State of the Art of Smart Cities: Multidimensional Approach and Future Perspectives

Insights from Recent Research and Global Trends

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Abstract— **Against the backdrop of rapid urbanisation, cities are confronted with increasingly complex and interrelated challenges, including accelerated population growth, growing strain on scarce resources, environmental deterioration, and global crises such as the COVID-19 pandemic. Consequently, the smart city concept has emerged as a promising solution. In recent years, this concept has attracted considerable attention, as it is widely perceived as an effective response to urban challenges such as demographic growth, traffic congestion, infrastructure pressure, and environmental degradation. However, despite this growing interest, the definition of the smart city remains largely dominated by a technocentric approach. This article presents a systematic review of the smart city concept based on the PRISMA methodology, conducted between 2016 and 2025, which corresponds to the last ten years during which the concept has evolved, particularly with the rise of d the emergence of new technologies. The research methodology relies on a structured literature review designed to address the research question concerning the definitions of smart cities. The analysis is based on 44 high- impact and widely cited journal publications selected from the Scopus and Google Scholar databases. The results indicate that most studies primarily emphasize technological dimensions, while social, environmental, and governance dimensions, particularly citizen participation, remain insufficient and less explored. Based on these findings, the study highlights conceptual ambiguities in existing definitions of the smart city and proposes a synthesized definition integrating a concept based on citizens and human capital. This multidimensional synthesis illustrates the foundations of the smart city concept, identifies gaps in the literature, and opens avenues for future research that adopts a more inclusive and collaborative approach.**

Keywords- Smart cities; Information and Communication Technologies (ICT); Human capital; Urban governance; Participation.

I. INTRODUCTION

Smart Cities represent a new and evolving concept shaping urban development in the 21st century. They aim to integrate Information and Communication Technologies (ICT) into urban management, in order to improve citizens' quality of life, enhance the efficiency infrastructures and services, and promoting sustainable economic growth [1]. This model is applied across various domains including transportation, energy, healthcare, education, governance, mobility, and environment management, with the objective of creating interconnected and intelligent urban spaces [2].

This systematic literature review on smart cities, covering the period from 2016 to 2025, aims to provide a comprehensive state of the art, examine the main definitions of the smart city concept, and identify research gaps, particularly regarding the consideration of collaborative social dimensions and governance. The study also builds on previous reviews centered on several key elements. First, it relies on a systematic approach covering a recent period, (2016 - 2025), in contrast to many earlier reviews focused on older periods and mainly on technological interpretations. It also presents the most recent conceptual developments of the smart city paradigm.

Our research adopts a multidimensional approach that highlights the social, human, participatory, and governance dimensions, which are still underexplored and rarely mentioned in the literature. It highlights conceptual ambiguities in existing definitions of the smart city and proposes a synthesized definition integrating a citizen- and human-capital-centered concept. Furthermore, it emphasizes the conceptual vagueness surrounding smart city definitions and proposes an integrated definition placing the concept around citizens and human capital. These contributions provide researchers, as well as policy makers and urban planners, with a clearer and more robust conceptual framework.

The reminder of this article is organized as follows. Section II presents the methodology employed for this systematic literature review, detailing the selection criteria and the databases consulted. Section III examines the different definitions of the smart city, highlighting conceptual variations and ambiguities. Section IV analyzes the results, with a particular emphasis on multidimensional perspectives, including technological, social, participatory, and governance aspects. Finally, Section V synthesizes the main findings, discusses their implications for researchers and policymakers, and proposes directions for future research.

II. METHODOLOGY

The first step of our literature review consisted of formulating the research questions, which helped define the orientation of the analysis process. This systematic review aimed to study the current state of smart cities, by examining their definition and criteria.

Our research questions were as follows:

- What is the definition of smart city?
- What are the criteria to be considered?
- What are the different typologies of models designed to support these definitions of smart city?
- What types of methodologies are implemented to bring these smart cities into existence?
- Are there levers and barriers for the creation and development of smart cities?

To address our questions, we chose to use the PRISMA method for the literature review. The first stage focused on a systematic literature review, based on a set of inclusion and exclusion criteria, allowing us to enrich our state of the art and ensure coverage of a maximum number of relevant articles for our study.

The process, presented in Figure 1, relies on collecting previous works from Scopus and Google Scholar using specific keywords. The combined use of several keywords proved necessary to reduce the number of results, as a single keyword generated too large a volume of articles to examine.

We conducted this systematic review following the PRISMA 2020 (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) recommendations dedicated to abstracts (11 items), [3]. We selected this methodology over others because it is well suited to the interdisciplinary nature of research on smart cities and emphasizes transparency and replicability, thus identifying the key elements that are often neglected, contrary to previous studies.

By highlighting an imbalance between technological approaches and human-centered approaches, this research offers a new perspective and insight on collaborative smart city models. Despite the abundance of publications on smart cities, existing research lacks a clear conceptual definition, and most are focused on technocentric approaches to the detriment of other human, social, and governance dimensions.

This research contributes to filling this gap by conducting a systematic review, based on the PRISMA methodology, notably of smart city definitions published between 2016 and 2025. This research emphasizes collaboration and participation within the smart city concept by systematically analyzing citizen involvement in co-creation processes and collaborative governance, which is as reflected in smart city definitions.

Figure 1 is inspired by the PRISMA methodology for systematic reviews and meta-analyses. In the first stage, 1,260 articles were identified in Scopus and 20 in Google Scholar. During this process, duplicates were removed; likewise, 2 articles were found to be retracted. After assessing their relevance, 1,254 articles from Scopus and 10 from Google Scholar were retained.

In initial screening, we examined the articles based on their title, keywords, and abstract, in order to determine their relevance to the research questions. After this process, 44 articles were identified, while 10 were excluded because they had no connection with the smart city.

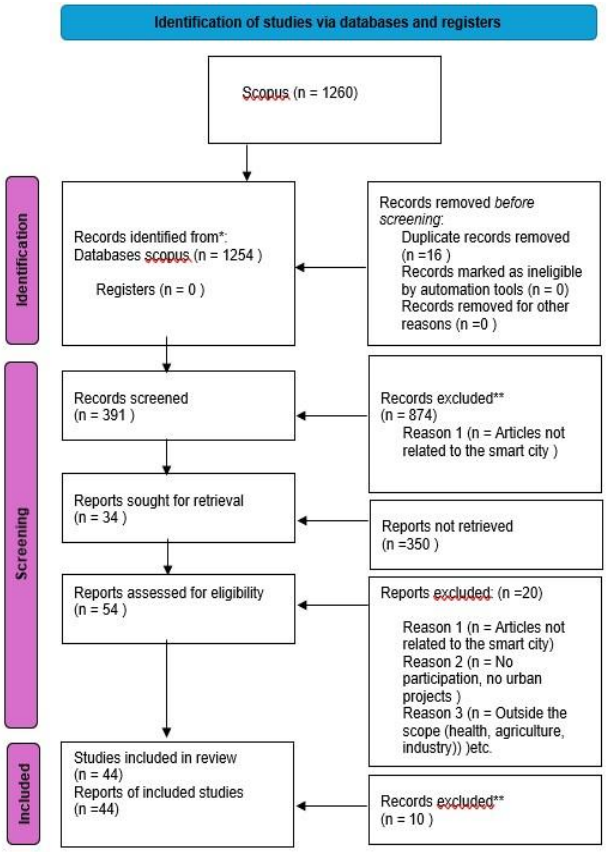

Figure 1. PRISMA method for systematic reviews and meta-analyses (2021).

III. RESULTS AND DISCUSSION

1. *Emergence and evolution of the smart city concept*

The neologism of the term “Smart City” appeared in the 1990s and was adapted to the integration of Information and Communication Technologies (ICT) to improve urban management. This expression is a strategy of firms, such as IBM, Cisco Systems, and Siemens AG, which consider cities as potential markets associated with the use of new ICT[5]. These companies play a key role in popularizing this concept to reconquer markets. At this stage, the company underwent a period of recession, from which it considered cities as an important potential market [6].

Indeed, the word “smart city” is a product of an advertising campaign by a private company; quickly, this term spread to the public to become a brand image, an “urban labeling” [7]. Its main objective is to promote their territories and their projects so that they become intelligent.

2. *Definitions of the Smart City: Critical Analysis of Literature*

The most frequently cited definition in the literature is that of Giffinger, according to which "a smart city is a city that performs well in a forward-looking perspective in its six characteristics (economy, citizens, governance, mobility, environment, and quality of life), based on the 'smart' combination of the talents and activities of autonomous, independent, and aware citizens" [8].This definition, among the earliest formulated, is particularly significant for two reasons. Unlike other definitions, Giffinger's approach does not directly mention technology but considers that the intelligence of the city can be achieved through different means. It emphasizes human intelligence more than digital intelligence; technology appears as a tool and not as an end in itself [9]. Urban intelligence is mainly based on citizens, their talents, and their institutions [6].

As shown in Figure 2, the smart city concept is characterized by six main elements:

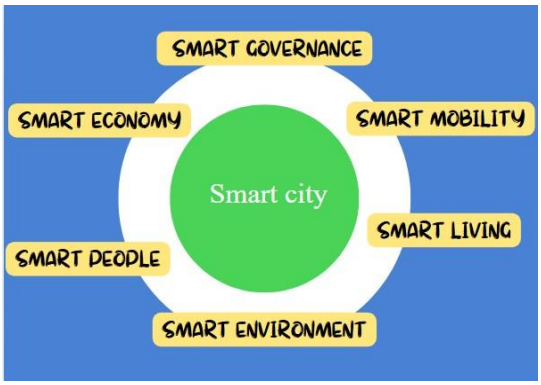

Figure 2. Conceptual diagram of the smart city dimension.

2.1. *Intelligent Citizen*

Within the smart city framework, citizens play a key role in urban transformation across economic, social, and environmental levels. The intelligence of the citizen is measured by the rate of use of new technologies to access participation in public life and also in education and distance learning; all of this promotes creativity and open-mindedness [10].

Furthermore, they collaborate with several experts on the professional level: administrators, architects, and engineers, to get their opinions on urban planning and city development [11]. The intelligent citizen is characterized by the adaptation of new technologies in their lifestyles toward environmentally friendly lifestyles, in their active participation, and in their social engagement [12].

This evolution of smart cities requires not only technology but also an educational model that encourages digital culture [13]. These initiatives aim to enhance residents' quality of life and promote participatory democracy through ICT [14]. To achieve this issue, it is recommended to adopt procedures aimed to integrating residents into the discussion that precedes the creation and development of smart cities [14].

Human capital refers to the set of skills, capabilities, and experiences of individual people. The development of smart cities relies on the importance of human capital, as it plays an essential role in innovation and growth [15].

The objective of this capital is to attract and develop talents by relying on values such as creativity, open-mindedness, and ethnic diversity [6]. The concept of smart cities emphasizes the importance of human capital, talent attraction, and social cohesion while ensuring access to technologies for all, including vulnerable populations. Human capital, which includes education, skills, and knowledge, is increasingly crucial for the economic success of developed countries [16].

2.2. *Intelligent Environment*

This pillar is based on the management of natural resources and waste treatment, which are at the center of smart city concerns. Firstly, the city enhances energy efficiency through the development of low-consumption public lighting and the implementation of other local energy production systems (photovoltaic solar panels on building roofs) [11].

Indeed, this dimension aims to use new technologies to address climate change challenges and reduce energy consumption, as well as to preserve natural resources through the implementation of sensors, for example for water leaks; in the field of agriculture, sensors and AI are used to optimize crop yields [17]. Intelligent waste management relies on IoT devices and sensors to monitor and manage waste collection and disposal, thereby reducing their environmental impact. The intelligent environment refers to the natural living conditions in the city (e.g., green spaces), the management of pollution and resources (e.g., reuse and replacement of resources), and environmental protection. Solutions that constitute an intelligent environment include, for example, efficient waste management [18]. The transformation of cities through new technologies has gradually integrated aspects of urban life as diverse as the economy, education, democracy, infrastructure, transport, environment, security, and quality of life [19].

2.3. *Intelligent Mobility*

Intelligent mobility refers to the implementation of digital transport solutions aimed at improving mobility and safety and being environmentally friendly through ICT [17], it also involves the development of public transport based on more environmentally friendly fuels through the integration of ICT and proactive citizen behavior [18].

The transport sector has been among the first to adopt digital technologies to optimize the management of urban flows. Indeed, access to real-time transport information, available on digital display boards in stations, bus stops, trains, or even via personal smartphones, allows users to obtain a multitude of information. The relationship between humans, vehicles, and their environment is currently undergoing transformation in the intelligent mobility sector [11] .

2.4. Intelligent Government

The intelligent government uses several smart application systems to serve the public. New technologies play an important role in city management on the governmental level. Indeed, these technologies facilitate administrative processes while speeding up procedures, whether through digitization of services, voting, or electronic channels [19].

Smart city governance involves developing new modalities of human collaboration by exploiting (ICT) to improve outcomes and promote more transparent governance processes [17]. Smart city applications for governance have the potential to radically change city management, enhancing transparency, accountability, and civic engagement. The increasing integration of technologies into urban life pushes authorities to rethink their role by adapting their modes of operation, tools, and services, as seen with dematerialization or simplification of administrative procedures, as well as the introduction of electronic voting [20] .

2.5. Intelligent Economy

The intelligent economy represents innovation through the integration of new technologies into initiatives and entrepreneurship. It provides a more efficient environment to attract companies, encourage the local economy, and create new job opportunities while ensuring sustainable growth [21]. Economic intelligence mainly manifests in competition between traditional and emerging companies in this new environment. Indeed, the economic value of data is generally co-constructed by multiple actors from different sectors; new collaborations occur between companies, innovation and research centers, governments, and citizens [6].

2.6. Intelligent Habitat

The integration of smart applications demonstrates the transition toward more sustainable management using technology, particularly sensors and advanced systems. Cities are shifting from a reactive model to a predictive model. Smart application systems aim to optimize the management of buildings, roads, and bridges [22]. Citing the example of smart building systems, they use IoT devices and sensors to monitor and manage energy consumption, indoor air quality, reducing costs and improving the quality of life for users' [6] .

Although the literature on smart cities is mainly focused on technological infrastructures and digital solutions, this study highlights the importance of dimensions still little explored, which are essential to generate concrete paths for both research and practice [23].

First, citizen participation and collaborative governance are central elements that remain insufficiently developed. Indeed, the citizens are often presented as beneficiaries of smart city initiatives. Despite their contribution and role as a co-creator in the design and development of the smart city, this contribution is rarely analyzed in depth. This insufficiency limits understanding of collaboration between citizens, public authorities, and private actors to improve the efficiency and social acceptance of smart city strategies. Second, human capital and social inclusion are marginalized compared to technological aspects [24].

Second, the literature mentions that information and communication technologies bring innovation and efficiency while neglecting inequalities in digital skills, access to technological tools, and social participation [25]. It is essential to address these issues to avoid technocentric smart city models and promote inclusive urban development [26].

Third, contextual and territorial approaches are largely not considered. Many definitions of smart cities continue to rely on technological solutions while neglecting economic, sociocultural, and institutional contexts [27].

This analysis highlights the need to design adaptive smart city models that integrate collaborative dynamics and local knowledge to address specific urban challenges. Furthermore, the work of Marrone and Hammerle emphasizes the complexity of roles and interactions among actors in smart cities, highlighting the low representation of citizens. Thus, it shows the predominance of technological actors in smart cities [28].

3. Our Position Regarding These Definitions

The concept of the smart city remains unclear and lacks a consistent definition in literature. It is mentioned heterogeneously according to the perspectives adopted by researchers and urban actors. Several articles do not provide any explicit definition concerning the smart city. Indeed, there are articles focused on technology [32][29], while others integrate several dimensions at once, although articles that focus solely on human resources or governance are fewer compared to other approaches. Research on smart cities indicates that no single definition prevails; rather, the concept is characterized by a multiplicity of interpretations across different dimensions.

This lack of definition generally poses difficulties for policymakers and urban planners seeking to implement a true smart city. Various studies suggest that the definition of the smart city is hybrid through several approaches, which fosters some confusion around the concept [30]. Our analysis of smart city definitions revealed several different explenations that often replace the term "intelligent" with digital or connected. Although there is no consensus on the smart city, six dimensions have been identified. It can be deduced that a smart city is a city based on information and communication technology, which integrates six key dimensions: economy, citizens, living environment, environment, governance, and mobility. We propose the following definition to highlight the key concepts, the importance given to services, and the specific objectives of smart cities:

- Humanistic: citizens are at the heart of the city and use technology as a means, not an end; collaborative, where stakeholder participation is essential to use the skills and intelligence to create effective and sustainable solutions.[31]
- Collaborative: the smart city is based on a process of co-creation and participation, founded on active collaboration among citizens, public authorities, and private stakeholders in the design, implementation, and evaluation of urban initiatives.[32]

• Thematic: the city is organized by different domains, such as transport, energy, health, education, or security.
• Contextual: centered on citizens, mobilizing all stakeholders to find effective and high-performance technological solutions applied to local needs [33].

By proposing a precise definition of the smart city, this research provides a reference framework to help policymakers and urban planners design a smart city model adapted to their context, with the aim of improving urban quality of life while promoting sustainable development.

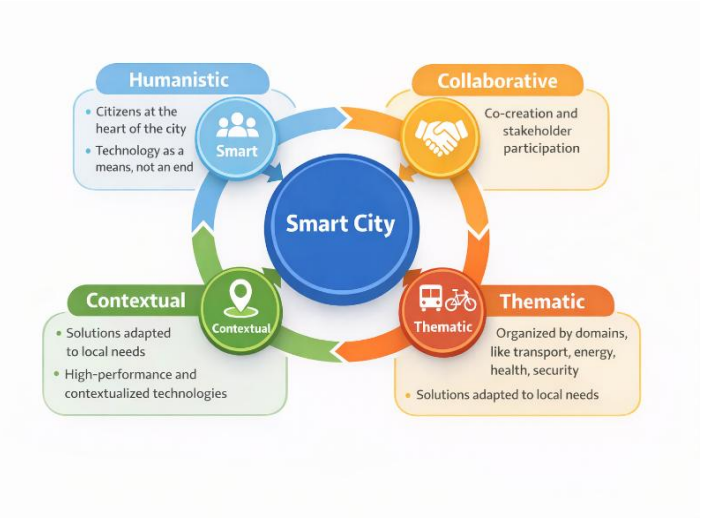

Figure 3. Conceptual Framework of the Smart City.

4. *Limits of Dominant Approaches to the Smart City*

4.1. Limited Integration of Collaboration and Citizenship

The results indicate that, despite the frequent presence of citizens in smart city definitions, collaboration and citizen participation are rarely mentioned as central elements of conceptual frameworks. Most studies contribute to considering citizens as mere users or beneficiaries, rather than as co-creators engaged in decision-making. This shows that participation remains a secondary dimension rather than a main structuring element in the development of smart cities. Consequently, collaborative dynamics remain weak, both in conceptual models and in the theoretical domain [34].

4.2. Persistent Conceptual Ambiguity of Smart City Definitions

Another element lies in the strong heterogeneity of smart city definitions present in the literature. The analysis explores several concepts influenced by technological, economic, environmental, or governance dimensions. This ambiguity generates inconsistencies in policies and practices related to smart cities. The absence of a unified definition limits cities' ability to develop coherent strategies, notably in citizen participation and collaboration.

IV. CONCLUSION

This systematic literature review on smart cities highlights the plurality of definitions and approaches in this field. Studies predominantly focus on the technological dimension, whereas human, social, and environmental aspects are less studied. The analysis of publications also reveals a lack of empirical validation of existing conceptual frameworks. First, the literature review relies on publications in English and French available in the Scopus and Google Scholar databases, which may have excluded research published in other languages or in less accessible journals.

Next, the study focuses only on the period 2016-2025 and on smart cities, which limits the generalization of the conclusions on a larger scale. Nevertheless, this approach opens perspectives and avenues for future research on smart cities, based notably on socio-technical and collaborative systems rather than focusing solely on simple digital devices.

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