Analyzing Smart Cities Governance Publications Using CiteSpace: Integration of Organizational Strategy and Human Resources for Sustainable Urban Development

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Abstract. This study aims to investigate the dominant themes in publications related to smart cities governance and the integration of organizational strategies and human resources for sustainable urban development. The study employs bibliometric analysis using CiteSpace software to collect articles related to Smart Cities Governance and sustainable urban development from the Scopus database. The data collected is processed using CiteSpace software to generate visualizations and analyze research trends and topic development in the field of Smart Cities Governance. The results of the study identified 10 clusters, with the largest cluster being "underground space," with 55 members and a silhouette value of 0.837 by LLR, smart cities by LSI, and knowledge management (3.09) by MI. The analysis showed that the use of underground space can be a solution to overcome the land constraints faced by large cities, as discussed in Goel, RK's work, which is the most cited article in this cluster. The most cited nodes in this cluster are "smart city," "sustainable development," and "urban development," indicating that sustainable Smart Cities development is a significant concern in research related to this cluster. The network analysis formed in the research clusters can provide useful information for experts and decision-makers in developing sustainable smart cities by considering the use of underground space as a solution to overcome land constraints. These findings are expected to guide experts and decision-makers in considering the use of underground space as one of the options in developing sustainable smart cities and overcoming the land constraints faced by large cities.

Keywords: Smart Cities · Development · Decision-Makers

1 Introduction

Rapid urban growth has created major challenges for urban governance in an effective and sustainable way [1–5]. In response to this challenge, the concept of smart cities has been adopted by various governments across the world as a promising approach [6–8].

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Smart cities integrate information and communication technologies (ICT) to improve efficiency, quality of life, and urban progress [9, 10]. But the implementation of smart cities does not only involve technological aspects; it also requires smart policies and good governance [11].

Smart cities governance involves governments and institutions managing and regulating smart city development, focusing on evaluation indicators, data collection, cross-sector coordination, and decision-making for efficient, sustainable development [12, 13]. Citizens are increasingly involved in policy making, and blockchain technology is explored for data collection and processing [14–16].

Smart transportation policy is one of the key aspects of developing sustainable smart cities. Smart transport policy involves the use of ICT to improve the efficiency and sustainability of urban transport, including efficient public transport, smart parking systems, multimodal transport integration, and app-based transport services [17, 18].

Although research on transport policy has been conducted by previous researchers, there is still a lack of understanding of how this research has affected sustainable urban development. Therefore, this study aims to quantify the impact of smart city governance research on sustainable urban development. To achieve this goal, we use CiteSpace, an application that can help identify the impact of research through quotation analysis.

Through the integration of organizational strategies and human resources, this research is expected to provide a deeper understanding of the impact of smart city governance research on sustainable urban development. Mapping relevant literature based on keywords, this research will provide valuable insights for policymakers and practitioners in formulating smart and sustainable urban policies and strategies. Thus, this research has high urgency as it provides an important contribution to understanding the impact of smart city governance research on sustainable urban development.

2 Research Method

The study evaluates literature using the Scopus database, analyzing articles from 201 documents. It uses API calls to find papers with TITLE-ABS-KEY (Smart Cities Governance) AND TITLE-ABS-KEY (Sustainable Urban Development) AND PUBYEAR > 2012 AND PUBYEAR < 2023 AND (LIMIT-TO (PUBSTAGE, “final”)) AND (LIMIT-TO (LANGUAGE, “English”)) AND (LIMIT-TO (SRCTYPE, “j”)).

The emerging field of visualises scientific knowledge using social network analysis and trend analysis [19], with software developed for science mapping [20, 21]. The research uses in-depth studies to explain and understand smart city governance patterns towards sustainable urban development, as indexed by Scopus. The research used analytical methods to evaluate Scopus database search results and analyse them using CiteSpace [22].

CiteSpace is a popular and leading Java-based software used to create colour maps from bibliographic data and visualise and dig out the instructive meanings of those maps [23, 24]. In this study, we analysed co-citation research documents on smart city governance and sustainable urban development. Co-citation analysis can reveal important keywords in papers as well as topics and concepts that tend to cross research areas [25]. In addition, a keyword-based explosion detection analysis is used to identify research limits among current publications.

3 Results and Discussion

From the results of analysis using CiteSpace, the research found ten clusters that describe key topics in smart city governance research, as shown in Fig. 1. These findings provide in-depth insight into smart city governance research trends. Through cluster analysis, the research identifies and groups together interrelated topics that provide a better understanding of the conceptual framework used in this research. The subsequent co-cited analysis provides additional information on topics that are trending by identifying the most frequently quoted publications together.

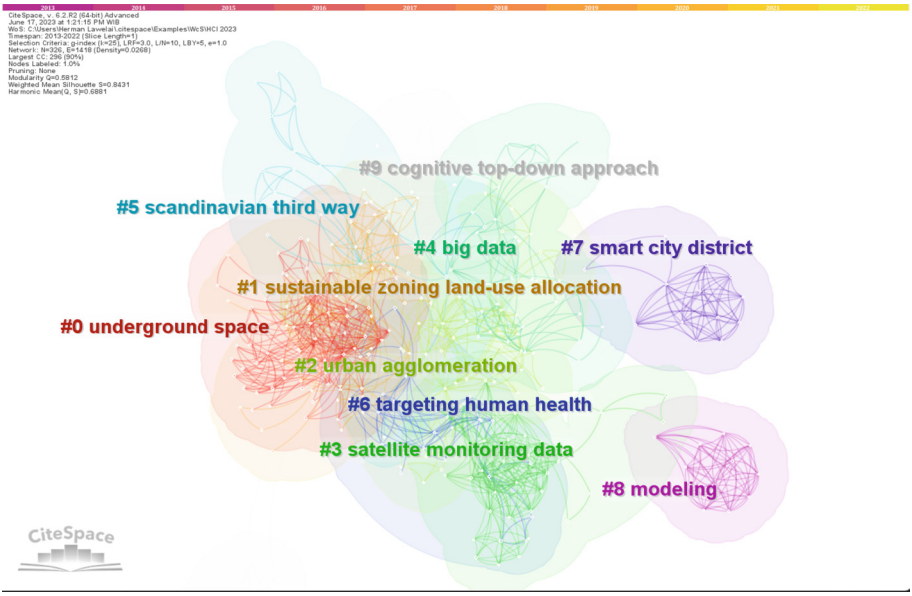

Fig. 1. The results of our cluster analysis are based on literature co-citations.

Figure 1 shows that the **underground space** cluster is the largest cluster has 55 members and a silhouette value of 0.837 by LLR, smart cities by LSI, and knowledge management (3.09) by MI. The most cited articles in this cluster are by Goel's (2015) research highlights India's urban living challenges due to population growth surpassing development. To address this, underground facilities have been implemented in developed countries. India has the potential to utilize underground space, offering additional space and natural protection [26]. Smart city governance research focuses on the use of underground space in urban development, emphasizing intelligent cities and sustainable urban development. To achieve sustainable development, cities must integrate organizational strategies, involve stakeholders, and leverage skilled human resources. By combining effective strategies and skilled human resources, cities can optimize the use of underground space for better urban interests.

The second largest cluster is the **sustainable zoning land-use allocation**, with 46 members and a silhouette value of 0.756 by LLR, smart cities by LSI, and app (0.68)

by MI. The most cited articles in this cluster are by Hammad et al. (2019) proposes mathematical frameworks to enhance sustainability in smart city decisions related to zoning, land use allocation, and facility location. The framework optimizes land use, new building locations, and infrastructure investment, considering social, economic, and environmental aspects. It also considers traffic impact through optimized traffic allocation to existing networks [27]. This research focuses on sustainable smart city development by optimizing decisions related to zoning, land use allocation, and facility location, considering social, economic, and environmental aspects.

The third largest cluster **urban agglomeration** has 42 members and a silhouette value of 0.762 by the LLR and LSI methods, and as an open data ecosystem with a value of 0.72 by the MI method. The most cited articles in this cluster are by Wong et al. (2022) study demonstrates the potential of blockchain technology in sustainable smart cities, enhancing social, environmental, and economic sustainability [28]. The research proposes a framework for designing and guiding the development of these cities. The cluster emphasizes the importance of urban governance and policy in urban agglomeration, with China and governance being frequently cited as topics.

The fourth cluster is the **satellite monitoring data**, with 36 members and a silhouette value of 0.92 by both LLR and LSI, and as air pollution (0.15) by MI. The most cited articles in this cluster are by Dincă et al. (2022) found that renewable energy, education, a circular economy, and EU government policies are effective methods for reducing air pollutants in smart cities. They also highlighted the importance of addressing activities that produce carbon dioxide and increase water pollution. Governance in smart cities emphasizes using satellite monitoring data for environmental monitoring, resource management, and decision-making [29]. This data can help develop conceptual frameworks for understanding the impact of policies and projects on population quality of life. The application of Internet of Things technology can facilitate data gathering and integrate urban life aspects for sustainable development.

The fifth largest cluster is the **big data** 31 members and a silhouette value of 0.85 by both LLR and LSI, and as smart region mobility framework (0.17) by MI. The most cited articles in this cluster are by Yigitcanlar et al. (2020) research highlights the emerging field of artificial intelligence (AI) in smart cities, focusing on technologies, algorithms, and applications. AI impacts business efficiency, data analysis, education, energy, environment, health, land use, security, transportation, and urban management [30]. Governance emphasizes sustainable land management and zoning approaches, with AI being discussed and evaluated for its contributions and risks. AI applications should be carefully considered to maximize benefits while minimizing risks.

The sixth largest cluster is the **scandinavian third way**, with 24 members and a silhouette value of 0.831 by LLR, smart city by LSI, and scientific literature (0.28) by MI. The most cited articles in this cluster are by Baraniewicz-Kotasiska (2022), which highlights the Scandinavian region's cooperation and political decision-making in influencing the development of Aarhus, Denmark's smart city. The city government adopted the Scandinavian third-way approach, implementing smart city activities and creating a modern city management model [31]. This research emphasises the importance of sustainable urban planning and development in the development of sustainable smart cities.

The seventh largest cluster is **targeting human health**, with 23 members and a silhouette value of 0.861 by LLR, smart city by LSI, and app (0.27) by MI. The most cited articles in this cluster are by Buttazzoni et al. (2020), who found that smart cities aim to improve public health but often overlook the importance of equality in interventions. Common characteristics of equality include residence, socio-economic status, social capital, and personal characteristics, while employment, gender, religion, race, ethnicity, culture, language, and education are less addressed. Existing assessments lack robust evaluation designs and commercially available technologies [32]. Research in this cluster focuses on incorporating and analysing equality considerations in health interventions to improve public health and well-being in smart cities.

The eighth cluster is the **smart city district**, 13 members and a silhouette value of 0.974 by LLR, smart energy systems for smart city districts: case study reininghaus district by LSI, and smart cities (0.04) by MI. The most cited articles in this cluster are by Maier (2016), which shows that a decentralised system with low-temperature waste heat and decentralised heat pumps in a building group is the most financially and ecologically viable solution to supply new buildings [33]. Therefore, research in this cluster focuses on approaches to the development of smart and sustainable energy systems by considering the use of renewable energy sources and energy efficiency in the context of smart city development.

The ninth largest cluster is the **modeling**, with 12 members and a silhouette value of 1 by LLR, insight by LSI, and smart cities (0.03) by MI. The most cited articles in this cluster are by Faber et al. (2018), whose research resulted in a visual analytical system (VAS) designed to collect, combine, and map data about the business ecosystem in the context of smart cities [34]. In sustainable smart city development, research in this cluster focuses on approaches that advance collaboration, innovation, and proactive management in the business ecosystem formed around smart city initiatives.

The ten largest cluster is the **cognitive top-down approach**, with 9 members and a silhouette value of 0.873 by LLR, self-sustainable smart cities by LSI, and smart cities (0.03) by MI. The most cited articles in this cluster are by Bai et al. (2022), whose research concluded that the Healthy Cities initiative in China should align with national and global strategic agendas like Healthy China 2030 and the SDGs by providing an inclusive governance framework for coherent cross-sectoral programmes. This requires utilising best practises and expanding assessment efforts to ensure systematic population health improvements [35]. The research cluster focuses on sustainable smart city development to improve population health.

4 Conclusion

The results of this study conclude that sustainable smart cities require organizational strategies, stakeholder involvement, and skilled human resources. Optimizing underground space and zoning, land use allocation, and facility location is crucial for sustainable development, considering social, economic, and environmental aspects. This study suggests a framework for planning and guiding urban development in agglomerations, emphasizing urban governance and policy. Conceptual frameworks help understand the impact of policies and projects on the quality of life of the population. IoT applications

facilitate data collection and integration of urban life aspects for sustainable development. Governance emphasizes sustainable land management and zoning approaches, with AI being evaluated for its contributions and risks. AI applications should be carefully considered to maximize benefits while minimizing risks. Health interventions should be equal to improving public health in smart cities. Sustainable energy systems should be developed using renewable energy sources and energy efficiency. Collaboration, innovation, and proactive management are essential in the business ecosystem for sustainable smart city initiatives.

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