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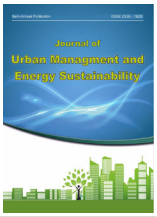

ORIGINAL RESEARCH PAPER

Identifying Criteria and Indicators for Smart Cities with an Emphasis on Sustainable Urban Development

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ABSTRACT

Given the increasing growth of urbanization and the challenges it poses, the use of modern information and communication technologies (ICT) has been considered a solution to improve efficiency, quality of life, and sustainability in cities. The research method used in this article is a systematic review of scientific sources and previous studies in the field of smart cities and sustainable urban development. Through the examination of various articles, reports, and studies, indicators and criteria related to these two domains have been identified and categorized. Additionally, searches were conducted in the Elsevier and Sage databases. Articles were selected based on their alignment with the research and a time frame of 2011-2025. Following the PRISMA 2020 statement for critical evaluation of articles, interpretation, analysis, and reporting of findings were conducted descriptively. The findings of this study indicate that smart cities can play a significant role in sustainable urban development. The indicators of sustainable urban development are categorized into three dimensions: economic, social and cultural, and environmental, and the role of ICT in each of these dimensions has been examined. In conclusion, this article finds that smart cities have significant potential to contribute to achieving sustainable urban development goals. However, to realize this potential, it is necessary to adopt a comprehensive and integrated approach to the development of smart cities, which includes attention to economic, social, and environmental dimensions, citizen participation, and collaboration between various public and private sectors.

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INTRODUCTION

Cities have long served as engines of innovation, economic growth, and social development. However, the rapid acceleration of urbanization has increasingly intensified pressures on urban systems, challenging city authorities to respond effectively to the complex and diverse needs of citizens. Traditional approaches to urban planning and management have often proven insufficient in addressing contemporary global challenges, including climate change, environmental degradation, resource scarcity, and social inequality. Consequently, there is a growing consensus on the need to shift toward more innovative, adaptive, and efficient forms of urban governance (Framework, 2018; Stratigea et al., 2015; Clarke, 2013). Within this transition, Information and Communication Technology (ICT) has emerged as a critical enabler for enhancing the efficiency, effectiveness, and responsiveness of urban services and management systems (Sharifi, 2019).

Alongside these urban developments, sustainable development has become a central paradigm guiding both global and urban policy agendas. The introduction of the Sustainable Development Goals (SDGs) by the United Nations in 2015 represented a significant milestone in addressing interconnected economic, social, and environmental challenges while promoting long-term well-being for future generations (Habitat, 2021; Sharifi et al., 2024; Masuda et al., 2022). Cities play a pivotal role in achieving these goals, as they concentrate population growth, economic activity, and resource consumption. The foundations of sustainable urban development trace back to the Brundtland Report (1987), which emphasized the importance of intergenerational equity. Today, sustainable urban development seeks to balance economic competitiveness, social inclusion, and environmental protection through integrated and forward-looking urbanization strategies. This challenge is increasingly urgent, given that more than 55% of the global population currently resides in urban areas—a proportion projected to rise to 68–70% by 2050 (Kaneda et al., 2020; Brundtland, 1987).

To address these challenges, cities worldwide have adopted various policy frameworks and planning instruments for infrastructure development in sectors such as water management, housing, land use, and energy, often aligned with the SDGs (Masuda et al., 2022; Sharifi et al., 2024). Concurrently, the concept of smart cities has gained prominence as a technology-driven approach aimed at improving urban performance and sustainability outcomes. Empirical and conceptual studies have examined different aspects of smart cities. Some studies have focused primarily on smart city technologies and their indicators, highlighting ICT applications, urban services optimization, and technological innovation as key drivers (Sharifi, 2019; Saffarsabzevar, 2024; Masuda et al., 2022). Other research has concentrated on sustainable urban development, emphasizing economic, social, and environmental dimensions, urban planning strategies, and alignment with SDGs (Fredericks et al., 2020; Kaneda et al., 2020). While these studies provide valuable insights, many have remained limited in scope, analyzing either smart city components or sustainability dimensions independently, without sufficiently exploring the interactions and synergies between them. Some integrated studies have attempted to link smart city indicators with sustainable urban development outcomes (Sharifi et al., 2024; IJUMES, 2025; Springer, 2023), but they often rely on descriptive approaches, focus on isolated indicators, or lack a comprehensive conceptual framework that systematically captures the relationships, synergies, and potential conflicts among indicators and sustainability dimensions.

This review of the literature highlights a significant gap: although smart city technologies and individual sustainability dimensions have been studied extensively, a comprehensive analytical framework that integrates smart city indicators with economic, social, and environ-

mental dimensions of sustainable urban development is still lacking. Addressing this gap is crucial for translating smart city strategies into meaningful sustainability outcomes and providing practical guidance for urban planning and policy-making.

In response to this gap, the primary objective of the present study is to identify and categorize smart city criteria and indicators with a specific focus on their relevance to sustainable urban development. By systematically analyzing the relationships, synergies, and potential conflicts between smart city indicators and the economic, social, and environmental dimensions of sustainability, this research aims to offer both theoretical and practical contributions. Specifically, the study seeks to answer the following research questions:

1.What are the specific criteria and indicators of smart cities that are most relevant to the economic, social, and environmental dimensions of sustainable urban development, and how do they interrelate?

2.How do smart city initiatives influence sustainable urban development outcomes, and what synergies, conflicts, or trade-offs can be identified between smart city indicators and sustainable development dimensions?

MATERIALS AND METHODS

The present study is classified as qualitative research in terms of the nature of the data and the analytical approach, and it employs a systematic literature review as the data collection method. The purpose of using this approach is to achieve a comprehensive, structured, and in-depth understanding of smart city criteria and indicators in relation to sustainable urban development. The statistical population of the study includes scholarly works (journal articles and books) that have addressed the topics of "smart cities" and "sustainable urban development," either independently or in combination.

The processes of literature searching, screening, and study selection were conducted in accordance with the PRISMA 2020 guidelines. The PRISMA framework, originally introduced in 2009 as Preferred Reporting Items for Systematic Reviews and Meta-Analyses, provides a comprehensive and standardized protocol for improving the transparency and quality of reporting in systematic reviews and meta-analyses. The 2020 version represents an updated and refined revision aimed at enhancing methodological rigor and clarity in reporting review processes (Sarkis-Onofre et al., 2021; Petticrew and Roberts, 2008; Moher et al., 2009).

The search strategy: A systematic search of the literature was conducted in major scientific databases, including Elsevier and SAGE. The search strategy was designed based on combinations of the following keywords using Boolean operators:

•"Smart City" OR "Smart Cities"

•"Sustainable Urban Development" OR "Urban Sustainability"

The AND operator was used to combine the concepts of smart cities and sustainable urban development, while the OR operator was applied to include synonymous terms. The search was limited to English-language articles published between 2011 and 2025 and restricted to studies with full-text availability. The total number of retrieved sources was identified according to the respective databases.

Approximately 3% of the studies were published in the years 2025, 2023, 2016, 2014, and 2013. About 4% of the sources were published in 2024, while approximately 12% were published in 2022 and 2021. Around 8% of the sources were published in 2018 and 2015. In addition, about 4% of the studies were conducted in 2024. Approximately 15% of the studies were published in 2020, about 13% in 2019, and around 7% in 2017. Finally, about 5% of the sources were published in 2012, and approximately 1% in 2011.

Details of the study identification and selection process are presented in(Fig. 1).

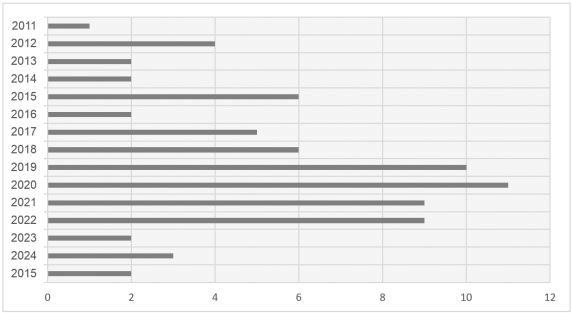

Figure 1: Proportion of studies based on the year of publication within the selected time frame

Quality Assessment: To ensure the methodological quality of the selected studies, the evaluation of articles was not based solely on journal quartile rankings (Q1) or impact factor. In addition to bibliometric indicators, the following qualitative criteria were considered in the assessment process:

Clarity of research objectives and research questions

•Transparency of the research methodology and data analysis process

•Direct relevance of the identified indicators to the dimensions of smart cities and sustainable urban development

•Conceptual coherence and analytical rigor

•Applicability of the findings for comparative and conceptual analysis

Only studies that met the minimum requirements of the above criteria were included in the final stage of analysis.

Inclusion and Exclusion Criteria: The inclusion criteria comprised studies related to smart cities and sustainable urban development, including empirical studies, descriptive research, case studies, and qualitative investigations. In contrast, conference papers, studies without full-text availability, and research that was not directly aligned with the objectives of this study were excluded from the review.

Study Screening and Selection Process:

The screening of studies was conducted independently by the authors in three stages: title screening, abstract screening, and full-text screening. Any disagreements were resolved through discussion and mutual agreement. This process contributed to enhancing the accuracy, transparency, and reliability of the research findings. A flowchart illustrating these stages is presented in (Fig. 2).

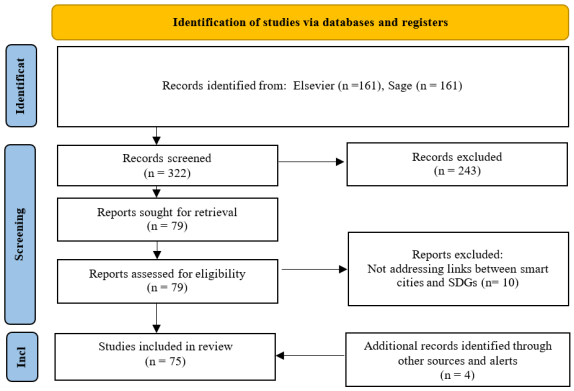

Figure 2: PRISMA Flow Diagram for Literature Search and Selection

DISCUSSION AND FINDINGS

Cities are living entities under human dominion, showcasing the most dramatic manifestations of human activity. Sustainable urban development requires a connected triangle that includes economy, society, and nature, facilitating the creation of a socio-economic system that does not harm the natural world (Yigitcanlar et al., 2019; Alagirisamy and Ramesh, 2022). There is no single definitive definition of sustainability at the urban scale, however, a set of sustainable urban characteristics is commonly used. These include intergenerational equity (social, geographical, and governance justice), protection of the natural environment, significant reduction in the use of non-renewable resources, economic vitality and diversity, community self-reliance, citizen well-being, and the fulfillment of basic human needs (Toli and Murtagh, 2020). Sustainability has always been a fundamental aspect of urban systems in ancient Iran. However, in contemporary times, this concept faces significant structural and practical challenges. Over the past century, social and economic transfor-

mations have gradually eroded the cohesion that once existed. It is evident that the progress and development of any society depend on effective management, deliberate planning, and the formulation of principles and policies for sustainable development. Nevertheless, without proper implementation, no development can occur, let alone be sustainable. Therefore, achieving desired outcomes requires transitioning sustainable development from theoretical frameworks into actionable practices, effectively transforming potential into reality (Rahimi et al., 2023).

Sustainable urban development is a crucial aspect for smart cities, as they must prioritize sustainable initiatives to ensure environmental compatibility and reduce their carbon footprint. This can include initiatives such as green buildings, renewable energy sources, and sustainable transportation options. Sustainable initiatives can also lead to cost savings for cities and citizens. For example, implementing energy-efficient technologies can result in lower energy bills for citizens and reduced operational costs for public facilities. Additionally, it can improve the quality of life for citizens by reducing pollution levels and promoting a healthier lifestyle (Gracias et al., 2023). Sustainable urban development is also based on three dimensions: economic, social, and environmental. These dimensions function together as a connected triangle to create a socio-economic system that does not harm the natural world (Yigitcanlar et al., 2019; Toli and Murtagh, 2020; Akbarpourganje et al., 2024).

-Economic Sustainability: Investing in green infrastructure, promoting a circular economy, and creating sustainable jobs in renewable energy sectors.

-Social Sustainability: Social and geographical justice, protecting citizens' rights, enhancing public health and safety.

-Environmental Sustainability: Protecting the natural environment, reducing the use of non-renewable resources, promoting renewable energies.

Due to issues arising from urban growth, such as resource depletion, environmental degradation, excessive energy consumption, air and water pollution, disposal of toxic waste, severe traffic congestion, inefficient decision-making processes, ineffective planning systems, improper management of urban infrastructure and facilities, inadequate housing and working conditions, decreased public health and safety, social vulnerability and inequality, and more (Bibri, 2018; Akbarpourganje et al., 2024). In turn, these issues affect the quality of life and well-being of citizens, as well as the efficiency of urban operations and performance. In summary, the multidimensional impacts of instability in modern and future cities are likely to be exacerbated by urbanization (Bibri, 2018).

Urban growth threatens the sustainability of cities, and thus, ICT has emerged as a key factor, playing a crucial role in mitigating the effects of urbanization and addressing sustainability challenges. The integration of ICT into these discussions stems from its widespread presence and new discoveries in computing, along with its extensive use in various urban systems and applications. Advanced technologies and complex modern approaches are now more necessary than ever to address the challenges and issues of modern and future cities. This pertains to how these cities are monitored, understood, analyzed, and consequently utilized, managed, organized, and planned to contribute to sustainable development goals and maintain their role. Increasingly, it is acknowledged that emerging and forward-thinking ICT, due to its vast untapped potential, offers a promising solution to accelerate and strengthen sustainable development processes, providing a hopeful response to urban sustainability challenges (Neirotti et al., 2014; Angelidou, 2015; Batty et al., 2012; Bibri and Krogstie, 2017).

Recent studies by (Bibri and Krogstie, 2021) suggest that the concept of smart cities has roots dating back to the 1970s, where they were

known as “cybernetic planned cities.” (Neirotti et al., 2014; Moulaii et al., 2020) also emphasize that the smart city concept originated from the smart growth movement in the 1990s, although its adoption in urban planning has been more recent.

In recent years, the concept of smart cities has gained increasing attention and popularity as a term and phenomenon in universities, research institutions, governments, policymakers, businesses, industries, and consultancies around the world (Neirotti et al., 2014). Despite the global spread of the smart city concept, there is still no unified definition for it, and a common definition remains elusive. Identifying common trends in smart cities globally is challenging. Furthermore, despite its widespread use and operationalization, the understanding of the concept remains vague and inconsistent (Ahvenniemi et al., 2017; Angelidou, 2015; Batty et al., 2012; Bibri, 2019; Chourabi et al., 2012; Marsal et al., 2014; Song et al., 2017; Wall and Stvropaulos, 2016; Li et al., 2019).

The concept of a smart city encompasses and builds upon previous paradigms such as the digital city, virtual city, ubiquitous city, creative city, knowledge city, hybrid city, information city, and sentient city, extending them further (Alnuaimi et al., 2015). As the smart city concept has evolved over recent decades, a paradigm shift has occurred from an initial focus on technology (emphasizing information and communication technology) for optimizing hard urban infrastructure (such as transportation, communications, waste, energy, water) to a more comprehensive approach. This new approach involves institutions, social infrastructure, and the central role of citizens (Ahvenniemi, 2017).

Consequently, the concept of a smart city has multiple meanings and is used by different individuals in various contexts. It is examined from different angles and manifests in the diverse ways governments launch initiatives to transform their cities into smart cities or undertake projects to rebuild and plan for becoming smart cities. Overall, numerous different definitions have been proposed with varying focuses and orientations (Alnuaimi et al., 2015). (Tab.1) presents a collection of additional definitions of smart cities with different focuses and orientations.

Table 1: Definitions of smart cities

Definitions	Resources
A smart city that uses ICT to meet market demand, i.e., the needs of citizens; an advanced and modern urban area that meets the needs of businesses, institutions, and especially citizens.	Tahmassby, 2022
A smart and sustainable city is an innovative city that uses ICT and other tools to improve the quality of life, operational efficiency, and urban services, while meeting the needs of current and future generations in economic, social, and environmental dimensions.	Singh et al., 2022
In the architecture of smart cities, Information and Communication Technology is used to improve living standards and manage them by citizens and the government.	Attranan et al., 2022
Smart cities are designed to manage the growing urbanization efficiently, energy consumption, preserve a green environment, improve economic standards and citizens' lives, and enhance people's ability to use ICT efficiently.	Ulah et al., 2020
Smart and sustainable cities are expected to be the cornerstone for achieving resource efficiency and sustainability on a global scale.	Angelakoglou et al., 2019
A smart city uses sensor technologies and smart technologies to bring about automated and real-time operations with a comprehensive understanding of urban activities based on a digital city.	Wang et al., 2019

Cities that include smart objects that intelligently, automatically, and collaboratively improve the quality of life, save human lives, and function as sustainable resource ecosystems.	Alsamhi et al., 2019
A smart city uses urban information and technologies to provide urban services on a large scale. These cities offer improved quality of life and a variety of innovative services such as energy, transportation, and healthcare.	Shoaib and Shamsi, 2019
A smart city is an urban environment that uses ICT and related technologies to improve the efficiency of the typical operations of a city and the quality of services (QoS) provided to its citizens.	Silva et al., 2018
A smart city utilizes a combination of data collection, processing, and dissemination technologies along with network and computational technologies, as well as data security and privacy measures. This combination encourages innovation in the application of technologies to enhance the overall quality of citizens' lives, covering various dimensions such as public services, healthcare, transportation, entertainment, and government services.	Garaibeh et al., 2017

The concept of a smart city remains difficult to define precisely. The best way to understand it is through the context in which it can be applied, as mentioned above. This means that smart city projects, programs, and initiatives are typically shaped by specific objectives, technological capabilities, financial capabilities, human and social resources, regulatory policies, institutional frameworks, political mechanisms, governance mechanisms, and more (Bibri, 2019).

A smart city is often defined by its objectives and is recognized as a more efficient, sustainable, equitable, and livable city (Alawdhi, 2012). The concept of a smart city primarily views the city as a complex system with multiple subsystems (Chourabi et al., 2012). The coordinated functioning of the subsystems as a whole ultimately enables them to operate in a smart and harmonious manner (Colldahl et al., 2013).

In other words, a city is a complex system that includes diverse and unpredictable interactions between its subsystems. The goal of smart city models is to find suitable solutions for managing this complexity, particularly by addressing the negative consequences of global urbanization and enhancing the quality of life for urban populations. The ultimate goal of a smart city is to provide intelligent services across all the city's vital capabilities. Examining smart city projects around the world reveals that there are various objectives, which include a range of differences and similarities (Aurigi, 2005).

-Reducing carbon emissions

-Achieving energy efficiency

-Impacting the development of specific industries through communication and information technology (multimedia or knowledge-based industries)

-Achieving a living environment with the highest quality for residents

-Developing green spaces within the city

-Developing advanced, accessible information infrastructure

-Achieving economic growth and quality of life simultaneously

-Developing sustainable communities

-Ensuring social compatibility among different groups of residents

-Evolving the city as a living laboratory for continuous and ongoing improvement.

A smart city is generally a multifaceted concept with diverse objectives, as outlined in scientific literature. Some experts emphasize achieving desirable outcomes in areas such as economic welfare, public health, and environmental sustainability, while others focus on enhancing civic engagement and developing open collaboration models. The first perspective primarily centers on government-led initiatives, whereas the second relies on participatory man-

agement processes. However, the reality is that the ultimate goals of cities are determined by the priorities and basic needs of urban residents. Smart city initiatives have garnered significant attention as tools for improving residents' quality of life, promoting economic growth, and addressing environmental challenges. Nonetheless, these initiatives have both advantages and disadvantages that require careful examination and management to maximize benefits and minimize negative impacts (Gracias et al., 2023).

This section examines some of the potential advantages and disadvantages of smart city initiatives and highlights the balances that need to be managed to maximize benefits and reduce negative impacts. (Tab. 2)illustrates the main advantages and disadvantages of smart cities.

Table 2: Advantages and disadvantages of smart cities

Advantages	Disadvantages
Improving quality of life	High operational costs
Increasing economic growth	Increasing privacy and security concerns
Increased stability	Standardization

One of the primary benefits of smart city initiatives is the improvement of quality of life. By leveraging technology, cities can enhance public safety, improve transportation systems, and provide better access to public services such as healthcare and education. This can lead to greater convenience, reduced commute times, and improved overall well-being for residents (Elberzhager et al., 2021; Kwak and Lee, 2021; Baiget al., 2017). In addition to improving quality of life, smart city projects can also enhance economic growth. These projects can attract new businesses, create jobs, and drive innovation. Also, the increased efficiency of urban services can lead to cost savings for both businesses and residents, which can further contribute to economic growth (Albino et al., 2015; Ismagilova et al., 2020; Wiig et al., 2015; Hu and Zheng, 2021). Promoting sustainability is also one of the potential benefits of smart city projects. By using renewable energy, reducing waste, and improving transportation systems, smart cities can reduce their environmental impact and move towards a more sustainable future (Bellini et al., 2022; Gharaibeh et al., 2017).

Despite their potential benefits, smart city initiatives are also accompanied by several drawbacks. The high implementation costs are one of the most significant challenges, as developing and deploying new technologies and infrastructure can be expensive and time-consuming. An increase in privacy and security concerns is also a potential drawback of smart city initiatives (Mohapatra, 2021; Kothadiya et al., 2021). By collecting and utilizing more data to optimize services and improve efficiency, there is a risk of data breaches and privacy violations, which can erode public trust and lead to negative reactions against smart city initiatives (Garcia et al., 2023; Mora, 2016). The lack of standardization is another potential challenge, as different technologies and systems may not be compatible with each other. This can lead to inefficiencies and limit the effectiveness of smart city initiatives (Kwak and Lee, 2021; Ismagilva et al., 2020).

In the present era, the concept of a smart city has gained attention as an effective solution for improving urban efficiency and sustainability. These cities can play a significant role in sustainable urban development. In theory, a smart city is a place that uses data and digital technology to improve efficiency in various urban domains (such as energy, transportation, and safety), ultimately leading to economic development, better quality of life, and sustainability

(Yigitcanlar and Cugurullo, 2020). However, in practice, this is not always the case. Existing

smart cities are often driven inconsistently by economic objectives and lack the ability to address social and environmental concerns (Shelton et al., 2015). For this reason, the focus of smart city research has shifted towards the "sustainable smart city" to balance the economic, social, and environmental dimensions of smart urbanization (Martin et al., 2018; Harsted and Wathne, 2019; Robertson, 2017; James, 2014).

There are various approaches to sustainable smart cities. There is a fundamental difference between sustainable smart cities and smart sustainable cities. Sustainable smart cities like Barcelona, London, Singapore, and Helsinki strive to achieve environmental sustainability by integrating data-driven technologies and solutions with green technologies and strategies. In contrast, smart sustainable cities like Stockholm, Copenhagen, Amsterdam, and Zurich enhance and maintain their contribution to environmental sustainability by advancing green technologies and strategies through data-driven solutions. As a smart sustainable city, Stockholm aims to utilize data-driven technologies to optimize energy efficiency, reduce air pollution, improve power grids, urban metabolism, and waste management, with the goal of becoming a climate-positive city by 2040 (Bibri et al., 2023). The difference between the two urban models is reflected in their initial definitions. A sustainable smart city is defined as an innovative city that uses ICT to improve the quality of life, efficiency of urban operations, and services. A smart sustainable city also meets the needs of its current residents without compromising the ability of others or future generations, and does not exceed environmental limits, and this is supported by the use of ICT (Bibri et al., 2023).

Identifying a set of relevant indicators is often the first step in developing an evaluation tool. Indicators can be selected using one or a combination of the following methods: literature review, expert surveys, and stakeholder consultation (Sharifi, 2019).

Smart People: Intelligent individuals can be considered one of the most important dimensions of a smart city. These individuals possess technological skills, live in a technological environment, have access to virtual education and educational spaces such as smart education, and their capabilities are managed to enhance initiative and creativity (Loo and Tang, 2019). In an environment where smart people are present, there is an emphasis on human resources, capacity management, and the processing and analysis of data by the people themselves for the purpose of decision-making and producing products and services. Human capital should be the primary focus of a city, with factors such as education level, culture, and access to leisure activities serving as measurement criteria. In general, a smart citizen produces and utilizes the human and social capital of the city. The intelligent production of goods like clothing, food, and tools can also contribute to improving people's livelihoods and the country's economy (Nam and Pardo, 2011).

Smart Environment: One of the most important components of a smart city, which has recently attracted the attention of many researchers, is the smart environment. The smart environment aims to improve the quality of citizens' lives by creating healthy and safe living conditions. This environment includes key factors such as smart energy, smart energy distribution networks, smart pollution monitoring and control, smart buildings, enhancement of natural resource quality, smart health, and smart advertising (Programme, 2012). Additionally, the smart environment provides the capability for intelligent measurement and monitoring, enabling better surveillance and control of pollution in the city through technological solutions. Smart pollution monitoring and control can include monitoring noise pollution and air pollution (Roy et al., 2018).

Smart Economy: The smart economy defines a city's competitiveness through an innovative approach in new business models, e-commerce, the creation of creative products and services,

entrepreneurship, ICT-based services, smart sales, smart industry, smart agriculture, and smart tourism. The concept of a smart economy provides effective solutions to strengthen the urban economy by improving the business environment and increasing its attractiveness to investors and talents, utilizing information and communication technologies for innovative economic growth (Nin et al., 2019).

Smart Living: The theme of smart living aims to improve the quality of citizens' lives by providing healthy and safe living conditions. One of the benefits of living in smart cities is easy access to a variety of cultural and social services. These services include the intelligent use of cultural centers, libraries, religious institutions, historical sites, and recreational facilities (Kumar and Dahiya, 2017).

Smart Transportation: Smart mobility provides integrated ICT infrastructure, offering transportation and logistics services to institutions and individuals, leading to the creation of a safe, clean, sustainable, integrated, and diverse transportation system. This system reduces transportation costs and time, and decreases air pollution. The primary goal of smart transportation is to reduce air pollution and carbon footprint. Clean systems include drones, hybrid vehicles, electric vehicles, and bicycles, which produce the least pollution. Smart transportation solves traffic problems by using intelligent rescue services, smart highways, smart roadside assistance, and intelligent traffic guidance systems. With the increase in urbanization, this system uses software, signs, and human guidance to inform about traffic (Soomro et al., 2018). Additionally, smart streets and smart parking systems have been developed in the city. Furthermore, to reduce energy consumption, smart lighting systems are used for traffic lights and urban illumination (Ahmed and Rani, 2018; Ma and Xue, 2019).

The relationships and how each of the smart city indicators influences the urban sustainable development indicators will be explained in (Tab. 3).

Table 3: The Impact of Each Smart City Indicator on Urban Sustainable Development Indicators.

Indicator	Sub-Indicators	Impact on Sustainable Development	Brief Analytical Description	References
Smart People	Free education, universities and schools, technology skills, capacity and productivity management	Social & Cultural	Access to education and technology skills increases citizen participation, community belonging, and quality of life.	(Loo and Tang, 2019; Nam and Pardo, 2011; (Kylili et al., 2020).
Smart Environment	Smart energy, energy distribution networks, renewable energy, smart buildings, pollution monitoring and control	Environmental	Use of renewable energy sources and intelligent waste management reduces resource consumption and controls pollution.	(Programme, 2012; Roy et al., 2018; Algahtani et al., 2020).
Smart Economy	Innovative products, smart industry, smart tourism, smart agriculture	Economic	Creation of jobs, attraction of investment, and increased economic productivity through technology and innovation.	(Kumar and Dahiya, 2017; Nin et al., 2019).

Smart Living	Smart healthcare services, cultural and social facilities, housing and welfare	Social & Cultural	Improves quality of life through access to intelligent healthcare, cultural, and recreational services, enhancing social well-being.	(Loo and Tang, 2019; Kumar and Dahiya, 2017)
Smart Transportation	Traffic management, clean and smart vehicles, road safety	Economic, Social & Environmental	Reduces traffic congestion, energy consumption, and pollution; increases safety, optimizes urban mobility, and lowers carbon footprint.	(Soomro et al., 2018; Ahmed and Rani, 2018; Ma and Xue, 2020).

RESULTS AND CONCLUSION

This study employed the PRISMA systematic review method to identify and analyze smart city indicators that contribute to sustainable urban development. After applying transparent inclusion and exclusion criteria, peer-reviewed journal articles and academic books published within the defined scope were systematically reviewed. Conference papers were initially identified during the screening phase but were excluded from the final analytical synthesis to ensure methodological consistency and quality control.

From a theoretical perspective, this research advances the smart city literature by demonstrating that smart city indicators do not operate independently, but rather form an interconnected system that collectively shapes sustainable urban development. Unlike earlier studies that examined smart city dimensions in isolation, this review highlights the synergistic and sometimes conflicting relationships among smart people, smart economy, smart environment, smart living, and smart transportation. For example, while smart economic initiatives enhance productivity and competitiveness, they may intensify energy consumption if not aligned with smart environmental strategies. This finding contributes to the theoretical shift from technology-centric smart city models toward integrated sustainable smart city frameworks.

The results indicate that smart people and smart economy indicators are the most frequently emphasized dimensions, reflecting a dominant policy orientation toward human capital development and economic growth. In contrast, smart transportation and environmental indicators receive comparatively less attention, despite their critical role in reducing carbon emissions and improving urban resilience. This imbalance suggests a structural gap in current smart city strategies and highlights the need for a more balanced sustainability-oriented approach.

From a policy and urban planning perspective, the findings imply that smart city initiatives should move beyond fragmented technological projects and adopt holistic planning frameworks that explicitly link ICT investments to environmental protection, social equity, and long-term urban resilience. Urban policymakers should prioritize inclusive digital infrastructure, integrate green technologies into economic development strategies, and ensure that smart transportation systems are aligned with climate mitigation goals. Without such integration, smart city projects risk reinforcing social inequalities and environmental pressures rather than alleviating them.

This study also acknowledges several limitations. First, as a systematic review, the analysis depends on the scope and quality of existing literature, which may underrepresent empirical evidence from developing countries. Second, the frequency-based analysis emphasizes dominant trends but does not measure the actual perfor-

mance or effectiveness of smart city indicators in real-world contexts. Additionally, some studies report contradictory outcomes regarding the social impacts of ICT-driven urban governance, particularly concerning digital inequality and privacy risks, which warrants further empirical investigation.

Based on these findings, future research should focus on quantitative and comparative empirical studies that assess how specific smart city indicators influence sustainability outcomes across different urban contexts. Longitudinal studies examining trade-offs between economic growth and environmental sustainability, as well as governance-focused research on citizen participation and data ethics in smart cities, are particularly needed. Moreover, developing composite evaluation models that integrate social, economic, and environmental indicators could significantly enhance evidence-based urban policymaking.

In conclusion, smart cities represent a powerful—but not inherently sustainable—urban development pathway. Their contribution to sustainable urban development depends on how effectively technological innovation is integrated with social inclusion, environmental responsibility, and sound governance. By providing an integrated analytical framework, this study offers both theoretical insight and practical guidance for policymakers and urban planners seeking to harness smart city strategies for

REFERENCES

AAhmed, S. H., Rani, S., (2018). A hybrid approach, Smart Street use case and future aspects for internet of things insmart cities. Future Generation Computer Systems, 79(3),777–974. https://doi.org/10.1016/j.future.2017.08.054

Ahvenniemi, H., Huovila, A., Pinto-Seppä, I., & Airaksinen, M. (2017). What are the differences between sustainable and smart cities?. Cities, 60, 234-245. https://doi.org/10.1016/j.cities.2016.09.009

Akbarpourganje, A., Behzadfar, M., Mofidi Shemirani, M., (2024). Explaining the factors affecting the sustainable development of Tehran with an emphasis on the components of a creative city. International Journal of Urban Management and Energy Sustainability, 5(4), 261-277. https://www.ijumes.com/article_721634.html

Al Nuaimi, E., Al Neyadi, H., Mohamed, N., & Al-Jaroodi, J. (2015). Applications of big data to smart cities. Journal of Internet Services and Applications, 6(1), 1-15. https://link.springer.com/article/10.1186/s13174-015-0041-5?cv=1&-session-id=3c4d668a0d524c78b41a10b639e-3fe9d

Alawadhi, S., Aldama-Nalda, A., Chourabi, H., Gil-Garcia, J. R., Leung, S., Mellouli, S., ... & Walker, S. (2012, September). Building understanding of smart city initiatives. In International conference on electronic government (pp. 40-53). Berlin, Heidelberg: Springer Berlin Heidelberg.https://link.springer.com/chapter/10.1007/978-3-642-33489-4_4

Albino, V., Berardi, U., Dangelico, R. M., (2015). Smart cities: Definitions, dimensions, performance, and initiatives. Journal of urban technology, 22(1), 3-21. https://www.tandfonline.com/doi/abs/10.1080/10630732.2014.942092

Allam, Z., Sharifi, A., Bibri, S. E., Jones, D. S., Krogstie, J., (2022). The metaverse as a virtual form of smart cities: Opportunities and challenges for environmental, economic, and social sustainability in urban futures. Smart Cities, 5(3), 771-801. https://www.mdpi.com/2624-6511/5/3/40

Alqahtani, F., Al-Makhadmeh, Z., Tolba, A., Said, W., (2020). Internet of things-based urban waste management systemfor smart cities using a Cuckoo Search Algorithm. ClusterComputers, 23, 1769–1780. https://link.springer.com/article/10.1007/s10586-020-03126-x

Alsamhi, S. H., Ma, O., Ansari, M. S., Almalki, F. A., (2019). Survey on collaborative smart drones and internet of things for improving smartness of smart cities. Ieee Access, 7, 128125-128152. https://ieeexplore.ieee.org/abstract/document/8795473/

Angelakoglou, K., Nikolopoulos, N., Giourka, P., Svensson, I. L., Tsarchopoulos, P., Tryferidis, A., Tzovaras, D., (2019). A methodological framework for the selection of key performance indicators to assess smart city solutions. Smart Cities, 2(2), 269-306. https://www.mdpi.

com/2624-6511/2/2/18
Angelidou, M., (2015). Smart cities: A conjuncture of four forces. Cities, 47, 95-106. https://doi.org/10.1016/j.cities.2015.05.004
Attaran, H., Kheibari, N., Bahrepour, D., (2022). Toward integrated smart city: A new model for implementation and design challenges. GeoJournal, 87(Suppl 4), 511-526.
https://doi.org/10.1007/s10708-021-10560-w
Aurigi, A., (2005). Making the digital city: the early shaping of urban internet space. Ashgate.
https://books.google.com/books/about/Making_the_Digital_City.html?id=rAYOiXirzk0C
Baig, Z. A., Szewczyk, P., Valli, C., Rabadia, P., Hannay, P., Chernyshev, M., Peacock, M., (2017). Future challenges for smart cities: Cyber-security and digital forensics. Digital Investigation, 22, 3-13. https://www.sciencedirect.com/science/article/pii/S1742287617300579
Batty, M., Axhausen, K. W., Giannotti, F., Pozdnoukhov, A., Bazzani, A., Wachowicz, M., Portugali, Y.,(2012). Smart cities of the future. The European Physical Journal Special Topics, 214, 481-518. https://link.springer.com/article/10.1140/epjst/e2012-01703-3.
Bellini, P., Nesi, P., Pantaleo, G., (2022). IoT-enabled smart cities: A review of concepts, frameworks and key technologies. Applied Sciences, 12(3), 1607. https://www.mdpi.com/2076-3417/12/3/1607
Bibri, S. E., (2018). Smart sustainable cities of the future. Springer Berlin Heidelberg. https://link.springer.com/content/pdf/10.1007/978-3-319-73981-6.pdf
Bibri, S. E., (2019). On the sustainability of smart and smarter cities in the era of big data: an interdisciplinary and transdisciplinary literature review. Journal of Big Data, 6(1), 25. https://link.springer.com/article/10.1186/s40537-019-0182-7
Bibri, S. E., Alexandre, A., Sharifi, A., Krogstie, J., (2023). Environmentally sustainable smart cities and their converging AI, IoT, and big data technologies and solutions: An integrated approach to an extensive literature review. Energy Informatics, 6(1), 9. https://link.springer.com/article/10.1186/s42162-023-00259-2
Bibri, S. E., Krogstie, J., (2017). On the social shaping dimensions of smart sustainable cities: A study in science, technology, and society. Sustainable Cities and Society, 29, 219-246. https://www.sciencedirect.com/science/article/pii/S2210670716305881
Bibri, S. E., Krogstie, J., (2021). Data-driven smart sustainable cities of the future: a novel model of urbanism and its core dimensions, strategies, and solutions. https://ntnuopen.ntnu.no/ntnu-xmlui/handle/11250/2735184
Chourabi, H., Nam, T., Walker, S., Gil-Garcia, J. R., Mellouli, S., Nahon, K., Scholl, H. J., (2012). Understanding smart cities: An integrative framework. In 2012 45th Hawaii international conference on system sciences (pp. 2289-2297). IEEE. https://ieeexplore.ieee.org/abstract/document/6149291/
Clarke, R. J. I. G. I., (2013). Business strategy: IDC government insights' smart city maturity model—Assessment and action on the path to maturity. International Data Corporation (IDC) Government Insights, Business Strategy# GI240620. Alexandria, VA: USA.
Colldahl, C., Frey, S., Kelemen, J. E., (2013). Smart cities: Strategic sustainable development for an urban world. https://www.diva-portal.org/smash/record.jsf?pid=diva2:832150
Elberzhager, F., Mennig, P., Polst, S., Scherr, S., Stüpfert, P., (2021). Towards a digital ecosystem for a smart city district: Procedure, results, and lessons learned. Smart Cities, 4(2), 686-716. https://www.mdpi.com/2624-6511/4/2/35
Evans, J., Karvonen, A., Luque-Ayala, A., Martin, C., McCormick, K., Raven, R., Palgan, Y. V., (2019). Smart and sustainable cities? Pipedreams, practicalities and possibilities. Local Environment, 24(7), 557-564. https://www.tandfonline.com/doi/full/10.1080/13549839.2019.1624701
Framework, I. C., (2018). A consensus framework for smart city architectures. Release v1. 0, September. https://standardsmichigan.com/wp-content/uploads/2018/04/14-43-NIST-IES-City-Frameworkdraft_20180207.pdf
Fredericks, J., Parker, C., Caldwell, G. A., Foth, M., Davis, H., Tomitsch, M., (2020). Designing smart for sustainable communities: Reflecting on the role of HCI foraddressing the sustainable development goals. In Paper presented at the proceedings ofthe 31st Australian conference on human-computer-interaction, Freman-

tle, WA, Australia. https://dl.acm.org/doi/abs/10.1145/3369457.3369550

Gharaibeh, A., Salahuddin, M. A., Hussini, S. J., Khreishah, A., Khalil, I., Guizani, M., Al-Fuqaha, A., (2017). Smart cities: A survey on data management, security, and enabling technologies. IEEE Communications Surveys & Tutorials, 19(4), 2456-2501. https://ieeexplore.ieee.org/abstract/document/8003273/

Gracias, J. S., Parnell, G. S., Specking, E., Pohl, E. A., Buchanan, R., (2023). Smart cities—a structured literature review. Smart Cities, 6(4), 1719-1743. https://www.mdpi.com/2624-6511/6/4/80

Haarstad, H., Wathne, M. W., (2019). Are smart city projects catalyzing urban energy sustainability? Energy Policy, 129, 918-925.
https://doi.org/10.1016/j.enpol.2019.03.001

Hu, Q., Zheng, Y., (2021). Smart city initiatives: A comparative study of American and Chinese cities. Journal of urban affairs, 43(4), 504-525. https://www.tandfonline.com/doi/abs/10.1080/07352166.2019.1694413

Ismagilova, E., Hughes, L., Rana, N. P., Dwivedi, Y. K., (2020). Security, privacy and risks within smart cities: Literature review and development of a Smart Cityinteraction framework. Information Systems Frontiers. https://link.springer.com/article/10.1007/s10796-020-10044-1

James, P., (2014). Urban sustainability in theory and practice: circles of sustainability. Routledge. https://www.taylorfrancis.com/books/mono/10.4324/9781315765747/urban-sustainability-theory-practice-paul-james

Shao, J., & Min, B. (2025). Sustainable development strategies for Smart Cities: Review and development framework. Cities, 158, 105663. https://www.sciencedirect.com/science/article/pii/S0264275124008771

Kaiser, Z. A., & Deb, A. (2025). Sustainable smart city and Sustainable Development Goals (SDGs): a review. Regional Sustainability, 6(1), 100193. https://www.sciencedirect.com/science/article/pii/S2666660X25000015

Kaneda, T., Greenbaum, C., Kline, K., (2020). 2020 world population data sheet. Retrieved from Washington, DC. https://www.prb.org/wp-content/uploads/2020/07/letter-booklet2020-world-population.pdf.

Kothadiya, D., Chaudhari, A., Macwan, R., Patel, K., Bhatt, C., (2021). The convergence of deep learning and computer vision: smart city applications and research challenges. In 3rd International Conference on Integrated Intelligent Computing Communication & Security (ICIIC 2021) (pp. 14-22). Atlantis Press. https://www.atlantis-press.com/proceedings/iciic-21/125960870

Kumar, T. M. V., Dahiya, B., (2017). Smart Economy in Smart Cities. TMV Kumar (Ed.), Smart Economy in Smart Cities içinde (ss. 3-76). Singapore: Springer. doi, 10, 978-981.

Kwak, Y. H., Lee, J., (2021). Toward sustainable smart city: Lessons from 20 years of Korean programs. IEEE Transactions on Engineering Management, 70(2), 740-754. https://ieeexplore.ieee.org/abstract/document/9381515/

Kylili, A., Afxentiou, N., Georgiou, L., Panteli, C., (2020). The role of Remote Working in smart cities: Lessons learntfrom COVID-19 pandemic. Energy Sources, Part a: Recovery, Utilization, and Environmental Effects. https://www.tandfonline.com/doi/abs/10.1080/15567036.2020.1831108

Li, X., Liu, H., Wang, W., Zheng, Y., Lv, H., Lv, Z., (2022). Big data analysis of the internet of things in the digital twins of smart city based on deep learning. Future Generation Computer Systems, 128, 167-177. https://www.sciencedirect.com/science/article/pii/S0167739X21003964

Loo, B. P. Y., & Tang, W. S. M., (2019). 'Mapping' smart cities 'mapping' smart cities. Journal of Urban Technology,26(2), 129–146. https://www.tandfonline.com/doi/abs/10.1080/10630732.2019.1576467

Ma, X., Xue, H., (2020). Intelligent smart city parking facility layout optimization based on intelligent IoT analysis. Computer Communications, 153, 145-151. https://www.sciencedirect.com/science/article/pii/S0140366419319036

Marsal-Llacuna, M. L., Colomer-Llinàs, J., Meléndez-Frigola, J., (2015). Lessons in urban monitoring taken from sustainable and livable cities to better address the Smart Cities initiative. Technological Forecasting and Social Change, 90, 611-622.
https://doi.org/10.1016/j.techfore.2014.01.012

Martin, C. J., Evans, J., Karvonen, A., (2018). Smart and sustainable? Five tensions in the visions

and practices of the smart-sustainable city in Europe and North America. Technological Forecasting and Social Change, 133, 269-278. https://www.sciencedirect.com/science/article/pii/S0040162518300477

Masik, G., Sagan´, I., Scott, J. W., (2021). Smart City strategies and new urban development policies in the Polish context.Cities, 108, 102970. https://www.sciencedirect.com/science/article/pii/S0264275120313184

Masuda, H., Kawakubo, S., Okitasari, M., Morita, K., (2022). Exploring the role of localgovernments as intermediaries to facilitate partnerships for the sustainable development goals. Sustainable Cities and Society, 82, Article 103883. https://www.sciencedirect.com/science/article/pii/S2210670722002049

Mohapatra, H., (2021). Socio-technical challenges in the implementation of smart city. In 2021 international conference on innovation and intelligence for informatics, computing, and technologies (3ICT) (pp. 57-62). IEEE. https://ieeexplore.ieee.org/abstract/document/9581905/

Moher D, Liberati A, Tetzlaff J, Altman DG. Academia and clinic annals of internal medicine preferred reporting items for systematic reviews and meta-analyses. Annu Intern Med. 2009;151(4):264-9. https://www.bmj.com/content/339/bmj.b2535.short

Moulaii, M. M., Kharvari, F., Shahhosseini, G., Esmailpour Zanjani, N., (2020). Definition and recognition of required factors for smartening cities in developing countries. International Journal of Urban Management and Energy Sustainability, 1(2), 15-23. https://www.ijumes.com/article_26837.html

Nam, T., Pardo, T. A., (2011). Conceptualizing Smart city with dimensions of technology, people, and institutions. pp. 282–291. https://dl.acm.org/doi/abs/10.1145/2037556.2037602

Neirotti, P., De Marco, A., Cagliano, A. C., Mangano, G., Scorrano, F., (2014). Current trends in Smart City initiatives: Some stylised facts. Cities, 38, 25-36. https://www.sciencedirect.com/science/article/pii/S0264275113001935

Ninčević Pašalić, I., Ćukušić, M., Jadrić, M., (2020). Smart city research advances in Southeast Europe. International Journal of Information Management, 58, 102127. https://doi.org/10.1016/j.ijinfomgt.2020.102127

Petticrew M, Roberts H. Systematic reviews in the social sciences: A practical guide. John Wiley & Sons; 2008 Apr 15. https://books.google.com/books?hl=en&lr=&id=ZwZ1_xU3E80C&oi=fnd&pg=PR5&dq=78.%09Petticrew+M,+Roberts+H.+Systematic+reviews+in+the+social+sciences:+A+practical+guide.+John+Wiley+%26+Sons%3B+2008+Apr+15.&ots=w_U6vOMYQv&sig=5gmxyjX3vU1wcW6p2oaZBNaCHvQ

Programme, N. E., (2012). UNEP promotes environ- mentally sound practices globally and in its own activities. This publication is printed on 100 % eco-fibers paper, usingvegetable—Based inks and other eco-friendly practices. Our distribution policy aims to reduce UNEP's car.

Rahimi, H., Behzadfar, M., Abdollahzade Taraf, A., (2022). Operational indicators of sustainable urban development in suburban areas (Case study: District 22). International Journal of Urban Management and Energy Sustainability, 4(2), 62-73. https://www.ijumes.com/article_708258.html

Ramírez-Moreno, M. A., Keshtkar, S., Padilla-Reyes, D. A., Ramos-López, E., García-Martínez, M., Hernández-Luna, M. C., Lozoya-Santos, J. D. J., (2021). Sensors for sustainable smart cities: A review. Applied Sciences, 11(17), 8198. https://www.mdpi.com/2076-3417/11/17/8198

Robertson, M., (2021). Sustainability principles and practice. Routledge. https://www.taylorfrancis.com/books/mono/10.4324/9780429346668/sustainability-principles-practice-margaret-robertson

Roy, K. S., Sowmya, S., Manasa, M., Alekhya, D., Abhinav,P., (2018). Decentralized weather monitoring system forsmart cities, 7(2), 67–69.

Saffarsabzevar, F., (2024). The contexts for realizing Iranian smart city; a study based on meta-synthesis. International Journal of Urban Management and Energy Sustainability, 5(3), 29-43. https://www.ijumes.com/article_714945.html

Sarkis-Onofre, R., Catalá-López, F., Aromataris, E., & Lockwood, C. (2021). How to properly use the PRISMA Statement. Systematic reviews, 10(1), 117. https://doi.org/10.1186/s13643-021-01671-z

Sharifi, A., (2019). A critical review of selected

smart city assessment tools and indicatorsets. Journal of Cleaner Production, 233, 1269–1283. https://www.sciencedirect.com/science/article/pii/S0959652619321341

Sharifi, A., Allam, Z., Bibri, S. E., Khavarian-Garmsir, A. R., (2024). Smart cities and sustainable development goals (SDGs): A systematic literature review of co-benefits and trade-offs. Cities, 146, 104659. https://www.sciencedirect.com/science/article/pii/S0264275123004717

Shelton, T., Zook, M., Wiig, A., (2015). The 'actually existing smart city'. Cambridge journal of regions, economy and society, 8(1), 13-25. https://academic.oup.com/cjres/article-abstract/8/1/13/304403

Shoaib, N., Shamsi, J. A., (2019). Understanding network requirements for smart city applications: Challenges and solutions. IT Professional, 21(3), 33-40. https://ieeexplore.ieee.org/abstract/document/8720139/

Silva, B. N., Khan, M., Han, K., (2018). Towards sustainable smart cities: A review of trends, architectures, components, and open challenges in smart cities. Sustainable cities and society, 38, 697-713. https://www.sciencedirect.com/science/article/pii/S2210670717311125

Singh, D. K., Sobti, R., Jain, A., Malik, P. K., Le, D. N., (2022). LoRa based intelligent soil and weather condition monitoring with internet of things for precision agriculture in smart cities. IET communications, 16(5), 604-618. https://doi.org/10.1049/cmu2.12352

Song, H., Srinivasan, R., Sookoor, T., Jeschke, S., (2017). Smart cities: foundations, principles, and applications. John Wiley & Sons. https://books.google.com/books?hl=en&lr=&id=3McmDwAAQBAJ&oi=fnd&pg=PP23&dq=Song,+H.,+Srinivasan,+R.,+Sookoor,+T.,+Jeschke,+S.,+(2017).+Smart+cities:+foundations,+principles,+and+applications.+John+Wiley+%26+Sons.+&ots=Pe87qiYVtF&sig=HxntMDNUksPzZIzQpdqF8w0-FYE

Soomro, S., Miraz, M. H., Prasanth, A., Abdullah, M., (2018). Artificial intelligence enabled IoT: Traffic congestion reduction in smart cities. In: IET Conference on Publications, Vol. 2018, no. CP747. https://digital-library.theiet.org/doi/abs/10.1049/cp.2018.1381

Stratigea, A., Papadopoulou, C.A., Panagiotopoulou, M., (2015). Tools and Technologies for planning the development of smart cities. J. Urban Technol. 22 (2), 43e62. https://www.tandfonline.com/doi/abs/10.1080/10630732.2015.1018725

Tahmasseby, S., (2022). The implementation of smart mobility for smart cities: A case study in qatar. Civ. Eng. J, 8(10), 2154-2171. https://scholar.archive.org/work/w2gvit6ecvgmbgcfk6h7rxkl7i/access/wayback/https://www.civilejournal.org/index.php/cej/article/download/3569/pdf

Toli AM ; Murtagh N., (2020) The Concept of Sustainability in Smart City Definitions. Front. Built Environ. 6:77. https://www.frontiersin.org/articles/10.3389/fbuil.2020.00077/full

Ullah, Z., Al-Turjman, F., Mostarda, L., Gagliardi, R., (2020). Applications of artificial intelligence and machine learning in smart cities. Computer Communications, 154, 313-323. https://www.sciencedirect.com/science/article/pii/S0140366419320821

UN-Habitat., (2022). Envisaging the future of cities. Retrieved from Nairobi, Kenya: https://unhabitat.org/sites/default/files/2022/06/wcr_2022.pdf.

Wall, R. S., Stavropoulos, S., (2016). Smart cities within world city networks. Applied Economics Letters, 23(12), 875-879. https://www.tandfonline.com/doi/abs/10.1080/13504851.2015.1117038

Wang, H., Zhang, M., Zhong, M., (2019). Opportunities and challenges for the construction of a smart city geo-spatial framework in a small urban area in central China. Smart Cities, 2(2), 245-258. https://www.mdpi.com/2624-6511/2/2/16

Wiig, A., (2015). IBM's smart city as techno-utopian policy mobility. City, 19(2-3), 258-273. https://www.tandfonline.com/doi/abs/10.1080/13604813.2015.1016275

Yigitcanlar, T., Cugurullo, F., (2020). The sustainability of artificial intelligence: An urbanistic viewpoint from the lens of smart and sustainable cities. Sustainability, 12(20), 8548.https://www.mdpi.com/2071-1050/12/20/8548

Yigitcanlar, T., Foth, M., Kamruzzaman, M., (2019). Towards post-anthropocentric cities: Reconceptualizing smart cities to evade urban ecocide. Journal of Urban Technology, 26(2),

147–152. https://www.tandfonline.com/doi/abs/10.1080/10630732.2018.1524249

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