

See discussions, stats, and author profiles for this publication at: <https://www.researchgate.net/publication/377362843>

Smart and Sustainable Cities: A Literature Review

Article · January 2024

CITATIONS

3

READS

1,284

1 author:



[Somtochukwu Ikewelugo](#)

University of Jos

5 PUBLICATIONS 3 CITATIONS

SEE PROFILE

Smart and Sustainable Cities: A Literature Review

Ikewelugo Somtochukwu

Department of Civil Engineering, University of Jos, Jos, Nigeria

Corresponding Author Email: sikewelugo@gmail.com, Tel: +2348140056772

Abstract:

This literature review on smart and sustainable cities provides a comprehensive overview of the multidisciplinary discourse surrounding urban development in the 21st century. The review synthesizes key findings from scholarly works, addressing themes such as technology integration, environmental sustainability, governance, and social inclusivity. The integration of Internet of Things (IoT) devices, data analytics, and artificial intelligence emerges as a crucial factor in enhancing urban efficiency. Environmental sustainability is emphasized through the incorporation of renewable energy sources, green infrastructure, and sustainable urban planning. Governance structures, particularly those reliant on data-driven decision-making, are identified as essential for informed urban management. Social inclusivity and equity are recurring themes, emphasizing the importance of ensuring that smart city initiatives benefit all residents and do not exacerbate social disparities. While the literature generally supports the transformative potential of smart and sustainable cities, it also acknowledges challenges such as privacy concerns, potential social inequalities, and financial barriers. This review provides valuable insights for policymakers, researchers, and practitioners seeking to navigate the complexities of building resilient, inclusive, and environmentally friendly urban environments.

Introduction:

In an era defined by rapid urbanization and technological advancements, the concept of smart and sustainable cities has emerged as a beacon of hope for addressing the complex challenges faced by urban environments. The term ‘Smart city’ is used to specify the ability of a city to respond as promptly as possible to the needs of citizens and adapt to sustainable development (Marinela Turtă et al., 2023). As populations continue to flock to urban areas, the need for innovative solutions to enhance efficiency, reduce environmental impact, and improve the quality of life becomes more pressing than ever. Smart cities are planned through aim of

improving all dimensions of society, creating accessible spaces, providing more security in the lifestyle, and well-being of citizens living in that city (de Bem Machado et al., 2021). Smart and sustainable cities are at the forefront of this movement, utilizing cutting-edge technologies and thoughtful urban planning to create urban spaces that are not only intelligent but also environmentally friendly and inclusive.

Defining Smart and Sustainable Cities:

Smart city concepts, approaches, and applications differ from one city to another. Even in the literature definitions, smart cities comprise multidisciplinary definitions that define smart cities based on experts and specialists (Balalov & Barabanova, 2022). Nevertheless, smart cities leverage technology to optimize urban functions and services, enhancing the quality of life for residents. According to Salama & Al-Turjman (2023), smart cities are a cutting-edge concept for managing urban regions that will improve sustainability and quality of life for residents. A smart city uses a high amount of data collected through intelligent infrastructure, people, and vehicles to generate new ideas and possibilities of investments, improve safety and security in the city and reduce susceptibility to disasters, economic growth, access to information, and ability to participate and take decisions in the city (Lamola, 2023). This involves integrating data and communication technologies into various aspects of city life, such as transportation, energy, healthcare, and public safety.

Sustainable cities on the other hand focus on minimizing their environmental footprint while promoting economic and social well-being. Since the 1980s and 1990s, sustainability issues were prominent on the academic and political governance scene (de Bem Machado et al., 2021). A sustainable city strategy is one of many urban planning approaches worthy of implementation to ensure long-term city growth and development (Masik et al., 2021). The smart sustainable city is a new concept that has emerged in the last few decades (Balalov & Barabanova, 2022).

Combining the concepts of smart and sustainable cities results in cities that use technology to achieve sustainability goals, fostering a harmonious relationship between the urban environment and its inhabitants. The term ‘Smart and Sustainable city’ is used to denote a city that is supported by a pervasive presence and massive use of advanced ICT, which, in connection with various urban domains and systems and how these intricately interrelate, enables cities to become more sustainable and to provide citizens with a better quality of life (Bibri & Krogstie, 2017). Building sustainable and smart cities also entails providing its citizens with satisfying and adaptable job and business opportunities, secure and cheap housing, a more democratic society, open governance, and a successful economy (Badi et al., 2022).

LITERATURE REVIEW

Introduction

The concept of smart and sustainable cities has gained significant attention in academic literature as urbanization continues to rise, and the need for innovative solutions to address urban challenges becomes more pronounced. This literature review aims to provide an overview of key themes and insights from scholarly works on smart and sustainable cities, covering topics such as technology integration, environmental sustainability, governance, and social inclusivity.

Literature review

In the specialized literature, the term smart city is used to specify the ability of a city to respond as promptly as possible to the needs of citizens and adapt to sustainable development (Marinela Turtă et al., 2023). Smart cities consider the quality of life and development of the city, which are influenced by transportation, government services and education, public safety, and health (Choenni, 2001; Marinela Turtă et al., 2023). Cities have a key role in fighting against climate change and the deployment of new intelligent technologies is seen as key factor in decreasing greenhouse gas emissions and improving energy efficiency of cities. When discussing sustainability and ICT and thus sustainable practices and smart solutions for cities, reference is made to the two concepts of sustainable cities and smart cities (Bibri & Krogstie, 2017). Scholars from different disciplines and practitioners from different professional fields have, over the past two decades or so, sought a variety of sustainable city models as well as smart city approaches that can contribute to sustainability and its improvement. The following topics are covered in this article.

Technology Integration and Urban Efficiency:

A substantial body of literature emphasizes the role of technology in enhancing urban efficiency and service delivery. Researchers have explored the integration of Internet of Things (IoT) devices, data analytics, and artificial intelligence in various aspects of urban life, including transportation, energy management, and waste management. For instance, Caragliu & Del Bo (2023) argue that smart technologies contribute to the optimization of urban systems, leading to more resource-efficient and responsive cities. (Anderson 2009) emphasizes that the integration of renewable energy resources cannot be achieved without the integration of “smart” infrastructure management and real-time systems performance monitoring systems. Prioritizing the use of renewable energy sources, such as solar and wind power reduces environmental impact and reliance on finite resources.

Environmental Sustainability:

The pursuit of environmental sustainability is a central theme in literature on smart and sustainable cities. Smart cities are environmentally sustainable cities primarily because such

cities tend to reduce the environmental impact of urbanization at the scientific economic and human level (Sheth 2017). Researchers such as Salama & Al-Turjman (2023b) emphasize the importance of integrating renewable energy sources, green infrastructure, and sustainable urban planning to mitigate environmental impact. Camilleri & Ratten (2019) agree that smart and sustainable cities interfaced with computerized systems improve economic, social, and environmental sustainability. Devadas et al (2013) also emphasizes that the path to sustainable development must pass through cities. The incorporation of smart grids and energy-efficient technologies is highlighted as a means to reduce carbon emissions and enhance overall ecological resilience.

Governance and Data-Driven Decision Making:

Governance structures and the role of data in decision-making processes are extensively explored in the literature. Scholars argue that data-driven governance enables city administrators to make informed decisions, enhance resource allocation, and improve overall city management (de Bem Machado et al., 2021). Additionally, collaborative platforms that engage citizens in decision-making processes are discussed as crucial for fostering a sense of community ownership and ensuring the inclusivity of smart city initiatives (Rahmat et al., 2023)

Social Inclusivity and Equity:

The social dimension of smart and sustainable cities is a growing area of research. Scholars highlight the importance of ensuring that technological advancements benefit all residents and do not exacerbate existing social disparities. Digital inclusion programs and efforts to bridge the digital divide are emphasized as critical components of building inclusive smart cities (Caragliu & Del Bo, 2023). According to Machado et al. (2021), a smart city model provides, according to the essentials of the inclusive innovation process, greater integration, and social equality, that is, greater access to different public services. Thus, an intelligent, inclusive, and “human” city is first and foremost a territory where services, uses, and general goods of a common nature are built, aiming to satisfy the basic needs of its citizens and their well-being. The concept of the “smart citizen” is explored, emphasizing the active participation of residents in shaping the future of their cities.

Challenges:

While the literature generally supports the idea of smart and sustainable cities, it also acknowledges challenges and critiques. Machado et al. (2021) discussed extensively these

challenges, emphasizing on multidisciplinary research spanning across computer science, engineering, environmental studies, urban planning and development, social sciences and industrial engineering on technologies, case studies, novel approaches, and visionary ideas related to data-driven innovative solutions and big data-powered applications to cope with the real-world challenges for building smart societies. Machado et al. (2021) also highlights a case study in Brazil where there are several challenges to transform smart cities into sustainable cities mainly due to the social and political realities of the country. (Lau et al., 2008) highlights privacy concerns related to the extensive use of data and surveillance technologies. The case study from Hong Kong emphasized on the social-cultural bearing for privacy issues, however states that in almost every private housing estate, surveys and interviews demonstrated that most residents have either accepted or adapted to the trade-off between privacy and convenience. Additionally, (Treude, 2021) emphasizes on the financial challenges associated with the initial investment required for implementing smart technologies.

Addressing these challenges requires a collaborative effort involving governments, businesses, communities, and academia. By acknowledging and actively working to overcome these hurdles, cities can move closer to realizing the vision of smart and sustainable urban environments.

Conclusion:

This literature review contributes to the discussion of the concept of sustainable and smart cities by reflecting a multidisciplinary approach, encompassing urban planning, technology, environmental science, and governance studies. While the discourse generally supports the transformative potential of smart and sustainable cities, ongoing research and critical examination of challenges are necessary to ensure that these initiatives genuinely contribute to creating resilient, inclusive, and environmentally friendly urban spaces. As cities continue to evolve, the literature provides valuable insights for policymakers, researchers, and practitioners working towards the goal of building smarter and more sustainable urban environments.

References

Badi, I., Stević, Ž., & Jibril, M. L. (n.d.). *Using the MCDM Approach to Evaluate Smart and Sustainable Cities*.

- Balalov, V. V., & Barabanova, T. A. (2022). The life cycle assessment of smart sustainable cities. *Stroitel'stvo: Nauka i Obrazovanie [Construction: Science and Education]*, 12(2), 72–101. <https://doi.org/10.22227/2305-5502.2022.2.6>
- Bibri, S. E., & Krogstie, J. (2017). Smart sustainable cities of the future: An extensive interdisciplinary literature review. *Sustainable Cities and Society*, 31, 183–212. <https://doi.org/10.1016/J.SCS.2017.02.016>
- Camilleri, M. A., & Ratten, V. (n.d.). *Special Issue "The Sustainable Development of Smart Cities through Digital Innovation."* <https://www.researchgate.net/publication/340477578>
- Caragliu, A., & Del Bo, C. F. (2023). Smart cities and the urban digital divide. *Npj Urban Sustainability*, 3(1). <https://doi.org/10.1038/s42949-023-00117-w>
- David Devadas, M., Ramamurthy, A., & Devadas Professor, M. D. (2013). *Smart Sustainable Cities: An Integrated Planning Approach towards Sustainable Urban Energy Systems, India*. <https://doi.org/10.13140/2.1.5166.4005>
- de Bem Machado, A., dos Santos, J. R., Richter, M. F., & Sousa, M. J. (2021). Smart cities: Building sustainable cities. In *Green Technological Innovation for Sustainable Smart Societies: Post Pandemic Era* (pp. 1–19). Springer International Publishing. https://doi.org/10.1007/978-3-030-73295-0_1
- Lamola, K. (2023). Building Sustainable Smart Cities and The Green Building Agenda. *Resourceedings*, 3(1), 43–49. <https://doi.org/10.21625/resourceedings.v3i1.952>
- Lau, S. S. Y., Wang, J., & Giridharan, R. (2008). Smart and Sustainable City - a Case Study from Hong Kong. In *Smart and Sustainable Built Environments* (pp. 33–42). Blackwell Publishing Ltd. <https://doi.org/10.1002/9780470759493.ch4>
- Marinela Turtă, I., Cuciureanu, M.-S., & Nepotu, G. (2023). *IMPACT OF SUSTAINABLE DEVELOPMENT ON SMART CITIES*. <http://iasismartcity.ro/>, <https://iasi.digital/>, www.mdap.ro and www.mfe.gov.
- Masik, G., Sagan, I., & Scott, J. W. (2021). Smart City strategies and new urban development policies in the Polish context. *Cities*, 108, 102970. <https://doi.org/10.1016/J.CITIES.2020.102970>
- Rahmat, A., Ashikin, N., & Bahari, M. (n.d.). *The Citizen-Centric Smart City (CCSC) model for sustainable smart city development*. <https://www.researchgate.net/publication/374975342>
- Salama, R., & Al-Turjman, F. (2023a). Sustainable Energy Production in Smart Cities. *Sustainability*, 15(22), 16052. <https://doi.org/10.3390/su152216052>
- Salama, R., & Al-Turjman, F. (2023b). Sustainable Energy Production in Smart Cities. *Sustainability*, 15(22), 16052. <https://doi.org/10.3390/su152216052>
- Sheth, K. N. (2017). *Smart Cities are Environmentally Sustainable Cities*. <https://www.researchgate.net/publication/317236347>

SmartGridEngineersUrbanSystemsManagementRiskandFinancialEngineeringEducationandEmploymentProgram-ColumbiaUniversityandPolytechnicInstituteofNYU2009. (n.d.).

Treude, M. (2021). Sustainable smart city—opening a black box. *Sustainability (Switzerland)*, 13(2), 1–15. <https://doi.org/10.3390/su13020769>