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Trends, obstacles, and opportunities for smart cities in urban space: A systematic literature review

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Abstract

Urbanisation and digitalisation are two significant trends in social development nowadays. The 'smart city' has been introduced to address the conflict between citizens' needs and urban services. However, while much attention has been directed towards the technological aspects, fewer studies have explored their urban impacts. This article presents a systematic review of the existing empirical literature on smart cities in urban space, aiming to investigate the trends of the research, and emphasise obstacles and potential opportunities for smart cities in urban space. The review covers 53 articles obtained from the Web of Science (WoS) and Scopus databases and followed the Preferred Reporting Items for Systematic Review and Meta-Analysis (PRISMA) statement. The findings reveal three main trends (smart city as a technique, as a tool, and as a way), five major obstacles (technological hegemony; surveillance and privacy; data integration difficulties; marginalisation and regional inequality; technocracy and discrimination), and four potential opportunities (interdisciplinary collaboration; platform integrations; inclusive citizen engagement; localised adaptive approaches) related to the objectives. Furthermore, the article highlights several recommendations related to context-based responsive planning strategies for local needs; a comprehensive examination of user perception frameworks; the integration of participatory approaches for more inclusive cities, and standardised measurement protocols for information exchange. This review contributes to policymakers and urban planners in their practices, provides valuable guidance to academics in various fields, and delivers implications for applying smart city concepts in the Global South and other developing countries.

Keywords: Smart cities, urban space, PRISMA, systematic review

TENDENSE, STRUIKELBLOKKE EN GELEENTHEDE VIR SLIM STEDE IN STEDELIKE RUIMTE: 'N SISTEMATIESE LITERATUUROORSIG

Verstedeliking en digitalisering is tans twee belangrike neigings in sosiale ontwikkeling. Die 'slim stad' is bekendgestel om die konflik tussen die behoeftes van inwoners en stedelike dienste aan te spreek. Hoewel baie aandag aan die tegnologiese aspekte gegee is, is minder studies gedoen oor die impak daarvan op stedelike ruimtes. Hierdie artikel bied 'n sistematiese oorsig van bestaande empiriese literatuur oor slim stede in stedelike kontekste, met die doel om navorsingstendense te ondersoek, sowel as om hindernisse en potensiële geleenthede vir slim stede uit te lig. Die oorsig sluit in 53 artikels, verkry uit die Web of Science (WoS) en Scopus-databasisse, en volg die PRISMA-riglyne vir sistematiese oorsigte en meta-analise. Die bevindings identifiseer drie hoofneigings (die slim stad as tegniek, as hulpmiddel en as benadering); vyf belangrike hindernisse (tegnologiese oorheersing; toesig en privaatheid; probleme met data-integrasie; marginalisering en streeksongelykheid; tegnokrasie en diskriminasie), en vier moontlike geleenthede (interdissiplinêre samewerking; platform-integrasie; inklusiewe burgerbetrokkenheid, en plaaslik-geskikte aanpassingsbenaderings). Die artikel maak ook verskeie aanbevelings, insluitend kontekssensitiewe beplanningsstrategieë wat plaaslike behoeftes aanspreek; deeglike evaluering van gebruikerspersepsies; deelname-gebaseerde benaderings vir meer inklusiewe stedelike ontwikkeling, en gestandaardiseerde meetprotokolle vir inligtingsuitruiling. Hierdie oorsig bied waardevolle insigte vir beleidmakers en stedelike beplanners, akademici en die toepassing van slim stad-konsepte in die Globale Suide en ander ontwikkelende lande.

LITSELA, LITŠITISO LE MENYETLA EA LITOROPO TSE BOHLALE LIBAKENG TSA LITOROPO: TLHAHLOBO E HLOPHISITSOENG EA LINGOLILOENG

Ho atamela ha batho litoropong (urbanisation) le ho tsoela pele ha theknoloji (digitalisation) ke mekhoa e meholo e hlahellang nts'etsopeleng ea sechaba matsatsing ana. Khopolo ea "toropo e bohlale" e hlahisitsoe e le mokhoa oa ho rarolla likhohlano tse teng pakeng tsa litlhoko tsa baahi le litšebeletso tsa litoropo. Leha ho le joalo, leha ho e-na le tlhokomelo e ngata e lebisitsoeng likarolong tsa

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theknoloji, liphuputso tse fokolang li shebane le tšusumetso ea tsona tikolohong ea litoropo. Sengoloa sena se fana ka tlhahlobo e hlophisitsoeng ea lingoliloeng tsa liphuputso tse teng mabapi le litoropo tse bohlale libakeng tsa litoropo, ka sepheo sa ho hlahloba mekhoa ea lipatlisiso le ho totobatsa litšitiso le menyetla e ka bang teng. Tlhahlobo ena e akaretsa lingoliloeng tse 53 tse fumanoeng ho Web of Science (WoS) le Scopus, 'me e latela melaoana ea PRISMA bakeng sa tlhahlobo ea lingoliloeng. Liphetho li senotse mekhoa e meraro e meholo (toropo e bohlale e le mokhoa, e le sesebelisoa, le e le tsela), litšitiso tse hlano (ho busoa ke theknoloji; tlhokomelo e feteletseng le boinotši; mathata a kopanyo ea data; khethollo ea libaka le ho se lekane; puso ea litsebi le khethollo), le menyetla e mene (ts'ebelisano pakeng tsa lits'ebeletso tse fapaneng; kopanyo ea liforomo; ho kenyeletsoa ha baahi ka botlalo; le mekhoa e ikamahanyang le maemo a lehae). Tlhahlobo ena e fana ka likeletso bakeng sa meralo ea maemo a lehae e arabelang litlhoko tsa baahi, ho hlahloba ka botebo maikutlo a basebelisi, ho kenyelletsa mekhoa ea boitokisetso ba sechaba, le ho theha litekanyo tse tloaelehileng bakeng sa phapanyetsano ea boitsebiso. Sena se thusa ba etsang melao le bahlophisi ba litoropo, le barutehi, haholoholo linaheng tse ntseng li hōla.

1. INTRODUCTION

Urbanisation and digitalisation have emerged as two 'megatrends' nowadays, presenting challenges across social, cultural, and urban domains (Kapoor, Bansal & Jain, 2020; Jedlinski & Sosik-Filipiak, 2022). In response to issues such as crime, congestion, and pollution, cities are increasingly striving to enhance their efficiency and sustainability through smarter approaches (Abdelkarim *et al.*, 2023; Biloria, 2021).

As smart cities become increasingly prevalent to address the conflict between citizen needs and urban services, related approaches will inevitably be encountered in diverse urban environments (Odufuwa *et al.*, 2018). Systems such as sensors will transform the fabric of urban spaces and influence users' perceptions *(Abdelkarim et al.*, 2023). This transformation extends to the spaces' characteristics and users' lifestyle, thereby converting urban spaces into venues for political, cultural, and social interactions (Aminah, 2021). The blurring of boundaries ultimately alters the original sense of place.

However, most of the literature on smart cities has focused on data-driven approaches (Biloria, 2021; Van Ameijde *et al.*, 2022), leaving a gap in the role of urban spaces in the development of smart cities. Therefore, a comprehensive study of smart city development trends, particularly in the fields of urban design and planning, is imperative. Specifically, from an urban perspective, the evolution of smart cities significantly influences the relationships among citizens, urban spaces, technologies, and public awareness (Borruso & Balletto, 2022; Jedlinski & Sosik-Filipiak, 2022). Consequently, it is essential to identify the obstacles and challenges encountered in contemporary cities and to seize potential opportunities to enhance people's quality of life and foster a stronger sense of place.

It is also noted that the existing literature often reflects a Global North orientation and tends to prioritise technical solutions over spatial and social complexities (Marques, 2021). This limits its applicability in more diverse urban contexts, especially in the Global South, where urban forms, governance structures, and socio-economic realities may differ significantly (Alizadeh & Prasad, 2024).

Therefore, this research article aims to analyse the existing literature on smart city practices within urban spaces. The objective of the systematic review is twofold. First, to review the current research trends regarding smart cities in urban space; secondly, to identify the obstacles and challenges encountered in the construction of spaces within contemporary cities. This study reviews and synthesises scientific records to identify, select, appraise, and integrate relevant studies for recommendations and implications for future research on smart cities practices. The findings attempt to contribute to decision-makers and urban planners in the development of smart cities, particularly in the Global South and developing countries.

2. LITERATURE REVIEW

2.1 Smart city and smart cities

The concept of the 'smart city' originated in the 1990s, when the emerging technologies significantly impacted urban and social development (Wang, Zhu & Du, 2024). In response, the smart city emerged as a solution for urban areas to address urban problems such as traffic congestion and air pollution through the Internet of Things (IoT) (Giffinger *et al.*, 2007; Hoang, 2021). However, the majority of existing literature indicates that there is no universally accepted definition of a smart city, as smart city models focus on different aspects, depending on the context, user needs, and political system (Borruso & Balletto, 2022).

In light of the aforementioned, several terms have been introduced, such as 'wired city', 'digital city', 'sustainable city', and 'universal city', which are sometimes used interchangeably with 'smart city' (Thompson, 2016; Ghani Khan, Elhadef & Mehmood, 2023; Prabowo *et al.*, 2023). 'Wired city' is used to describe highly connected urban areas through Information and Communication Technologies (ICT) (Papa, Gargiulo & Galderisi, 2013). 'Digital city' involves the virtual reconstruction of cities, using digital technologies (Hollands, 2008). In contrast, 'sustainable city' emphasises environmental sustainability (Ahvenniemi *et al.*, 2017), whereas a 'universal city' focuses on accessibility (Singh *et al.*, 2022). It is evident that these terms have different definitions and meanings, indicating different aspects of urban innovation associated with smart cities (Firmansyah *et al.*, 2019). Therefore, to ensure the consistency and credibility, this article uses the term 'smart city' as the main reference point throughout the discussion.

2.2 Factors of smart cities

The discussion of factors influencing smart cities in urban spaces is multifaceted. From a policy perspective, the triple and quadruple helix models support the importance of human factors, including behaviours and interactions between citizens, businesses, academia, and government (Thompson, 2016; Daher, Kubicki & Guerriero, 2017; Han *et al.*, 2023). Other studies concentrated on the technology-people and people-people interactions to facilitate effective support for planning processes (Lim *et al.*, 2018; McKenna, 2020; Punt *et al.*, 2020). Rahman and Ufiteyezu (2023) further subdivided it into three categories: infrastructure, devices, and internet. This highlights the physical carriers, revealing the importance of urban spaces. Moreover, the importance of urban management is also emphasised, with particular attention paid to the functionality of public spaces (Abdelkarim *et al.*, 2023).

These discussions collectively highlight the intricate dynamics between people, technology, urban space, and process within cities. However, previous research has often neglected the role of urban spaces in this field. One critical shortcoming in the existing literature is the tendency to treat urban spaces as undifferentiated, ignoring the specific sociocultural, economic, and spatial contexts that shape the urban experience. Many smart city frameworks, particularly those influenced by the Euro-American body of knowledge, often adopt a generalised, one-size-fits-all approach to urban design and technological integration (Alizadeh & Prasad, 2024). This overlooks the diverse realities of urban environments, which vary widely across different regions, particularly between the Global North and the Global South.

Research has shown that the lack of attention to the differentiated nature of urban spaces leads to the imposition of generic technological solutions that may not be suitable for all urban contexts. For example, the implementation of smart technologies in the Global South requires careful consideration of cultural, social, and physical dynamics, as these factors often influence the success or failure of such initiatives (Marques, 2021). Therefore, recognising the hybridity of urban spaces, where digital, physical, and social elements intersect, is essential for developing successful smart city solutions. This is the main focus of this article.

2.3 Urban space in smart cities

Urban space has historically been inextricably linked to technological evolution. It serves as the spatial manifestation of both ‘daily life’ and ‘social life’, exerting a deep influence on the attitudes, behaviours, and values of the citizens (Zgórska, Kamrowska-Zaluska & Lorens, 2021; Wang *et al.*, 2024). Nowadays, the information society is reconfiguring the physical structure of the city, transforming it into a meeting place for “politics and culture, social and individual spheres, and expressive and instrumental space” (Aminah, 2021: 222).

In the context of smart cities, Harrison and Dourish (1996) have categorised the space into three types, namely material, virtual, and hybrid. Wang *et al.* (2024) expressed a similar view, defining the spaces as physical, information, and social space. These frameworks reveal that urban space extends beyond tangible form, encompassing digital and social dimensions that interact in complex ways. In this context, urban space becomes relational beyond traditional material considerations, emerging from interactions among individuals, communities, and digital infrastructures. The integration of smart technologies redefines urban spaces through physical layout, as well as through dynamic social networks and digital connectivity.

As stated earlier, the four factors of smart cities include people, technology, urban space, and processes. This implies that technological advancement is inextricably linked to the evolution of urban space through interactions, which, in turn, reconfigure the physical structure and social functions of cities. It is, therefore, necessary to integrate smart city characteristics at all levels of the urban environment, thereby transforming the city’s identity. This provides the requisite theoretical background for a comprehensive understanding of the evolution path of smart cities in urban space and offers a scientific foundation for future policies and practices. In this study, urban space as the research focus is defined as the dynamic interaction zone where physical form, digital networks, and social activities converge and evolve through smart technologies.

3. METHODS

The study aims to provide an initial understanding of the trends, challenges, and opportunities of urban spaces within contemporary cities. The authors employed the Preferred Reporting Items for Systematic Review and Meta-Analysis (PRISMA) statement, which included information sources (Web of Science and Scopus databases), eligibility criteria, the systematic review process (identification, screening, and eligibility), as well as data extraction and synthesis.

3.1 PRISMA

PRISMA serves as a reporting guideline designed to identify future research priorities, synthesise data for a comprehensive understanding, and formulate causal theories by identifying, selecting, appraising, and synthesising previous studies across various fields (Llorens-Gámez *et al.*, 2022). Raman, Hutagalung and Abdul Rahman (2022) also support the fact that systematic reviews facilitate the identification of trends and gaps, by analysing the existing literature. In this article, the researchers conducted a thorough investigation of topics related to trends, obstacles, and opportunities for smart cities in urban spaces, providing valuable information for future reviews.

3.2 Information sources

This review used the Web of Science (WoS) and Scopus databases. The WoS database is renowned for its extensive repository across various disciplines (Shaffril, Krauss & Samsuddin, 2018), including urban studies, environmental sciences, and urban planning. The Web of Science Core Collection served as the primary information source for this review. Furthermore, the Scopus database covers peer-reviewed publications in various scientific, technical, and social science fields (Sapiyi, Suradi & Mustafa, 2022). The selection of both WoS and Scopus ensures the inclusion of high-impact publications in this study. However, other databases such as Google Scholar and PubMed were excluded, due to no peer-review process, no relevant papers, or not supporting search strings (Campoverde-Molina, Lujan-Mora & Garcia, 2020).

3.3 Inclusion and exclusion criteria

Several criteria were established for this study. The first criterion pertained to language. To avoid potential biases and translation difficulties, non-English literature was excluded, limiting the review to English records. The second criterion focused on document type. To ensure the rigour of the research, only peer-reviewed articles were included, while proceedings, book chapters, and other types were excluded, due to the challenges in assessing their quality in the absence of peer review (Jang Jaya *et al.*, 2023). Many systematic reviews also consider the timeline of publications. Considering the 'smart city' as an emerging concept, all publications from the earliest date of publication up to the date of retrieval (11 July 2024) were included in the study.

3.4 Systematic review process

The review process involved four stages. The first step was to determine the keywords in the search process. In this phase, the Boolean query method was employed to precisely and accurately locate documents for screening. As discussed in the previous section, only peer-reviewed articles that mentioned the term 'smart city' were included in the study. Other similar terms were excluded from this review, as they may have distinct focuses and objectives. In addition, 'urban space' was considered another relevant keyword.

After removing duplicates, a total of 241 unique records were identified for the screening process. These records were reviewed based on their titles and abstracts, resulting in the removal of 178 records. Following the screening, the next step was the eligibility assessment, during which 63 papers were evaluated in full text to ensure that they met the criteria of being valid records, discussing topics related to smart cities, and focusing on urban spaces. During this step, 10 records were removed, due to a lack of relevance, leaving a total of 53 articles for the final analysis (Figure 1).

3.5 Data extraction and synthesis

The remaining articles were synthesised, focusing on the proposed objectives. Appropriate themes and sub-themes were identified by initially reading titles and abstracts, followed by a second careful reading that coded the corresponding sentences and paragraphs.

4. RESULTS

According to the objectives, the review concentrated on three primary themes, encompassing a total of 12 sub-themes: research trends (three sub-themes), obstacles (five sub-themes), and opportunities (four sub-themes) related to smart cities in urban space (see Table 1). The findings provided a thorough analysis of contemporary smart city practices within urban spaces.

Figure 2 illustrates the global distribution of related research in this study. It reveals that China and

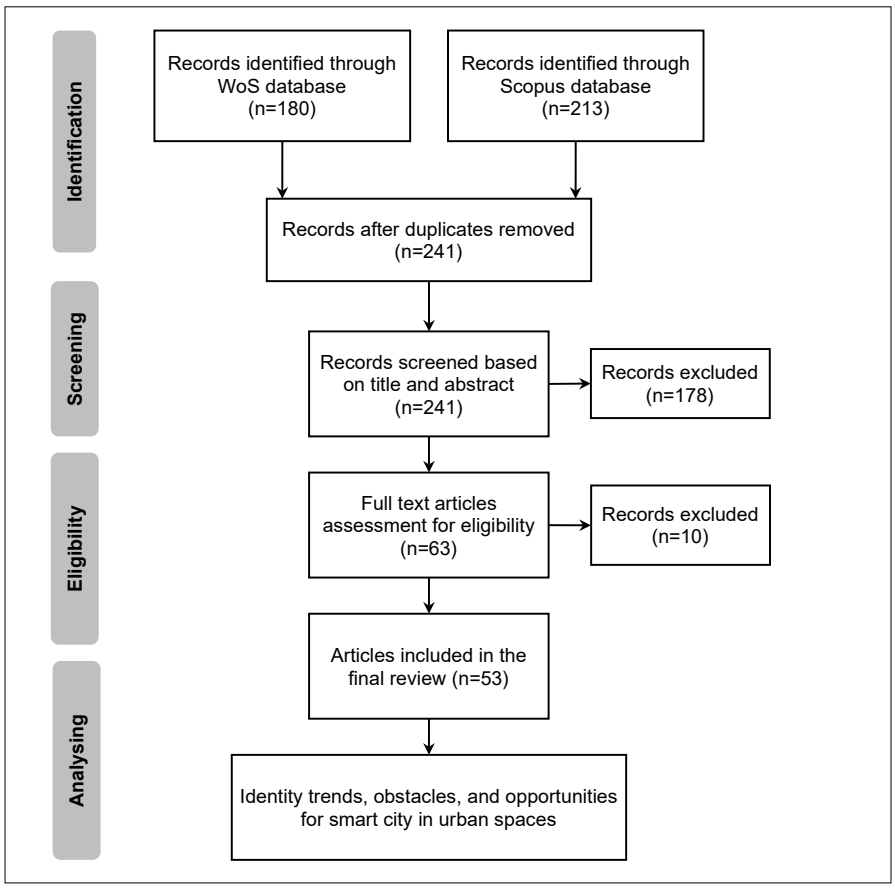

Figure 1: The flow diagram of the study

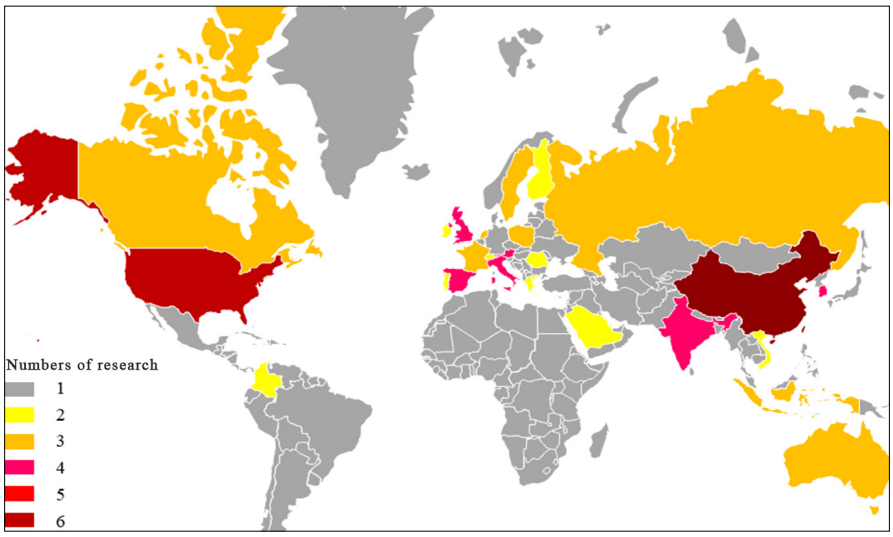

Figure 2: Global distribution of related research

the United States have the highest concentration of research, followed by several European countries, South Korea, and India, with moderate levels of academic contributions. However, countries in South America, Africa, and parts of Asia show minimal documented studies. This distribution suggests a strong research focus in technologically advanced and rapidly urbanising nations, while regions with lower engagement may reflect limited academic resources or emerging interest in smart city development (Alizadeh & Prasad, 2024).

4.1 Trends for smart city in urban space

In this section, the current trends of smart cities in urban spaces are identified. These trends reflect the evolving nature of urban environments and highlight the dynamics between people, technology, urban space, and process within cities.

4.1.1 Smart city as a technique to identify problems in urban space

The first approach represents an innovative strategy that leverages technologies such as big data and social media to collect and analyse information on urban life, including pedestrian flow, housing, and transportation (Rodrigues *et al.*, 2022; Han *et al.*, 2023). In this context, a smart city is perceived as a means for authorities to identify problems within urban spaces. Open-source data is widely used for urban development. In Italy, Geographic Information System (GIS) was employed to process instrumental query metrics (Garau & Annunziata, 2019). In a separate study, Pérez-Delhoyo (2017) used radio frequency (RF) and Global Positioning System (GPS) to analyse urban accessibility. Furthermore, computing technologies such as virtual reality (VR), multi-agent simulation (MAS), and OpenStreetMap have been applied to spatial analysis and geospatial and statistical modelling (Li *et al.*, 2016; Martinez & Mahajan, 2023). Sensor data has also been employed to characterise the urban environment to support decision-making (Encalada *et al.*, 2017; Erhan *et al.*, 2019; Robinson & Franklin, 2021; Zhou, 2022). A study in Poland advocated for the data sets integration to develop new tools with existing data (Uciechowska-Grakowicz *et al.*, 2023). In addition, parametric modelling was used to assist architects and policymakers in strategic planning (Daher *et al.*, 2017). In this context, both the government and business sectors have demonstrated significant interest. Han (2023) explored how the government dominates urban development through an integrated platform. De Lange (2019) also elucidated how governments and businesses use data to inform decision-making.

Apart from objective data, subjective input also plays a crucial role, highlighting citizen participation (Erhan *et al.*, 2019). South Korea (Choo *et al.*, 2023), Ireland (Rodrigues *et al.*, 2022), and the United States (McLean *et al.*, 2016) have launched ‘urban labs’ or ‘living labs’, where cities are regarded as nodes that guide citizens as participants in the reconfiguration of social, technological, and spatial aspects. Citizens can also be viewed as end-users, providing valuable data on urban infrastructure and services. In Zurich, a mobile application enabled participatory spatiotemporal perception, engaging users in public affairs through online deliberation (Pournaras, 2020). Fan and Loo (2021) also advocated for the use of smartphone applications to understand and promote street life.

Furthermore, some studies integrate subjective and objective data through triangulation. This approach can mitigate potential errors that may arise from a single data set and compensate for the inaccessibility of data, due to technical and theoretical constraints. Shi and Song (2022) introduced deep learning tools to identify and classify images, thereby understanding urban imagery. Visvizi (2021) examined the walkability of streets, by incorporating both objective and subjective data into a model index.

In short, these advancements suggest the transformative potential of integrating diverse data sources and technological innovations to improve urban planning strategies.

4.1.2 Smart city as a tool to enhance the quality of life in urban space

Smart cities serve as not only data-driven solutions, but also platforms for enhancing interaction. “Media city” has been realised through interactive touchscreen information kiosks that promote engagement between users and public spaces (Lee & Lee, 2022). The “smart” and “green” design principles proposed by Greek researchers advocate for amenities such as Wi-Fi zones and touch screens to encourage green spaces use (Gospodini & Manika, 2020).

Table 1: Summary of the trends, obstacles, and opportunities for smart cities in urban space

Author/Investigation	Design*	Trends			Obstacles					Opportunities			
		TC	TO	WA	TH	MR	DI	SP	TD	IC	PI	CE	LA
Abdelkarim 2023 - Liveability in Qatar	QL		■		■	■		■	■			■	
Almatar 2024 - City streets' liveability Riyadh, Saudi Arabia	MX		■						■				
Aminah 2021 - Pedestrian space in Indonesia	QL								■			■	
Arroyo-Menéndez 2022 - Digital inequalities in Spain	QT					■						■	
Blacutt 2020 - Hearing-impaired people	QL			■					■			■	
Borruso 2022 - Image of the smart city	QL			■		■		■	■	■			
Chen 2023 - Smart cities and urban happiness	QT		■							■		■	■
Choo 2023 - Living lab in South Korea	QL	■			■				■	■		■	
Daher 2017 - Parametric modelling in Luxembourg	QL	■											
Datta 2020 - Smart safety city in India	QL				■	■							
de Falco 2019 - Assessment of European smart cities	QL					■	■				■		■
de Lange 2019 - Interactive media in urban spaces	QL	■	■	■	■			■	■				
Deitz 2021 - Safe movement in the USA	QT			■					■				
Encalada 2017 - Smart tourism in Lisbon, Portugal	QT	■			■	■	■	■	■	■			
Enlund 2022 - The role of sensors in Norrköping, Sweden	QL			■					■	■			
Erhan 2019 - Green spaces in Sheffield, UK	MX	■											
Fan 2021 - Jaywalking in Hong Kong, China	QT	■			■					■	■		
Gandhi 2021 - Museums and heritage sites in Pune, India	MX				■								■
Garau 2019 - Blue-green infrastructure in Italy	MX	■			■				■		■	■	■
Gorgol 2024 - Blue-green infrastructure in Vienna, Austria	MX												■
Gospodini 2020 - Smart and green public spaces in Greece	MX		■										■
Han 2023 - Smart city construction in China	QL	■	■		■		■			■	■	■	■
Hoang 2021 - Digitisation of shophouse projects in Vietnam	QL		■										
Jedlinski 2022 - Crosswalks in Poland	MX			■									
Jordan 2016 - Digitally-enabled creative writing	QL			■									■
Kostko 2021 - The ideal image of city in Russia	QT			■				■		■		■	■
Kuzior 2024 - Assumptions and solutions for SDG Goal 11	QL				■								
Lee 2022 - Participatory media in South Korea	QL		■		■								
Li 2016 - Characteristics on the block scale in China	QT	■											■
Liu 2021 - Green spaces in China	QT	■											
Liu 2020a - Green spaces in China	QT	■											

(Continued on Next Page)

Author/Investigation	Design*	Trends				Obstacles				Opportunities			
		TC	TO	WA	TH	MR	DI	SP	TD	IC	PI	CE	LA
Liu 2020b - Green spaces in China	QT	■			■								
Martinez 2023 - Green recreation spaces	QT	■				■							
McKenna 2020 - Multidimensionality of smart cities	MX											■	
McLean 2016 - Smart grid project in the USA	QL	■							■				■
Oh 2020 - Preferences for smart city in South Korea	QT		■			■			■			■	
Pérez-Delhoyo 2017 - Urban accessibility	MX	■									■		
Pournaras 2020 - Cycling safety in Zurich, Switzerland	QT	■			■			■				■	
Punt 2020 - Planning support systems in Australia	MX	■			■		■			■		■	
Rachmawati 2023 - The use of public spaces and services	QL		■									■	■
Robinson 2021 - Sensor deserts in the UK and USA	QT	■				■		■		■		■	
Rodrigues 2022 - Hegemonic of smart cities in Ireland	QL				■								■
Romanova 2018 - Innovation management in Russia	QL				■								
Rosol 2022 - Justice in the smart city	QL								■			■	
Rysz 2015 - Urban development in smart cities	QL			■						■		■	■
Schuilenburg 2018 - Transformation of the security design	QL			■					■				
Shi 2022 - Smart city image in Chongqing, China	QT	■											
Uciechowska-Grakowicz 2023 - Green space in Poland	QT	■					■						
Venerandi 2023 - Forms of smart city districts in France	QT			■							■		■
Visvizi 2021 - Walkability in the smart city	QT	■											
Wang 2024 - Smart city construction in China	QT									■	■	■	■
Zgórska 2021 - Changes on urban structures and functionality	QL			■									
Zhou 2022 - Realisation of cultural space strategy	QT	■											

Trends	**Obstacles**	**Opportunities**
TC = Smart city as a technique TO = Smart city as a tool WA = Smart city as a way	TH = Technological hegemony SP = Surveillance and privacy DI = Data-integration difficulties MR = Marginalisation and inequality TD = Technocracy and discrimination	IC = Interdisciplinary collaboration PI = Platform integrations CE = Inclusive engagement LA = Localised adaptive approach

* QL = Qualitative; QT = Quantitative; MX = Mixed methods.

This concept is further exemplified in the “Interactive Art City”, where multimedia art fosters interaction with the audience (De Lange *et al.*, 2019).

In addition, smart services and facilities integrated into urban environments are transforming people’s lifestyles. Abdelkarim (2023) developed a framework for smart, liveable public spaces, validating the impact of embedded technologies on the quality of life. Concurrently, Almatar (2024) and Hoang (2021) discussed the potential of smart platforms to improve liveability, specifically regarding streets and traditional shophouses. Oh (2020) further examined residents’ quality of life from three perspectives: technology, facilities, and services, revealing that citizens are particularly interested in smart initiatives that enhance their safety, comfort, and convenience. This argument is supported by Chen (2023) and Rachmawati (2023), highlighting the essential role of technological innovation in improving public safety, offering efficient services, and enhancing environmental sustainability, thereby increasing the quality of life.

In short, a smart city aims to optimise urban living by integrating data-driven solutions, interactive spaces, and advanced technologies. This integration is designed to improve the quality of life and foster interactions.

4.1.3 Smart city as a way to influence people’s perception of urban space

Technological empowerment has transformed the urban landscape and serves as a way to influence perceptions and behavioural patterns. Blacutt (2020) and Deitz (2021) identified the significance of technological support and relevant geographic data in fostering a sense of security for people with disabilities, from an inclusive perspective. Similarly, Schuilenburg (2018) highlighted the impact of smart architecture on emotional responses, which, in turn, affects tourist behaviour. Jedlinski and Sosik-Filipiak (2022) explored ‘iGen’, those born between 1995 and 2012, examining how their lifestyle has been shaped by the internet. Enlund (2022) illustrated how social media and other digital platforms influence spatial imagination.

Within this nexus, emerging ideologies and imagery are increasingly being visualised, ultimately shaping the physical fabric of a new lifestyle (Rysz & Mazurek, 2015). For example, the ‘Playful City’ project invited citizens to co-create visions for the future city through gamification, a form of interactive engagement that involved people directly in the development of their urban environments (De Lange *et al.*, 2019). This active participation in shaping urban spaces demonstrates the connection between technology, individuals, and their surroundings.

Thus, smart cities are more than simply new design paradigms; they represent the materialisation of societal aspirations, leading to the creation of new urban images. By using data-driven solutions, smart cities can transform the physical space and engage citizens in meaningful ways, reshaping their interactions and perceptions of their urban surroundings.

4.2 Obstacles for smart city in urban space

Current trends in smart cities reveal potential challenges within urban environments. These challenges encompass data privacy concerns, social inequalities, and governance problems. It is essential to understand these obstacles, in order to promote sustainable and inclusive urban living.

4.2.1 Technological hegemony

Technological hegemony has become a significant obstacle in contemporary society. Abdelkarim (2023) criticised the technological and instrumental approach, emphasising citizen participation. Romanova (2018) advocated for the accessibility and comfort of citizens in urban spaces, rather than technocratic minimalism that neglects essential factors. Similar sentiments were expressed in the living labs of South Korea (Choo *et al.*, 2023). Meanwhile, Lee (2022) noted that such solutions often overlook software considerations, which are forcefully integrated into cities with diverse textures, resulting in suboptimal efficiency.

These solutions often result in unforeseen consequences. For instance, objective data may not align with subjective preferences of citizens. Digital solutions often struggle to accommodate individual preferences, which can lead to discrepancies between proposed principles and actual outcomes (Pournaras, 2020). Fan and Loo (2021) identified additional limitations, including personal characteristics such as age and gender, subjective factors such as the sense of safety and comfort, and the standardisation and unification of these attributes. In this context, Punt (2020) advocated that to mitigate such issues, it is crucial to foster dialogue between developers and users, as well as among users themselves, in order to improve the adequacy and granularity of data.

4.2.2 Marginalisation and regional inequality

Unequal access presents another challenge. Abdelkarim (2023) affirmed the importance of information accessibility, by proposing a framework for liveability. Datta (2020) further elucidated the potential violence that may arise from disparities in infrastructure, highlighting the technology gap experienced by marginalised groups within the city. This aligns with Encalada *et al.*’s (2017) assertion that the interaction between infrastructure deficiencies and marginalised communities exacerbates the digital divide. Conversely, smart city initiatives in Europe have tended to concentrate on the core areas of cities, revealing an uneven distribution of interests and resources (De Falco *et al.*, 2019). This spatial segregation, in turn, intensifies the boundaries within social spaces (Arroyo-Menéndez *et al.*, 2022). From a management perspective, Oh (2020) suggested that the reliability and durability of public entities should be taken into account.

Another concern is the inequity in data access. Martinez and Mahajan (2023) highlighted the lack of data accuracy, suggesting that disparities in data may arise from resident engagement and regional differences. Similarly, Robinson and Franklin (2021) introduced the concept of "sensor deserts", pointing out social and spatial imbalances.

4.2.3 Data integration difficulties

While the aforementioned statements supported the notion of insufficient data acquisition, De Falco *et al.* (2019) presented a contrasting perspective. They argued that, even if resources are unevenly distributed, urban peripheries should not necessarily be labelled as "deserts". On the contrary, these peripheral areas often possess substantial urban infrastructure but encounter challenges in accessing and using it, due to the fragmented nature of these subsystems. As Han *et al.* (2023) described, these "information cocoons" impede the enhancement of management systems. They also emphasised the need for highly integrated platforms that connect stakeholders (Encalada *et al.*, 2017). Furthermore, Punt *et al.* (2020) and Uciechowska-Grakowicz *et al.* (2023) respectively advocated for data integration in software support and model development.

4.2.4 Surveillance and privacy

However, the openness and integration of data also present challenges related to security, privacy, and transparency. In Lisbon (Encalada *et al.*, 2017) and Zurich (Pournaras, 2020), questions were raised regarding information governance. De Lange *et al.* (2019) discussed how the control and transparency of open datasets could influence individuals' perceptions and self-orientation. It has also been suggested that new technologies could foster resentment and erode trust among residents (Kostko & Pecherkina, 2021). Similarly, while acknowledging privacy concerns, the authors recognised the positive impacts and potential benefits of these technologies. Smart systems such as cryptography, blockchain technology, and biometric identification have been advocated as components of public privacy policies to enhance security (Abdelkarim *et al.*, 2023).

4.2.5 Technocracy and discrimination

The application of innovations significantly influences the lifestyles and social status of urban residents. Aminah (2021) suggested that urban management and official surveillance undermine the power of the poor, due to their conflicting interests. Similarly, in Italy, innovations driven by political and economic motives have marginalised the needs of children, particularly in urban planning and public space design, where child-friendly infrastructure was overlooked (Garau & Annunziata, 2019). Controversies also arose in the United States, where a lack of data regarding people with disabilities led to the neglect of their specific needs in smart city developments such as inadequate accessibility features and the absence of inclusive services (Deitz *et al.*, 2021). This situation has led to new forms of discrimination, extending beyond marginalised communities to encompass the welfare, needs, and rights of all individuals, further expanding social inequalities in urban environments (Encalada *et al.*, 2017; De Lange *et al.*, 2019; Blacutt & Roche, 2020).

Lack of knowledge can also lead to exclusion. Oh (2020) found that citizens' lack of confidence could potentially undermine participation. This finding echoed similar results from South Korea's 'Living Labs', where traditional citizen engagement methods such as surveys often resulted in monotonous and passive participation (Choo *et al.*, 2023). In addition, insufficient participation could lead to biases that prioritise personal needs over broader issues. McLean *et al.* (2016) argued that positioning citizens as consumers could result in incomplete participation, thereby exposing power dynamics and inequalities.

4.3 Opportunities for smart city in urban space

While acknowledging the challenges, it is crucial to recognise the promising opportunities. These include collaboration, integration, participation, and localisation. By leveraging these opportunities, smart cities can move toward a more inclusive and responsive future.

4.3.1 Interdisciplinary collaboration

From Korea to Europe, from tourist hubs to metropolises, researchers have discussed the crucial role of collaboration among various stakeholders, including citizens, experts, policymakers, and technology developers. Punt (2020) highlighted that the dialogue between citizens and developers may enhance the effectiveness of smart tools. Rysz and Mazurek (2015) underscored the importance of collaboration between government and community. Building on this, Han *et al.* (2023) further stressed the significance of collective efforts among government, technology, and society, viewing smart cities as a process of co-evolution among diverse stakeholders. Choo *et al.* (2023) introduced a new dimension, by emphasising the role of citizens while also asserting the necessity of domain experts. Encalada *et al.* (2017) affirmed the importance of mutual information exchange and collaboration between governments and researchers for the assessment of tourist attractions. Fan and Loo (2021) proposed new opportunities for collaboration among academia, industry, and government to enhance urban interventions.

Dialogue and collaboration are essential for the development of smart cities. Similarly, cross-regional and interdisciplinary cooperation plays a significant role in this process. Kostko and Pecherkina (2021) and Wang *et al.* (2024) analysed how inter-regional synergies can enhance collaboration. Enlund *et al.* (2022) advocated for the integration of technology across various spatial levels, ranging

from the individual, familial, and community levels to the city, regional, national, and global scales.

4.3.2 Platform integrations

Collaboration among officials, experts, citizens, and technologists is a critical factor. Within this context, the integration of platforms becomes essential. De Falco *et al.* (2019) emphasised that merging social and technological aspects could mitigate spatial segregation issues, thereby addressing housing challenges in metropolitan areas. From the perspective of children's activities, Garau and Annunziata (2019) argued that integration in the planning process signifies the recognition of children's rights and contributes to the development of their personalities.

Data integration has also facilitated academic research. Fan and Loo (2021) confirmed that high computational power and advanced algorithms allow researchers to extract fine-grained spatiotemporal patterns, providing new methodologies across various disciplines. For instance, data vendors have made pre-processed and anonymised data sets publicly accessible. This openness lowers technical barriers and enables researchers to directly incorporate these data sets into studies. Venerandi *et al.* (2023) advocated for a focus on integrating indicators at a finer spatial granularity to expand research areas and outcomes. Han *et al.* (2023) criticised the self-serving behaviour of governments in the competition for data ownership, which has resulted in delays. This criticism indirectly highlights the current priority of data integration and consolidation.

4.3.3 Inclusive citizen engagement

Promoting meaningful citizen engagement is another important aspect. Punt *et al.* (2020), Chen (2023), and Han *et al.* (2023) elucidated the benefits of citizen participation in creating public value. Aminah (2021) argued for street vendors' access to pedestrian areas as a realisation of cultural civility. Blacutt and Roche (2020) identified "DeafSpace" as an inclusive component. Similarly, advocating for children's rights represents a shift towards broader citizenship (Garau & Annunziata, 2019). Wang *et al.* (2024) further proposed social welfare programmes for the elderly population.

Arroyo-Menéndez *et al.* (2022) emphasised the need to develop inclusive smart city initiatives that minimise additional suffering, particularly among groups most affected by the digital divide, to ensure that they can also benefit from the opportunities these technologies offer. Similar sentiments were echoed by McKenna (2020), who explored that citizen engagement is crucial for developing a sense of ownership and enhances the effectiveness of these initiatives. In the context of Russian cities, Kostko and Pecherkina (2021) examined urban identities and the acceptance of smart development. Their study revealed that, when citizens' perceptions align with the smart city's vision, engagement increases, thus leading to more successful adoption of smart initiatives. However, it is crucial to implement policies that incentivise participation. For instance, token-curated registries (Pournaras, 2020), the gamification of public spaces (De Lange *et al.*, 2019), and citizen science initiatives (Robinson & Franklin, 2021) promote engagement through incentives, thereby enhancing residents' understanding and awareness of smart cities. Other potential avenues include open dialogue with officials and institutional measures (Rysz & Mazurek, 2015; Oh, 2020; Choo *et al.*, 2023).

4.3.4 Localised adaptive approaches

Han *et al.* (2023: 1) explicitly pointed out that "[t]here is no one-size-fits-all approach to smart city construction". Localised adaptive design provides a pathway to support engagement by designing urban spaces to the specific needs and preferences of local communities, thereby promoting inclusivity and sustainability (Chen, 2023). The authors encouraged each city to explore the most suitable path based on its cultural background and potential. This perspective aligns with De Falco *et al.*'s (2019) advocacy for flexible approaches that consider historical and cultural contexts, as well as localised management methods. Li *et al.* (2016) emphasised protecting and inheriting local characteristics for sustainable development. Furthermore, Rysz and Mazurek (2015) and Rachmawati *et al.* (2023) highlighted the discrepancies in urban requirements, diverse spatial configurations, and governance structures, while Wang *et al.* (2024) elaborated on the disparities in resource availability.

In addition, Garau and Annunziata (2019) and Rodrigues *et al.* (2022) analysed the adaptability of smart cities in various environments. Similarly, Gorgol (2024) emphasised the importance of greenfield and brownfield developments in shaping urban identities. These spaces, influenced by historical and cultural contexts, are more deeply integrated into urban identities, due to their appealing characteristics, as posited by Gospodini and Maniki (2020) and Jordan (2016). Meanwhile, as McLean *et al.* (2016) and Gandhi *et al.* (2021) noted, current smart cities often follow a 'replicable model', which is not an effective approach to addressing urban challenges. Therefore, localised adaptive design presents a significant opportunity nowadays.

5. DISCUSSION

As a response to urbanisation, the smart city is emerging as a means to facilitate the efficient functioning of society, while making significant contributions to environmental, economic, and other concerns (Liu *et al.*, 2020). These innovations are subtly integrated into our daily lives, transforming the way in which we perceive and interact with our surroundings (Uciechowska-Grakowicz *et al.*, 2023; Venerandi *et al.*, 2023). However, it is crucial to emphasise that the primary goal of the smart city is to enhance

the quality of life (Abdelkarim *et al.*, 2023). This article presents a systematic review of 53 studies from the WoS and Scopus databases to investigate research trends and highlight the challenges and potential prospects for smart cities in urban spaces. The reviewed literature can be categorised into three main themes, with a total of 12 sub-themes identified, revealing the following findings.

5.1 Trends for smart city in urban space

The study emphasises three major trends in research (Figure 3). The predominant trend is the utilisation of techniques such as big data and social media to collect and analyse data from various aspects of urban life. This approach enables urban planners and policymakers to effectively identify and address urban issues, ultimately enhancing the quality of life for citizens. Scholars and governments are employing computational technologies, including open-source data, sensor data, as well as virtual and augmented reality, for spatial analysis (Li *et al.*, 2016; Encalada *et al.*, 2017; Garau & Annunziata, 2019; Zhou, 2022; Martinez & Mahajan, 2023). Meanwhile, the integration of multiple data sets and the application of parametric modelling methods are improving strategic planning and decision-making processes (Daher *et al.*, 2017; Uciechowska-Grakowicz *et al.*, 2023). By synthesising diverse data sources, these methods provide planners with more holistic insights into urban systems, enabling comprehensive strategies that better align with dynamic urban processes (De Lange *et al.*, 2019; Han *et al.*, 2023). Furthermore, participatory planning through 'living labs' supports collaborative interventions for innovative urban solutions (De Lange *et al.*, 2019; Rodrigues *et al.*, 2022; Choo *et al.*, 2023). Subjective input data from citizens fosters planning initiatives that are grounded in the needs and aspirations of local communities (Erhan *et al.*, 2019). Overall, this trend reflects advancements in data-driven approaches, computational tools, and participatory methods that are reshaping urban planning strategies. These innovations provide urban planners with comprehensive understanding for urban systems, promoting more inclusive and adaptive solutions that align with local needs.

The second approach frames the smart city as an essential framework that integrates technology into public spaces to promote interaction and participation. Examples such as 'Public Play Space' and 'Interactive Art City' demonstrate how interactive technology enhances the user experience in urban environments (De Lange *et al.*, 2019; Gospodini & Manika, 2020; Lee & Lee, 2022). Furthermore, the incorporation of smart technologies, services, and facilities into urban areas is transforming lifestyles and highlighting the positive impact of embedded technology on residents' well-being (Oh, 2020; Abdelkarim *et al.*, 2023; Han *et al.*, 2023). This evolution emphasises the importance of a smart city in facilitating deeper connections between individuals and their environments, providing valuable insights for designing more interactive, inclusive, and responsive public spaces.

However, the third trend transcends a mere technological perspective, highlighting how the information revolution reshapes the relationship between individuals and information, profoundly impacting urban structures and influencing citizens' perceptions and actions. Studies indicate that technology can enhance the sense of security for marginalised groups such as the hearing impaired and disabled (Blacutt & Roche, 2020; Deitz *et al.*, 2021), while also shaping the lifestyles of younger generations such as 'iGen' (Jedlinski & Sosik-Filipiak, 2022). Initiatives such as the 'Playful City' project demonstrate how citizen engagement can be fostered through gamification, realising innovative visions for future cities (De Lange *et al.*, 2019). Smart cities encompass not only technology, but also societal dimensions. The interplay between emerging ideologies and images influences the formation of new lifestyles (Rysz & Mazurek, 2015; Jordan, 2016). These developments reflect aspirations, underscoring a comprehensive design approach (Venerandi *et al.*, 2023). Overall, this reflects the dynamic interaction among technologies, people, urban spaces, and processes, fundamentally transforming perceptions, behaviours, and urban life. As a result, there is a need for new standards in urban planning and designing that prioritise strategies addressing emerging needs and visions, thereby ensuring resilient, inclusive, and supportive urban environments.

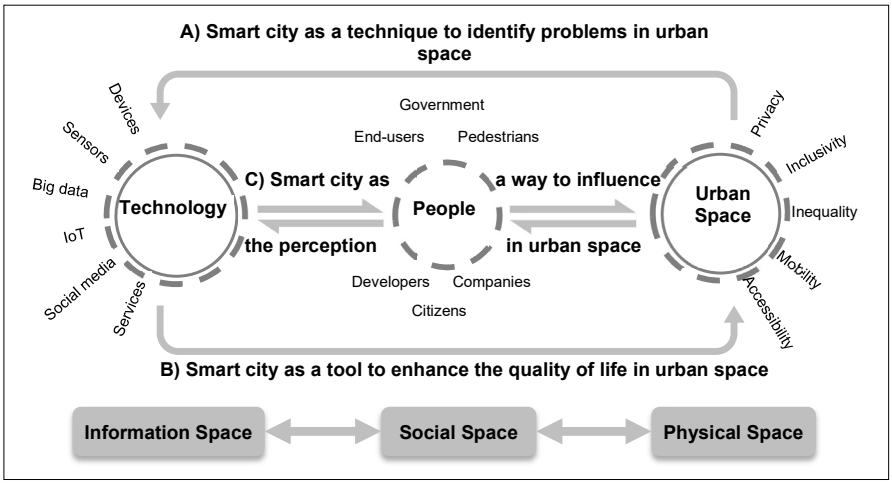

Figure 3: Schematic diagram of the relationships among the factors in smart cities

Source: Authors

5.2 Obstacles for smart city in urban space

However, the rapid evolution of cities has also introduced a series of challenges. A significant challenge is technological hegemony, characterised by the imposition of standardised technological solutions that fail to consider the diverse needs and contexts of different regions (De Lange *et al.*, 2019; Datta, 2020; Lee & Lee, 2022). This trend has led to the homogenisation of urban environments, overlooking the unique social and cultural fabric of each city (Gandhi *et al.*, 2021; Han *et al.*, 2023). Furthermore, the dominance of certain technologies neglects essential considerations of citizen interaction and participation, undermining the fundamental planning principles of inclusivity and sustainability (Abdelkarim *et al.*, 2023; Choo *et al.*, 2023). Compounding these issues is the widespread problem of marginalisation and inequality, where specific populations, particularly marginalised communities, encounter significant barriers to accessing and benefiting from smart city initiatives (Robinson & Franklin, 2021; Arroyo-Menéndez *et al.*, 2022). This inequality exacerbates the digital divide and perpetuates existing social disparities, leading to further exclusion from essential urban resources (Encalada *et al*., 2017; De Falco *et al.*, 2019; Datta, 2020).

Furthermore, the complexity of urban systems presents significant challenges in data integration and management. The fragmentation and isolation of data sources often impede efforts to develop holistic and interoperable management systems, hindering effective decision-making and resource-allocation processes (Encalada *et al.*, 2017; Han *et al.*, 2023; Uciechowska-Grakowicz *et al.*, 2023). Meanwhile, advancements in smart technologies raise legitimate concerns regarding the collection, storage, and use of sensitive personal information, with growing apprehensions surrounding surveillance, privacy, and data security (Encalada *et al.*, 2017; Pournaras, 2020; Robinson & Franklin, 2021). This situation poses a risk of eroding public trust, potentially weakening residents' acceptance of smart city initiatives designed to enhance their urban experience (De Lange *et al.*, 2019; Abdelkarim *et al.*, 2023).

This inadvertently perpetuates existing imbalances and discrimination, particularly against marginalised and vulnerable groups (Blacutt & Roche, 2020; Aminah, 2021; Deitz *et al.*, 2021). From exclusionary planning practices to algorithmic biases embedded in decision-making processes, the implementation of smart cities has the potential to exacerbate social inequalities and further marginalise communities that are already deprived of their rights (Garau & Annunziata, 2019; Liu *et al.*, 2020; Fan & Loo, 2021). Given these challenges, there is an urgent need for more inclusive and participatory approaches that prioritise equity, diversity, and social justice.

Several studies have identified additional potential challenges. The first is to cultivate citizens' digital literacy and capabilities to overcome the resistance of social conservatives (Enlund *et al.*, 2022; Almatar, 2024; Wang *et al.*, 2024). It is equally crucial for citizens to adapt to spatial diversity and enhance their sense of place, ensuring that the urban design reflects the identities and values of the communities (Jordan, 2016; Kostko & Pecherkina, 2021). Another is the lack of unified measurement standards, which hinders evaluation and information exchange for responsive urban policies (Gorgol, 2024). Finally, the gap between assumptions and implementation warrants attention (Kuzior, 2024). This gap may stem from issues related to technology, management, or policy, and it requires coordination among all parties involved.

5.3 Opportunities for smart city in urban space

Every cloud has a silver lining. The smart city concept highlights potential opportunities, with interdisciplinary collaboration being the most significant. Scholars and authorities emphasise the essential role of collective efforts that involve diverse stakeholders, including citizens, policymakers, academics, and developers (Fan & Loo, 2021; Choo *et al.*, 2023; Han *et al.*, 2023). Research from various countries supports the notion that smart city initiatives should be rooted in the actual needs and desires of communities to enhance their acceptability and effectiveness (Garau & Annunziata, 2019; Punt *et al.*, 2020). In this context, the integration of platforms serves as a key driver, facilitating data exchange across different domains and promoting collaboration and resource availability (Fan & Loo, 2021; Wang *et al.*, 2024). Bridging the social and technical domains addresses spatial segregation and fosters more comprehensive urban planning and management strategies (De Falco *et al.*, 2019). However, the complex nature of data governance and privacy issues must be addressed to ensure that robust policies are implemented to protect the rights of urban residents (De Lange *et al.*, 2019).

Simultaneously, inclusive citizen engagement presents a significant opportunity, with scholars advocating for residents to actively participate in decision-making processes. By fostering open dialogue, cities can harness the collective wisdom of their citizens to co-create solutions that address local needs more effectively (Oh, 2020; Abdelkarim *et al.*, 2023; Choo *et al.*, 2023). However, meaningful engagement also requires recognising the voices of underrepresented groups (Blacutt & Roche, 2020; McKenna, 2020; Aminah, 2021). In addition, localised adaptive approaches offer a promising avenue for achieving citizen-centric development, emphasising unique cultures, histories, and contexts (Li *et al.*, 2016; De Falco *et al.*, 2019; Han *et al.*, 2023). Nevertheless, achieving such localisation requires a departure from the one-size-fits-all mentality and a shift towards more

flexible and responsive planning strategies (McLean *et al.*, 2016; Garau & Annunziata, 2019).

Moreover, new opportunities have been proposed such as researching innovative methods of urban embedding (Lee & Lee, 2022) and conducting mixed-methods research to standardise attributes (Chen, 2023; Venerandi *et al.*, 2023).

6. CONCLUSION

This article analysed the concept of smart cities from an urban space perspective, highlighting current trends, potential obstacles, and future research opportunities in the urban planning and policymaking field. The development of smart cities has transitioned from a technology-driven approach to a human-centred methodology. This shift necessitates an examination of potential interactions and their effects on perception, behaviour, and lifestyle within the city. In response to this transition, urban planners and experts have implemented proactive measures; however, some underlying issues inevitably persist. Based on the review, the authors identified five primary challenges: technological hegemony, surveillance and privacy concerns, difficulties in data integration, marginalisation and regional inequalities, as well as technocracy and discrimination. Concurrently, to address these challenges, several opportunities for the future of smart cities were proposed, including interdisciplinary collaboration, platform integration, inclusive citizen participation, and localised adaptive approaches. The review also highlighted the need for future research to incorporate perspectives from the Global South and developing countries to minimise existing inequalities.

The study also presented several recommendations. First, the study highlighted the need for context-based approaches that address local needs, cultural nuances, and socio-economic realities. These approaches should consider specific urban issues such as applying smart technologies to energy efficiency, waste management, traffic systems, and urban design. It is equally important to acknowledge the limited research focused on southern and developing countries, where smart city initiatives often face significant obstacles. Vulnerable communities in these regions may struggle with issues such as weak governance structures, insufficient data systems, and a shortage of technical expertise. Without addressing these foundational barriers, smart city initiatives may unintentionally expand existing inequalities rather than deliver inclusive and equitable urban improvements.

Secondly, it emphasised the importance of user perception frameworks and called for a comprehensive examination of these paradigm shifts, which can inform more responsive planning practices.

Thirdly, urban planners should prioritise the integration of participatory approaches. This involves actively including the voices of all urban citizens, particularly underrepresented groups, in decision-making processes. This fosters a sense of belonging and enhances the effectiveness of urban initiatives.

Lastly, establishing standardised measurement protocols is vital for improving information exchange and enhancing data accessibility across urban sectors. Researchers in the field of urban planning should advocate for these standards to facilitate better coordination among stakeholders and support decision-making processes. This will contribute to the decision-makers and urban planners in the smart city development, especially from urban domains, while also providing valuable guidance to researchers across various disciplines and implications for applying smart city concepts in the Global South and developing countries.

7. LIMITATIONS AND RECOMMENDATIONS

This study has several limitations. First, while Scopus and WoS provide broad academic coverage, their indexing practices tend to prioritise journals from Western institutions. This may lead to an underrepresentation of insights from the Global South, which is noted as a limitation of this review.

Secondly, the eligibility process is subjective and may result in the omission of articles that could warrant further in-depth research.dd

In addition, the reliance on a Boolean string for search queries may exclude articles containing pertinent information. These limitations could introduce bias into the final dataset. Therefore, it is recommended that future studies broaden the literature search and research areas to enhance the investigation.

Future studies should be designed to address specific contextual nuances, with a particular focus on the unique challenges and opportunities present in developing countries. The rise of disruptive technological innovations marks a pivotal moment for these nations, offering them the potential to close the developmental gap that separates them from more advanced economies (Han *et al.*, 2023). In this context, it is crucial to broaden the scope beyond traditional domains such as smart services and big data. Instead, a thorough examination of users' perceptual frameworks and emotional responses transformations is necessary, leading to a more inclusive and responsive urban planning. Moreover, including underrepresented voices and participatory strategies will address the potential for marginalisation in smart city development, contributing to resilient urban environments. Lastly, standardised measurement is essential for improving information exchange and data accessibility, which is vital for further research on urban policies and management.

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