinal qualitative research on citizens' experiences with AI use in smart-city service delivery would supplement bibliometric mapping with empirical findings. In addition, this highlights the need for additional research on the construction of inclusive cities.

AUTHOR CONTRIBUTIONS

Conceptualization and theory: SZ and SU; research design: SZ, GT, SU, BZ and DY; data collection: SZ, SU and DY; analysis and interpretation: SU, BZ and DY; writing draft preparation: SZ, GT, SU, BZ and DY; supervision: SZ, GT, SU, BZ and DY; correction of article: SZ, GT, SU, BZ and DY; proofread and final approval of article: BZ and DY. All authors have read and agreed to the published version of the manuscript.

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Information about the authors

***Sultan A. Zhubanazarov** – PhD student, Karaganda University of Kazpotrebsoyuz, Karaganda, Kazakhstan, email: szhubanazar@gmail.com, ORCID ID: https://orcid.org/0000-0002-0782-7719

Gulnur S. Tapenova – PhD, Karaganda University of Kazpotrebsoyuz, Karaganda, Kazakhstan, email: gulnur.tapenova_19@mail.ru, ORCID ID: https://orcid.org/0000-0001-5139-3287

Sairan N. Ulakov – Cand Sc. (Econ.), Professor, Karaganda University of Kazpotrebsoyuz, Karaganda, Kazakhstan, email: s.ulakov@keu.kz, ORCID ID: https://orcid.org/0000-0002-6867-2407

Bauyrzhan A. Zhunusov – Candidate of Economic Sciences, Professor, Aktobe Regional University named after K. Zhubanov, Aktobe, Kazakhstan, email: zhunussov1958@gmail.com, ORCID ID: https://orcid.org/0000-0002-1888-8453

Desislava I. Yordanova – Doctor of Sciences, Professor, Sofia University "St Kliment Ohridski", Sofia, Bulgaria, email: d_yordanova@feb.uni-sofia.bg, ORCID ID: https://orcid.org/0000-0003-4042-2681

Авторлар туралы мәліметтер

***Жұбаназаров С.А.** – PhD докторант, Қазтұтынуодағы Қарағанды университеті, Қарағанды, Қазақстан, email: szhubanazar@gmail.com, ORCID ID: https://orcid.org/0000-0002-0782-7719
Тапенова Г.С. – PhD, Қазтұтынуодағы Қарағанды университеті, Қарағанды, Қазақстан, email: gulnur.tapenova_19@mail.ru, ORCID ID: https://orcid.org/0000-0001-5139-3287
Улаков С.Н. – э.ғ.к., профессор, Қазтұтынуодағы Қарағанды университеті, Қарағанды, Қазақстан, email: s.ulakov@keu.kz, ORCID ID: https://orcid.org/0000-0002-6867-2407
Жунусов Б.А. – э.ғ.к., профессор, Қ.Жұбанов атындағы Ақтөбе өңірлік университеті, Ақтөбе, Қазақстан, email: zhunussov1958@gmail.com, ORCID ID: https://orcid.org/0000-0002-1888-8453
Йорданова Д.И. – ғылым докторы, профессор, Әулие Климент Охрид атындағы София университеті, София, Болгария, email: d_yordanova@feb.uni-sofia.bg, ORCID ID: https://orcid.org/0000-0003-4042-2681

Сведения об авторах

***Жұбаназаров С.А.** – PhD докторант, Карагандинский университет Казпотребсоюза, Караганда, Казахстан, email: szhubanazar@gmail.com, ORCID ID: https://orcid.org/0000-0002-0782-7719
Тапенова Г.С. – PhD, Карагандинский университет Казпотребсоюза, Караганда, Казахстан, email: gulnur.tapenova_19@mail.ru, ORCID ID: https://orcid.org/0000-0001-5139-3287
Улаков С.Н. – к.э.н, профессор, Карагандинский университет Казпотребсоюза, Казахстан, email: s.ulakov@keu.kz, ORCID ID: https://orcid.org/0000-0002-6867-2407
Жунусов Б.А. – к.э.н., профессор, Актюбинский региональный университет имени К.Жубанова, Актобе, Казахстан,
email: zhunussov1958@gmail.com, ORCID ID: https://orcid.org/0000-0002-1888-8453
Йорданова Д.И. – доктор наук, профессор, Софийский университет "Св. Климент Охридского", София, Болгария,
email: d_yordanova@feb.uni-sofia.bg, ORCID ID: https://orcid.org/0000-0003-4042-2681