

REVIEW

Innovation in Geospatial Information Technology: Connecting Urban Security, Spatial Governance, and Smart City Development

Hao Zhang ^{1,2}, Yunge Wang ¹, Wangke Lin ¹, Jun Xu ², Haiyan Xu ^{1,2*}, Junxian Chen ³, Quanlong Fan ²

¹ Zhejiang College of Security Technology, Wenzhou 325000, China

² Zhejiang Cheng'an Big Data Co., Ltd., Wenzhou 325000, China

³ WenZhou Port Group Co., Ltd., Wenzhou 325000, China

ABSTRACT

Rapid urbanization and digital transformation are reshaping how cities address challenges related to security, governance, and sustainable development. Geospatial information technology (GIT) has become a base infrastructure for smart cities, where the gathering, synthesis, and examination of spatially explicit information are used to deliver data to make decisions in cities. Even after its increasing significance, the current body of research on geospatial innovation is still divided into the spheres of urban security, spatial governance, and smart city development. Such fragmentation restricts the integration of theoretical work, as well as limits the possibility of developing coherent policies and governance institutions. This article includes a systematic and integrative review of innovation in geospatial information technology to analyze the relationship between technological, data-driven, and institutional innovation and urban security practices, spatial governance processes, and smart city initiatives. Based on peer-reviewed sources on urban studies, geography, planning, and information science, the review generalizes the main trends in real-time spatial analytics, artificial intelligence, participatory geospatial platforms, and urban digital twins. The review shows that geospatial systems facilitate anticipatory governance, cross-sector coordination, and evidence-based urban management, and that it provides an integrative conceptual lens on the existing literature on smart cities and urban governance, as it positions geospatial information technology as a socio-technical infrastructure, as opposed to a technical tool. The paper recognizes the voids in critical research and the

*CORRESPONDING AUTHOR:

Haiyan Xu, Zhejiang College of Security Technology, Wenzhou 325000, China; Zhejiang Cheng'an Big Data Co., Ltd., Wenzhou 325000, China; Email: 20096347@zjcst.edu.cn

ARTICLE INFO

Received: 11 January 2026 | Revised: 28 February 2026 | Accepted: 5 March 2026 | Published Online: 2 March 2026

DOI: <https://doi.org/10.30564/jees.v8i3.13101>

CITATION

Zhang, H., Wang, Y., Lin, W., et al., 2026. Innovation in Geospatial Information Technology: Connecting Urban Security, Spatial Governance, and Smart City Development. *Journal of Environmental & Earth Sciences*. 8(3): 1–16. DOI: <https://doi.org/10.30564/jees.v8i3.13101>

COPYRIGHT

Copyright © 2026 by the author(s). Published by Bilingual Publishing Group. This is an open access article under the Creative Commons Attribution-NonCommercial 4.0 International (CC BY-NC 4.0) License (<https://creativecommons.org/licenses/by-nc/4.0/>).

directions into the future on how to build ethical, inclusive, and context-sensitive geospatial systems that can allow the creation of secure, governable, and sustainable urban futures.

Keywords: Geospatial Information Technology; Urban Security; Spatial Governance; Smart Cities; Urban Digital Twins

1. Introduction

The world is changing the way cities are planned, governed, and secured with rapid urbanization, change of technology, and increasing socio-spatial risks and threats. By the year 2050, almost 70% of the world population will be living in urban areas, increasing the pressures associated with the safety of the population, the resilience of infrastructure, the sustainability of the natural environment, and social justice^[1]. In this regard, cities are becoming very digital and data-intensive to deal with complexity and uncertainty. Geospatial information technology (GIT) has become one of such strategies as it has become a key enabler of infrastructure in the collection, analysis, visualization, and governance of spatially explicit urban data. The development of geographic information systems (GIS), remote sensing, global navigation satellite systems, spatial big data analytics, and artificial intelligence has radically altered the way urban space is observed, understood, and controlled^[2-4].

Concurrently, three interconnected spheres, namely urban security, spatial governance, and smart city development, are currently of primary interest in modern urban studies and practice. Urban security has long since gone way beyond the ancient conceptualization of crime prevention to include disaster risk mitigation, emergency public health, infrastructure security, and climate hazards. Spatial governance focuses on the organization of actors, institutions, and knowledge at multiple spatial scales in order to direct urban development in a just and sustainable way. Meanwhile, the development of smart cities encourages the consolidation of digital technologies and data infrastructure to make cities more efficient and responsive and improve the quality of life^[5]. Although these areas are frequently talked about separately, in practice, they are more and more becoming interdependent due to the combined dependency on geospatial data, analytics, and digital infrastructures.

Geospatial information technology serves as a special place at the crossroads of these areas. Geospatial technologies offer spatial intelligence that can be used to connect

security issues, governance practices, and smart city programs by using crime hotspots and emergency response systems, and the creation of participatory planning platforms and urban digital twins. Integrated command centres, location-based decision-support systems, and real-time dashboards are emerging as the key instruments of urban operations coordination in most cities. These readings point towards the idea that GIT is not only a technical tool, but a transversal socio-technological system that facilitates power dynamics, priority of policies and urban knowledge production^[6,7].

Although its significance is on the increase, current literature on geospatial innovation is still scattered across disciplinary and thematic lines. Research on the topic of urban security is prone to concentrate on predictive law enforcement, surveillance devices, or disaster management, which typically depend on the technical performance, with little regard for the governance consequences^[8]. Spatial governance research puts more emphasis on institutional arrangements, participation, and policy coordination, but often does not theorize the importance of advanced geospatial analytics and real-time data infrastructures. Smart city texts, in turn, tend to pre-empt digital platforms, sensors, and data integration, but present geospatial technology as a background element, not an organizing logic. This has led to a deficiency in integrative knowledge regarding the simultaneous effects of geospatial information technology innovations on the results of urban security, governance, and smart city directions^[3].

There are theoretical and practical implications of this fragmentation. In theory, it constrains the emergence of integrative frameworks capable of elucidating the spatial data and technologies to restructure city power structures, decision-making, and risk management approaches. In practice, it leads to policy silos whereby security-oriented geospatial systems value efficiency and control, but governance-oriented platforms value participation and transparency, which are not well coordinated^[9]. These contradictions are becoming more apparent in the arguments about privacy, the biases of algorithms, data justice, and the disproportion-

ate access to technological advantages for urban residents. Devoid of a logical synthesis, cities stand the risk of integrating geospatial innovations that will increase short-term operational capability at the cost of long-term governance legitimacy and social trust^[10].

It is against this background that the article aims to have a systematic and integrative review of innovation in geospatial information technology, and how innovation has been used in the context of urban security, spatial governance, and smart city development^[3]. In contrast to considering them as distinct areas of application, this review conceptualizes them as mutually dependent parts of modern urban systems that are mediated by geospatial data and technologies more and more. The article attempts to explain how geospatial innovation is a shared infrastructural base of wide-ranging urban agendas by synthesizing research on urban studies, geography, planning, information science, and public administration^[11].

Three general research questions guide the review. To start with, what has changed in geospatial information technology in response to the new urban challenges, and what are the key technological, data-related, and institutional innovations of recent developments? Second, what are the ways these geospatial innovations are deployed in the spheres of urban security, spatial governance, and smart cities initiatives, and what do they have in common or differ in terms of their purposes, practices, and results? Third, what are the synergies, tensions, and trade-offs associated with integrating geospatial technologies to work together to achieve security, governance, and smart city objectives (with respect to ethical, legal, and social implications)?

This article contributes to the literature in several ways by answering these questions^[12,13]. First, it promotes an integrative conceptual approach that makes geospatial information technology a fundamental socio-technical infrastructure of the modern urban systems, instead of a domain-specific instrument. Second, it brings together formerly separate research lines of studies, identifying how real-time spatial analytics, urban digital twins, and participatory geospatial platforms perform in the context of security, governance, and smart city contexts. Third, it also outlines the important gaps and research directions for the future, such as comparing studies, Global South approaches, and governing structures that can help mitigate ethical and accountability issues related to AI-driven geospatial systems^[14–16].

Despite the growing body of literature on smart cities and urban digital technologies, most existing reviews examine geospatial technologies primarily as supporting tools within broader smart city infrastructures. This article advances the literature by positioning geospatial information technology as a core socio-technical infrastructure that connects urban security, spatial governance, and smart city development. The novelty of this review lies in three aspects. First, it reconceptualizes geospatial information technology not merely as an analytical instrument but as a structural platform shaping urban decision-making, risk management, and governance processes. Second, the review integrates three research domains that are typically treated separately—urban security studies, spatial governance scholarship, and smart city research—into a unified analytical framework. Third, by synthesizing interdisciplinary literature across urban studies, geography, information science, and public administration, the review highlights how emerging geospatial innovations such as AI-enabled spatial analytics, participatory mapping platforms, and urban digital twins simultaneously influence security management, governance coordination, and smart urban services.

Through this integrative perspective, the article contributes to the development of a more comprehensive understanding of the role of spatial intelligence in contemporary urban systems and provides a conceptual bridge between geospatial science and the broader field of smart urban governance. **Figure 1** shows the conceptual framework of this review, which places geospatial information technology as a transversal infrastructure to connect urban security with spatial governance and the development of smart cities^[17–20].

2. Review Methodology and Conceptual Foundations

The article is written in a structured and integrative review to analyze the concept of innovation in geospatial information technology, and its contribution to the interrelation between urban security, spatial governance, and the development of smart cities. Since the subject is interdisciplinary, both systematic literature search and conceptual synthesis are used, which allows for the wide scope of the subject and theoretical assimilation. The review is not intended to be a

one-sided discussion on technical developments or individual fields of application but to reflect the role of geospatial innovations as socio-technical infrastructures integrated into a larger system of urban governance and security^[3,16].

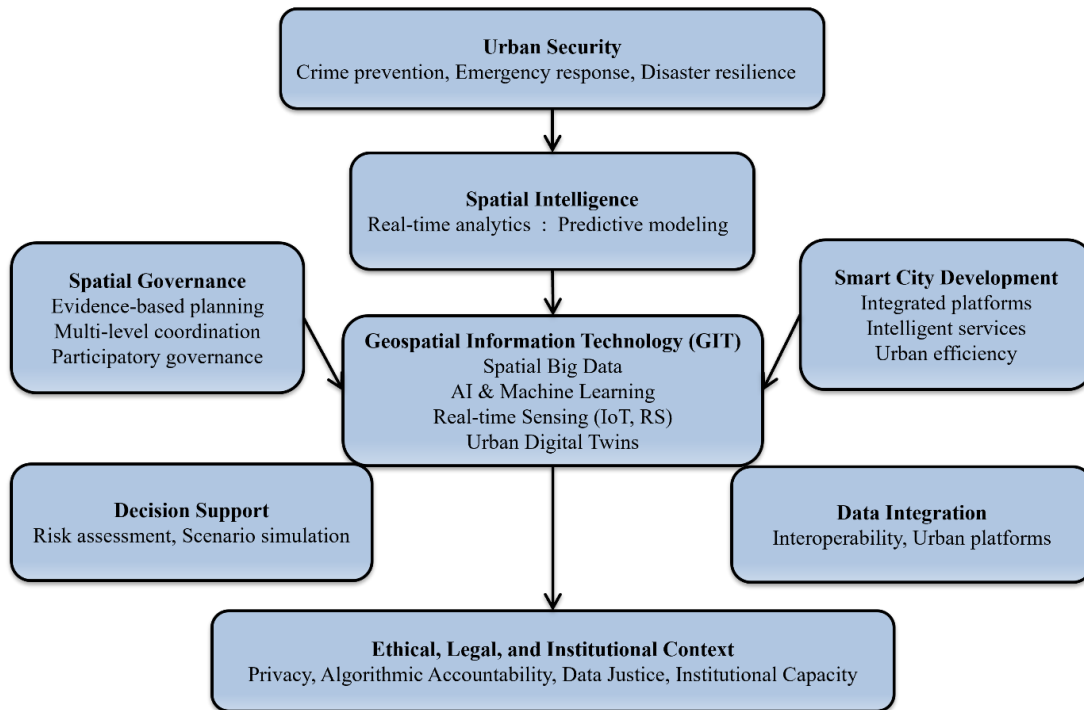


Figure 1. Conceptual framework illustrating the integrative role of geospatial information technology in linking urban security, spatial governance, and smart city development.

2.1. Literature Search Strategy

The search of the literature was performed in the major international academic databases that are generally accepted in the research of Science Citation Index (SCI) and Social Sciences Citation Index (SSCI)-indexed databases, like Web of Science Core Collection and Scopus. To have a wide coverage of disciplines with respect to geography, urban studies, planning, information science, public administration, and computer science, these databases have been chosen. Relevant publications were found based on a set of keywords associated with geospatial information technology, urban security, spatial governance, and the development of smart cities. The search terms were variants and combinations of the concepts like geospatial information technology, GIS, spatially related data, urban security, public safety, spatial governance, urban governance, smart cities, and digital twins.

To seize the effect of recent discoveries but at the same time achieve enough historical depth, the search was narrowed down to the literature published since the beginning of the 2000s, during which time the concept of digital GIS

began to develop, spatial big data was discovered, and smart city projects were introduced. The search was done iteratively, and a refinement of the keywords could be done as new thematic clusters were discovered during preliminary screening. Key review articles, reference lists, and highly cited empirical studies were also reviewed to find other relevant publications that were not identified through database searches^[21–23].

2.2. Inclusion and Exclusion Criteria

There were clear inclusion and exclusion criteria to make sure that the literature reviewed was good, relevant and consistent. Peer-reviewed journal articles in English were included, as is common in SCI-level review studies. Preference was given to articles that were published in internationally known journals and dealt with urban studies, geography, planning, and geoinformatics, among others. Non-peer-reviewed documents (such as conference papers, technical reports) and documents that were foundational or often mentioned in the academic literature were excluded^[24].

Substantively, the articles were included if they covered at least one of the following dimensions: innovation in geospatial information technology, usage of geospatial technologies in urban security or risk management, the role of spatial data in governance and planning, or the geospatial basis of smart city development. Research that was centered on rural settings, solely on technical algorithm development, and not in an urban environment, or city-based projects that did not include a spatial or geospatial aspect were ruled out. The filtering process produced a filtered corpus of literature that represents not only technological progress but also governance-focused discussions in terms of the research purposes^[4,25].

2.3. Analytical and Review Framework

The reviewed literature was analyzed using a thematic synthesis method aimed at finding out the prevalent patterns, conceptual interconnections, and new research frontiers. Following a preliminary screening on the basis of titles and abstracts, full texts were studied in order to obtain the main information on the purpose of research, methodologies, technological innovations, and implications for governance. Themes and conceptual categories reoccurred and were narrowed down through the process of re-reading and comparing the results.

The analysis framework focuses more on cross-domain integration rather than structuring the review by sectors of application or technologies it is applied to. The innovations in geospatial information technology are discussed within the framework of their simultaneous impact on urban security practices, spatial governance practices, and models of smart cities development. This will enable one to identify common logics and institutional structures and socio-technical conflicts that cross-cut across personal policy spheres. Ethical, legal, and social considerations are addressed as part of the analysis framework, and this represents the increasing awareness of the significance of these aspects in data-driven urban systems^[26].

2.4. Evolution of Geospatial Information Technology in Urban Contexts

The conceptual basis of this review is based on an interpretation of geospatial information technology as a developing assemblage of tools, data, and institutional practices. The initial urban uses of GIS were preoccupied with mapping,

management of inventory, and spatial analysis used in plans. The development of remote sensing, global navigation satellite systems, and spatial databases over time increased the scale and the scope of urban geospatial analysis. In more recent times, the combination of spatial big data, artificial intelligence, and cloud computing has made it possible to monitor the processes of a city in real-time, conduct predictive analytics, and simulate the processes dynamically^[27].

Such technological changes have made geospatial systems evolve into real-time urban intelligence infrastructure as opposed to the traditional geospatial systems that were the preserved analytical frameworks. The examples of these innovations include urban digital twins, sensor networks, or location-based services, as they allow the physical urban environment and a digital representation to provide continuous feedback^[28,29]. Consequently, geospatial information technology is shifting the paradigm by not only analyzing cities, but also ruling them as well as securing them. **Figure 2** summarizes the evolution of geospatial information technology in the urban setting.

2.5. Urban Security, Spatial Governance, and Smart City Paradigms

The main conceptual lenses that are used to analyze geospatial innovation in this review are urban security, spatial governance, and smart city development. City security is defined in a loose sense to mean crime prevention, emergency management, disaster risk reduction, infrastructure protection, and preparedness of the community to health hazards. Spatial governance is the process of integration of actors, institutions, and decision-making processes at spatial scales, where emphasis is on spatial knowledge, spatial participation, and spatial accountability. Smart city development refers to smart and data-driven plans that enhance the efficiency, sustainability, and livelihood of cities.

Though analytically distinct, these paradigms are becoming more and more convergent with each other because of mutual dependence on geospatial data and technologies. Geospatial information systems enable security-focused surveillance and risk modelling, governance-focused planning and engagement, and smart city systems that can combine various urban functions. This overlap highlights the importance of an integrative conceptual approach that will be able to represent the synergies as well as tensions

between these fields. Placing geospatial information technology at the intersection of this intersection, the review offers

a contextual basis for how innovation transforms modern urban systems in both facilitating and challenging terms^[30].

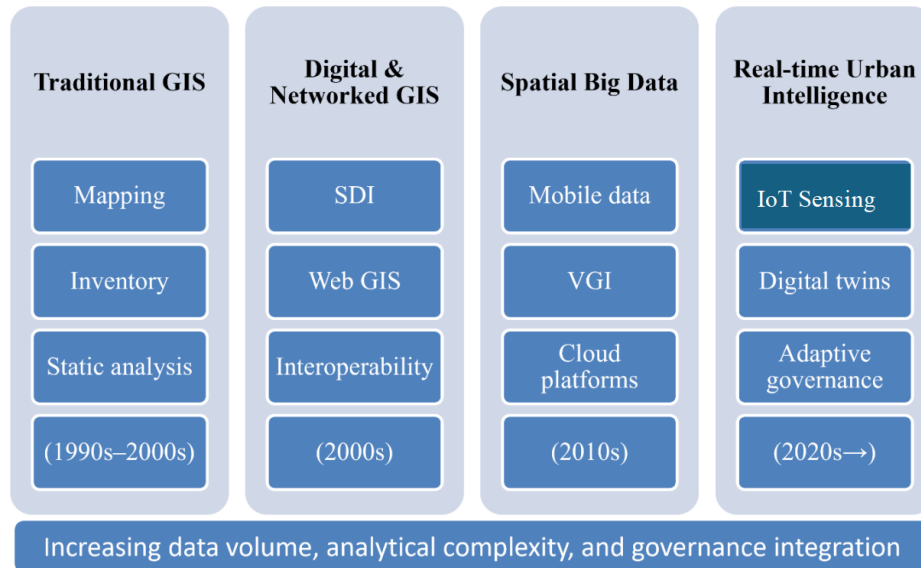


Figure 2. Evolution of geospatial information technology in urban contexts, from traditional GIS to AI-enabled and real-time urban intelligence systems.

3. Geospatial Innovation across Urban Security, Spatial Governance, and Smart City Development

Geospatial information technology innovation has been instrumental in transforming the way the city meets its requirements for security, governance, and intelligent urban development^[25]. Technological, data-driven, and institutional innovations in geospatial systems, rather than evolving in isolation, are increasingly functioning across all of these spaces, allowing new types of urban intelligence. At the same time, they present complex governance and ethical concerns. This part summarizes the discussion of the literature in geospatial innovation by exploring how technology and data infrastructures contribute to urban security operations, spatial governance processes, and smart city projects, and how their applications relate and interrelate in modern urban mechanisms^[31].

3.1. Technological and Data Innovations in Urban Geospatial Systems

The past few decades have seen the transformation of the stagnant geospatial analysis of the map to dynamic and real-time city geospatial systems. The development of sens-

ing technology, cloud computing, and artificial intelligence has facilitated the uninterrupted collection and processing of huge amounts of spatially referenced data. The cities have started being observed with a complex of sensors, mobile devices, satellites, and social media, producing heterogeneous datasets of urban life, encompassing both the physical and social aspects of the city.

The current trends have increased the analytical tools of geospatial information technology, enabling real-time visualization, predictive modeling, and scenario simulation. Machine learning has been used on spatial data to identify patterns, predict hazards, and make urban processes more efficient. Simultaneously, the increased access to open geospatial data and the offering of voluntary geographic information have diversified sources of data and have allowed citizens, individual actors, and civil society organizations to contribute. The combination of these inventions has made the geospatial systems adaptive infrastructures that support a broad spectrum of urban applications. The literature reviewed indicates that geospatial innovations are implemented in various spheres of cities, though with diverse objectives and governance connotations^[4,32]. **Table 1** provides a summary of significant geospatial innovations and how they can be used in urban security, spatial governance, and smart city development.

Table 1. Key geospatial information technology innovations and their applications across urban security, spatial governance, and smart city development.

Geospatial Innovation	Urban Security	Spatial Governance	Smart City Development
Spatial big data analytics	Crime prediction, risk assessment	Evidence-based planning	Real-time urban monitoring
AI and machine learning	Predictive security modeling	Automated spatial analysis	Intelligent urban services
Urban digital twins	Emergency simulation	Scenario-based planning	Integrated urban platforms
Volunteered geographic information	Community safety reporting	Participatory planning	Citizen engagement tools
IoT-enabled spatial sensing	Real-time surveillance	Infrastructure monitoring	Smart mobility and environment

3.2. Geospatial Technologies for Urban Security and Resilience

Geospatial innovation has been applied to security in the city, which has become one of the most visible application fields. Spatial analysis has been utilized to assist crime mapping and hot spot identification, but innovations can be applied to it by utilizing predictive analytics and real-time monitoring. Geospatial systems are becoming useful in predictive longevity techniques applied to crime prevention by relying on historical crime, socio-demographic data, environmental, and mobility data^[33].

In addition to crime prevention, geospatial technologies are also very important in emergency management and disaster resilience. Early warning systems for floods, earthquakes, heatwaves, and emergency health directions of the population depend on spatial data on how much the population is exposed to risks and the direction of the response. In times of crisis, geospatial platforms allow situational awareness by combining real-time data from various sources to facilitate coordination among emergency services and decision-makers. The applications point out the ability of geospatial innovation to increase urban resilience, but also bring up issues of surveillance, data accuracy and unequal coverage among urban populations^[10].

3.3. Geospatial Technologies for Spatial Governance and Urban Planning

Geospatial information technology helps in facilitating evidence-based policy coordination and decision-making at various spatial levels in the realm of spatial governance. Spatial data are becoming crucial to the design of land-use, infrastructure, and environmental planning of urban areas by urban planners and policymakers. High-level geospatial analytics will allow for analyzing alternative development conditions, evaluating cumulative effects, and tracking pol-

icy implications over time^[20].

The geospatial systems also promote the coordination process between government agencies through the establishment of common data spatial infrastructures and interoperable systems. These infrastructures facilitate transparency and accountability by providing spatial information to more stakeholders. Consequently, geospatial innovation is leading to a transition of hierarchical planning models to more networked and data-driven governance arrangements. These systems, however, rely on the institutional capacity, data standards, and governance systems that control data sharing and utilization.

3.4. Participatory and Collaborative Geospatial Governance

An emerging literature points to the contribution of geospatial innovation to facilitating participatory and collaborative types of urban governance. Public participation GIS and web-based mapping systems enable the participation of citizens in sharing local knowledge, setting spatial preferences, and participating in planning. They are becoming common in assisting community mapping, participatory budgeting, and co-design projects, especially where the standard methods of planning are accused of being unwelcoming to marginalized populations^[3].

Citizen sensing projects and crowdsourced spatial data extend the range of participation further as they enable residents to develop real-time information concerning the circumstances in urban areas, e.g., traffic jams, the quality of the environment, or service availability. Although these methods can make knowledge production in cities more democratic, it also implies that some issues about data quality, representativeness, and the disproportionate ability of communities to interact with the digital environment arise. Therefore, participatory geospatial governance has to be perceived as an avenue of inclusion and a place of constant struggle^[34].

3.5. Ethical, Legal, and Social Implications of Geospatial Innovation

With the increasing integration of geospatial information technology with the city security, governance system, and the smart city, ethical, legal, and social ramifications have become the center of scholarly discussion. The issues of privacy, surveillance, and data protection are especially acute in security-related applications, in which real-time tracking and predictive analytics may deemphasize the differences between protection and social control. These issues are further compounded by algorithmic bias and opacity, which can cause or intensify existing inequalities because automated spatial decision-making systems can replicate and/or amplify them.

Issues of accountability, transparency, and ownership of data are critical questions of the responsible use of geospatial innovation as far as governance is concerned. The asymmetric access to geospatial information and analytics may strengthen power inequities among institutions, private actors, and citizens. These issues highlight the importance of governance systems that incorporate ethical issues into the development and implementation of geospatial systems. Instead of viewing ethics as an external charge, ethics-by-design methods are progressively being advocated in the literature to ensure technological innovation is coordinated with ethics concepts such as inclusivity, fairness, and democratic accountability^[18].

4. Integrating Urban Security, Spatial Governance, and Smart City Development

Although geospatial information technology is extensively used in the field of urban security, spatial governance, or smart cities, its most radical potential is that it can help merge these areas into a common urban intelligence platform. Geospatial innovation is no longer the instrument of parallel policy functions but rather the connective infrastructure to tie together risk management, governance processes, and digital urban services. This part summarizes the literature to investigate the conceptualization and operationalization of such integration and the controversy it presents, including the use of synergistic frameworks and smart city platforms, and the tensions associated with cross-domain convergence^[2].

4.1. Synergistic and Integrative Frameworks

Recent studies have conceptualized geospatial information technology as a type of boundary-spanning system that facilitates the coordination between institutional, sectoral, and spatial boundaries. Geospatial systems enable the alignment of security-oriented, governance-oriented, and development-oriented goals by offering common spatial representations and interoperable data infrastructures. As an example, spatial risk analysis in disaster management can be applied to land-use planning, and governance platforms based on the inclusion of a spatial indicator can increase the transparency and accountability of security-related interventions^[35].

Such integrative structures tend to focus on the fact that geospatial data is also viewed as a shared language where various actors can bargain the priorities and the responsibilities. In this respect, geospatial information technology can provide not only technical interoperability, but also cognitive and organizational. The literature proposes that these frameworks can be best supported by institutional arrangements that promote the sharing of data, cross-sector partnership and adaptive learning. Integration, however, is hardly smooth at all, with the policy logics, performance measures, and ethical principles defining the design and application of geospatial tools in various fields^[36].

4.2. Smart City Platforms and Urban Intelligence

Another vivid expression of integrated geospatial innovation is smart city platforms. These systems usually integrate real-time spatial information, analytical models, and interfaces to urban information visualization in order to facilitate decision-making and monitoring information systems^[19]. Dashboards, control centers, and urban operation platforms are becoming more and more centralized and are used to coordinate the work of traffic management, emergency assistance, environmental surveillance, and the services offered to the population. The geospatial information technology has a fundamental role in such systems, as it facilitates the spatial integration of heterogeneous data and urban functions^[37,38].

A major phenomenon in this respect is the rise of urban digital twins, an offer of dynamic, spatially explicit urban systems simulations. Digital twins consider the combination

of geospatial data, real-time sensor data, and predictive models to enable decision-makers to examine different scenarios and determine the possible effects before interventions are taken. The literature identifies the capacities of these tools to augment anticipatory governance and evidence-based policy-making. Simultaneously, their governance is criticized, such as model transparency and data ownership, and the concentration of decision-making authority in technocratic bodies^[16].

4.3. Tensions and Trade-Offs in Cross-Domain Integration

Although it has been reported that there is promise of integrated geospatial systems, there is also an in-depth focus on the tensions and trade-offs that come with cross-domain convergence in the literature. Among the main contradictions is that of efficiency and participation. Although integrated platforms can facilitate the decision-making process and address operational effectiveness, they can also exclude the deliberative process and limit the chances of meaningful public interaction. On the same note, the quest to ensure the security of urban areas by real-time surveillance and predictive analytics may clash with the principles of privacy, data protection, and civil liberties^[39–41].

The other important trade-off is standardization/contextual sensitivity. Standardized data models and indicators are frequently crucial in giving integrated geospatial sys-

tems interoperability, but standardization can ignore both local knowledge and cultural diversity and place-based conditions. This conflict can be especially observed in the areas of smart cities that aim to scale technological solutions in different urban settings. The literature argues that it is necessary to have mechanisms of governance that can mediate these trade-offs by introducing ethical considerations, accountability structures, and participatory processes in the design and operation of integrated geospatial infrastructures. Even though integrated geospatial systems present great opportunities for governance, they also present new trade-offs and risks. **Table 2** provides a summary of these opportunities and challenges^[3,16,42].

When put into combination, these debates serve to accentuate that the integration based on geospatial information technology is not a technical feat by any means but a heavily political and institutional one. Integrated urban geospatial systems require the distribution of power, responsibility, and knowledge to be effective and legitimate among the actors. This knowledge of these dynamics is critical to determining whether geospatial innovation can help create smarter, safer, and more inclusive cities or whether it indicates that it strengthens existing inequalities and governance challenges^[43–45]. **Figure 3** synthesizes the major tensions and trade-offs that are brought about by integrated geospatial urban systems.

Table 2. Governance opportunities and associated risks arising from the integration of geospatial information technology across urban domains.

Dimension	Opportunities Enabled by GIT	Associated Risks and Challenges
Urban security	Faster response, anticipatory governance	Surveillance, privacy infringement
Spatial governance	Transparency, coordination	Technocratic dominance
Smart city platforms	System integration, efficiency	Centralization of power
Participation	Citizen data contributions	Digital exclusion
Decision-making	Evidence-based policies	Algorithmic bias and opacity



Figure 3. Key tensions and trade-offs associated with the integration of geospatial information technology across urban domains.

5. Discussion

As shown in the previous sections, geospatial information technology innovation has emerged as a core driver of the formation of modern urban security practices, spatial governance schemes, and smart city developmental directions. Having been compiled out of various literature strands, this review has uncovered the integrative capacity of geospatial systems as well as the issues surrounding their growing role in the urban decision-making process. This discussion reflects on the more general theoretical implications of these findings and their applicability to urban policy and practice^[46].

5.1. Theoretical Implications

Conceptually, the review suggests that geospatial information technology should not be considered a neutral tool of urban analysis. Rather, geospatial systems can be understood as socio-technical infrastructures that actively assist in defining, prioritizing, and addressing urban issues. The way security, governance, and smart cities merge with each other using common geospatial platforms shows how spatial data and analytics affect institutional logics, power relations, and knowledge production processes in urban centers.

The results also add to the current controversies on urban studies and governance theory on data-driven and algorithmic governance. An example of recon figurative digital technologies in governance is the process of geospatial innovation that facilitates the anticipatory decision-making process, real-time monitoring, and intersectoral coordination. Simultaneously, these features also bring novel types of reliance on technical skills and algorithmic frameworks, which cast doubt on the ideas of transparency, responsibility, and democracy. It is through spatial governance and smart city development that the geospatial information technology is positioned at the crossroads of urban security, which allows the review to serve as a conceptual bridge between Geoscience and the wider theoretical discourse of smart urbanism and digital governance^[47–50].

Moreover, the review highlights the significance of spatiality as the background aspect of research on smart cities. Although a lot of smart city literature focuses on data, platforms, and sensors, the spatial structure and territorial implications of these systems are inadequately theorized. Geospatial information technology is a foreshadowing of the

spatial distribution of risks, resources, and opportunities in which digital innovation can be used to reduce inequalities in urban areas, as well as worsen their effects. This view supports the demands of more place-based approaches to urban governance theories that would take into consideration the place-based variations and the socio-spatial justice.

5.2. Practical and Policy Implications

Practically and policies, the results of this review can be significant to urban planners, policymakers, and city administrators. The increased inter-relationship between geospatial systems, in the context of security, governance, and smart city programs, implies the introduction of coordinated policy frameworks that would cut across the administrative silos. Instead of creating geospatial applications of individual functions in isolation, cities can enjoy the advantage of investing in common spatial data infrastructures that will enable interoperability, quality of data, and future scalability^[51].

Another issue presented in the review is the significance of governance arrangements that are balanced in terms of efficiency and inclusivity. Although integrated geospatial platforms have the potential to enhance operational effectiveness and situational awareness, transparency in decision-making processes and meaningful involvement of the public make it legitimate. Open geospatial data policies, participatory mapping, and capacity building can be used to ensure geospatial innovation of more democratic and accountable urban governance.

Meanwhile, the proliferation of geospatial technologies within the framework of urban security requires effective ethical and legal protection. The policymakers need to resolve the problem concerning privacy protection, algorithmic bias, and reasonable use of surveillance technologies. Data misuse and social exclusion are some of the risks that can be curbed by embedding the aspect of ethics into the design and implementation of geospatial systems. This is especially essential in smart city projects, which make use of real-time monitoring and predictive analytics, where the impacts of errors or biases may be severe^[52–55].

Lastly, the review recommends that geospatial innovation ought to be perceived as a continuous process, as opposed to a technological upgrade. The governance structures should be adaptable and flexible as urban issues change and new sources of data are developed. To maintain the re-

wards of geospatial information technology and control its risks, it is critical to invest in institutional learning, cross-sector collaboration, and interdisciplinary expertise. Cities can achieve a greater benefit through geospatial systems by aligning technological innovation with governance principles of good governance and social responsibility to promote sustainable, secure, and inclusive urban development.

6. Research Gaps and Future Directions

Though innovation in geospatial information technology has produced considerable breakthroughs in urban secu-

rity, spatial governance, and smart city development, the literature reviewed demonstrates that some critical gaps should be addressed by other scholars^[25]. The gaps highlighted in this paper are critical to the advancement of theoretical knowledge, enhance empirical credibility, and also to make geospatial innovation produce equitable and sustainable urban futures. The chapter presents the primary research areas to be considered in the future study, giving specific attention to methodological, geographical, governance-related, and ethical aspects^[16]. Continuing on the synthesis made above, **Table 3** presents the primary research gaps that are found in the literature and suggests the corresponding future research directions.

Table 3. Key research gaps identified in the literature and corresponding future research directions.

Research Dimension	Identified Gap	Suggested Future Direction
Methodology	Predominance of cross-sectional case studies	Longitudinal and comparative research
Geography	Global North bias	Global South and context-sensitive studies
Governance	Limited AI accountability analysis	Governance models for automated geospatial systems
Ethics	Ethics treated as secondary	Ethical-by-design geospatial infrastructures
Integration	Domain-specific analyses	Cross-domain and interdisciplinary frameworks

6.1. Methodological and Empirical Limitations

An evident gap in the literature is the preponderance of case-based and cross-sectional studies. Although these studies are rich in information about the specific uses of geospatial technologies, they are not always longitudinal views that could help to capture the way in which geospatial systems can change and transform the ways in which they influence governance and security. Longitudinal and comparative studies that analyze the long-term institutional, social, and spatial impacts of geospatial innovation in various urban settings would be useful in future research^[23,56].

Also, empirical research often focuses on technical performance or operational efficiency and provides little assessment of more general governance results. It is important to have more elaborate assessment systems that bring together both quantitative performance measures and qualitative evaluation of institutional change, stakeholder perceptions, and socio-spatial equity. More integrated and multi-layered insights into geospatial innovation in action can be achieved based on mixed-methods methods that integrate spatial analysis, policy analysis, and stakeholder engagement^[57].

Future research would benefit from adopting more explicitly interdisciplinary methodological frameworks. One

promising direction involves integrating spatial data science techniques—such as machine learning, network analysis, and spatial econometrics—with traditional urban governance and policy analysis methods. These approaches can improve the capacity to evaluate how geospatial systems influence urban decision-making processes, institutional coordination, and socio-spatial inequalities.

In addition, urban digital twin simulation models represent an emerging methodological frontier. By combining real-time sensor data, geospatial databases, and predictive models, digital twins allow researchers to experiment with alternative urban policy scenarios and evaluate the potential impacts of interventions related to security, infrastructure resilience, or environmental management.

6.2. Geographical and Contextual Biases

The literature assessed in the current article is highly biased toward urban areas in the Global North, those whose digital infrastructures and a solid institutional foundation. Consequently, little is known about the working of geospatial information technology in urban areas where resources are scarce, the urban areas are informally developed, or poorly governed. This geographical discrimination will restrict the

extrapolation of current results and endanger the further propagation of models based on technologies that are not necessarily right in various socio-political settings^[58].

In the future, it is important to consider more focus on Global South cities and other underexplored areas, where geospatial innovation can be of various types and have other priorities. The cross-city comparison involving cities having different governance systems, digital maturity, and socio-economic status can be used to identify context-specific channels for incorporating geospatial technologies in urban security and governance practices. This kind of research can also play a significant role in understanding the ways in which geospatial innovation can assist inclusive development instead of consolidating current inequalities.

6.3. Governance of AI-Driven and Automated Geospatial Systems

Another research frontier that is coming out as an important research area is the increasing integration of artificial intelligence and automated decision-making in geospatial systems. Although AI-based spatial analytics are beneficial to predictive power and efficiency, they also introduce a new governance issue of transparency, accountability, and control. A large number of existing publications assume AI as a technical improvement without adequately investigating the consequences on the decision-making prerogative and responsibility of institutions^[59,60].

Future studies should consider designs of governance systems that can manage AI-driven geospatial systems, such as algorithmic accountability, explainability, and human control. To create regulatory and organizational frameworks that bring automated geospatial decision-making into a democratic ethos and popular confidence, an interdisciplinary effort that enlists the services of law, ethics, and public administration is especially required.

6.4. Ethical, Legal, and Social Dimensions

Despite the growing acceptance of ethical issues in the literature, these issues are still considered secondary aspects and not considered part of the geospatial innovation. Privacy protection, surveillance, data ownership, and algorithmic bias are a set of issues that have disproportionately been considered in all areas of usage. Studies on urban security,

especially, are more often focused on effectiveness, rather than ethical reflection, whereas governance-related studies are unlikely to pay much attention to technical design decisions^[61,62].

Indeed, ethical-by-design thinking ought to be embraced in future research that requires inserting normative value systems into geospatial systems development and implementation. This will involve the analysis of the ways ethical considerations might be implemented using system architecture, data governance policies, and processes of participation. More focus should also be given to the distributive effects of geospatial innovation, such as the beneficiaries of advanced spatial technologies, as well as those who may not get to benefit and may be marginalized or excluded^[63].

6.5. Toward Integrated and Reflexive Research Agendas

Lastly, the review identifies the importance of having additional integrative and reflexive research agendas across disciplinary and sectoral lines. Instead of analyzing urban security, spatial governance, and smart city development as individual fields, future research ought to clearly explore their interrelations and interdependence by studying them using geospatial information technology. Integrative research of this nature can be useful in identifying the synergies, foreseeing the conflicts, and informing the formulation of more consistent urban policies^[64–66].

Interdisciplinary collaboration will be essential for advancing research on geospatial innovation in urban systems. Future studies could employ mixed-method research designs that combine GIS-based spatial analysis with qualitative governance research, including institutional analysis, stakeholder interviews, and policy evaluation. Participatory GIS and citizen science approaches can also be used to incorporate community knowledge into spatial datasets and decision-making processes. Furthermore, comparative cross-city studies and longitudinal research designs can help identify how different governance arrangements, technological capacities, and socio-economic contexts influence the effectiveness of geospatial systems in urban security and smart city initiatives. Such methodological pluralism would enable a more comprehensive understanding of the technological, institutional, and societal dimensions of geospatial innovation.

7. Conclusion

The review has discussed innovation in geospatial information technology and its changing contribution to the relationship between urban security, spatial governance, and the development of smart cities. Through an interdisciplinary literature synthesis, the article establishes how geospatial systems are no longer instruments of analytical power but rather constitute a set base of socio-technical infrastructure that defines the manner in which cities are monitored, governed, and secured. Sensing, data integration, and spatial analytics innovations allow creating real-time urban intelligence, and at the same time, restructure institutional arrangements and decision-making mechanisms.

One of the main contributions of this review is the integrative view. The article does not differentiate between urban security, spatial governance, and smart city initiatives as autonomous areas but emphasizes their enhanced overlap by depending on a common data source (geospatial) and platform. In these areas, geospatial information technology enables proactive governance, intersection or coordination, and policymaking based on evidence. Meanwhile, the review indicates that integration is also characterized by rather chronic tensions of privacy, participation, accountability, and socio-spatial inequality. These frictions allow highlighting the political essence of geospatial innovation and the necessity to have governance structures that can help to reconcile conflicting goals. The review is also an advancement of theoretical insights since it places geospatial information technology at the nexus of smart urbanism, spatial governance, and security studies. This view preempts the position of spatiality as a vital and under-theorized aspect of data-driven urban change. The article adds to the larger discussions on the topic of digital governance and algorithmic urban decision-making by highlighting the importance of geospatial systems and their role in the concept of urban knowledge production and power relations.

This review has a number of limitations. Similar to most literature reviews, the analysis is limited to the accessibility and dispersion of existing research that is geographically uneven and methodologically discontinuous. Although attempts have been undertaken to incorporate various research traditions, geospatial technologies are changing very fast; thus, there are new applications that may not be fully reflected in the literature. Such constraints indicate the exis-

tence of more empirical and theoretical research that needs to be undertaken as geospatial innovation keeps developing.

In the prospect, the conclusions of this review imply that the future of smart and secure cities will not only be pegged on the level of sophistication in technology but also the quality of governance systems around geospatial systems. To ensure that geospatial innovation facilitates inclusive, transparent, and accountable urban development, ethical design, the capacity of the institution, and participatory processes should be maintained over a long period. Geospatial information technology can positively help in solving complex urban challenges by ensuring that technological progressions are not compromised at the expense of good governance and social responsibility.

To sum up, geospatial information technology plays a central role in modern-day urban change. Its ability to combine security, governance, and smart city goals provides great potential in improving urban resilience and sustainability. Simultaneously, the potential can be achieved through a critical approach to the social, political, and ethical aspects of geospatial innovation. This review will offer a platform on which such engagement can take place, as well as a roadmap that researchers can follow to continue to create more secure, governable, and equitable smart cities in the future.

Funding

This work is a project supported by the Scientific Research Fund of the Zhejiang Provincial Education Department (grant number Y202456064).

Institutional Review Board Statement

Not applicable.

Informed Consent Statement

Not applicable.

Data Availability Statement

No new data were created or generated in this study. As this is a review, it is based on data and information from previously published sources, which are cited in the reference list.

Conflicts of Interest

The authors declare no conflict of interest.

References

- [1] Cohen, J.E., 2005. Human Population Grows Up. *Scientific American*. 293(3), 48–55.
- [2] Botezatu, U.-E., 2023. Space Technologies, Smart Cities, and National Security: A Smart(er) State Synergy. *Smart Cities International Conference (SCIC) Proceedings*. 11, 241–252.
- [3] Li, Y., Lai, Y., Lin, Y., 2024. The Role of Diversified Geo-Information Technologies in Urban Governance: A Literature Review. *Land*. 13(9), 1408.
- [4] Sharma, P., Singh, R., Srivastava, A., 2021. Analyzing the Role of Geospatial Technology in Smart City Development. In: Sharma, P. (Ed.). *Geospatial Technology and Smart Cities: ICT, Geoscience Modeling, GIS and Remote Sensing*. Springer: Cham, Switzerland. pp. 1–20.
- [5] Ljungkvist, K., 2021. Toward an Urban Security Research Agenda in IR. *Journal of Global Security Studies*. 6(2), oga019.
- [6] Franco, E., 2022. The Coding Prometheus Is Blind: Socio-Technological Imaginaries on GitHub. *Inter-culture Journal: Online-Zeitschrift für Interkulturelle Studien*. 21(36), 49–67.
- [7] Nagavi, J.C., Shukla, B.K., Bhati, A., et al., 2024. Harnessing Geospatial Technology for Sustainable Development: A Multifaceted Analysis of Current Practices and Future Prospects. In: Sharma, C., Shukla, A.K., Pathak, S., et al. (Eds.). *Sustainable Development and Geospatial Technology: Volume 1: Foundations and Innovations*. Springer: Cham, Switzerland. pp. 147–170.
- [8] Pesqueira, A., de Bem Machado, A., 2026. Challenging the Boundaries of Urban Security: AIP, Ethical Governance, and the Future of Smart Cities. In: Abdelmottlep, M. (Ed.). *AI-Driven Policing and Urban Security in Smart Cities*. IGI Global Scientific Publishing: Hershey, PA, USA. pp. 81–128.
- [9] Abujder Ochoa, W.A., Iarozinski Neto, A., Vitorio Junior, P.C., et al., 2025. The Theory of Complexity and Sustainable Urban Development: A Systematic Literature Review. *Sustainability*. 17(1), 3.
- [10] Rezvani, S., Falcão, M.J., Komljenovic, D., et al., 2023. A Systematic Literature Review on Urban Resilience Enabled with Asset and Disaster Risk Management Approaches and GIS-Based Decision Support Tools. *Applied Sciences*. 13(4), 2223.
- [11] Osakwe, J., Akongne, N.N., Osakwe, N.C., et al., 2025. Integrating Data Analytics and GIS for Smart City Development: A Systematic Literature Review. In *Proceedings of the 2025 IST-Africa Conference (IST-Africa)*, Nairobi, Kenya, 28–30 May 2025; pp. 1–11.
- [12] He, W., Chen, M., 2024. Advancing Urban Life: A Systematic Review of Emerging Technologies and Artificial Intelligence in Urban Design and Planning. *Buildings*. 14(3), 835.
- [13] Kotsev, A., Minghini, M., Tomas, R., et al., 2020. From Spatial Data Infrastructures to Data Spaces—A Technological Perspective on the Evolution of European SDIs. *ISPRS International Journal of Geo-Information*. 9(3), 176.
- [14] Gruen, A., 2013. SMART Cities: The Need for Spatial Intelligence. *Geo-Spatial Information Science*. 16(1), 3–6.
- [15] Sofianopoulos, S., Faka, A., Chalkias, C., 2025. SDI-Enabled Smart Governance: A Review (2015–2025) of IoT, AI and Geospatial Technologies—Applications and Challenges. *Land*. 14(7), 1399.
- [16] Tao, W., 2013. Interdisciplinary Urban GIS for Smart Cities: Advancements and Opportunities. *Geo-Spatial Information Science*. 16(1), 25–34.
- [17] Gil, J., 2020. City Information Modelling: A Conceptual Framework for Research and Practice in Digital Urban Planning. *Built Environment*. 46(4), 501–527.
- [18] Rasoulzadeh Aghdam, S., Bababeimorad, B., Ghasemzadeh, B., et al., 2025. Social Smart City Research: Interconnections between Participatory Governance, Data Privacy, Artificial Intelligence and Ethical Sustainable Development. *Frontiers in Sustainable Cities*. 6, 1514040.
- [19] Roche, S., 2014. Geographic Information Science I: Why Does a Smart City Need to Be Spatially Enabled? *Progress in Human Geography*. 38(5), 703–711.
- [20] Scott, G., Rajabifard, A., 2017. Sustainable Development and Geospatial Information: A Strategic Framework for Integrating a Global Policy Agenda into National Geospatial Capabilities. *Geo-Spatial Information Science*. 20(2), 59–76.
- [21] Jeansoulin, R., 2016. Review of Forty Years of Technological Changes in Geomatics toward the Big Data Paradigm. *ISPRS International Journal of Geo-Information*. 5(9), 155.
- [22] Song, K., Chen, Y., Duan, Y., et al., 2023. Urban Governance: A Review of Intellectual Structure and Topic Evolution. *Urban Governance*. 3(3), 169–185.
- [23] Yu, D., Fang, C., 2023. Urban Remote Sensing with Spatial Big Data: A Review and Renewed Perspective of Urban Studies in Recent Decades. *Remote Sensing*. 15(5), 1307.
- [24] Yan, H., 2025. Trends in Empirical Research in English for Specific Purposes: A Systematic Review of SSCI-Indexed Journal Articles (2014–2023). *SAGE Open*. 15(1). DOI: <https://doi.org/10.1177/21582440251328460>

- [25] Pandey, P., Priyadarshni, P., 2025. The Role of Geospatial Technology in Sustainable Urban Development: Innovations, Challenges, and Future Prospects. In: Yadava, R.N., Ujang, U. (Eds.). *Geospatial Innovation: Igniting Smart Cities, Eco-Synergy, and Urban Resurgence*. Springer: Cham, Switzerland. pp. 109–122.
- [26] Zhang, Y., Chen, S., Akintunde, T.Y., et al., 2024. Life Course and Mental Health: A Thematic and Systematic Review. *Frontiers in Psychology*. 15, 1329079.
- [27] Yang, F., Zeng, G., Du, C., et al., 2008. Spatial Analyzing System for Urban Land-Use Management Based on GIS and Multi-Criteria Assessment Modeling. *Progress in Natural Science*. 18(10), 1279–1284.
- [28] Darwish, D., 2025. Geospatial AI Future Perspectives. In: Darwish, D., Chemingui, H. (Eds.). *Recent Trends in Geospatial AI*. IGI Global Scientific Publishing: Hershey, PA, USA. pp. 297–324.
- [29] Razak, Q., Ali, M., 2025. Artificial Intelligence–Driven Decision Support Systems for Sustainable Urban Planning. *Global Journal of Multidisciplinary and Applied Sciences*. 3(3), 1–8.
- [30] Varzeshi, S., Fien, J., Irajifar, L., 2025. Integrating Smart City Technologies and Urban Resilience: A Systematic Review and Research Agenda for Urban Planning and Design. *Smart Cities*. 9(1), 2.
- [31] Ujang, U., Yadava, R.N., 2025. Introduction to Geospatial Innovation for Smart City Development, Eco-Synergy, and Urban Resurgence. In: Yadava, R.N., Ujang, U. (Eds.). *Geospatial Innovation: Igniting Smart Cities, Eco-Synergy, and Urban Resurgence: Geospatial Technologies for Smart Cities*. Springer: Cham, Switzerland. pp. 3–15.
- [32] Sunny, M.A.U., 2024. Unveiling Spatial Insights: Navigating the Parameters of Dynamic Geographic Information Systems (GIS) Analysis. *International Journal of Science and Research Archive*. 11(2), 1976–1985.
- [33] Pirasteh, S., Varshosaz, M., 2019. Geospatial Information Technologies in Support of Disaster Risk Reduction, Mitigation and Resilience: Challenges and Recommendations. In: Rajabifard, A. (Ed.). *Sustainable Development Goals Connectivity Dilemma*. CRC Press: Boca Raton, FL, USA. pp. 93–108.
- [34] McCall, M.K., Dunn, C.E., 2012. Geo-Information Tools for Participatory Spatial Planning: Fulfilling the Criteria for ‘Good’ Governance? *Geoforum*. 43(1), 81–94.
- [35] Stephens, W., van Steden, R., Schoonmade, L., 2024. Boundary Spanning in Local Governance: A Scoping Review. *Administration & Society*. 56(2), 99–144.
- [36] Pelizza, A., 2021. Towards a Sociomaterial Approach to Inter-Organizational Boundaries: How Information Systems Elicit Relevant Knowledge in Government Outsourcing. *Journal of Information Technology*. 36(2), 94–108.
- [37] Daniel, S., Doran, M.-A., 2013. Geosmartcity: Geomatics Contribution to the Smart City. In *Proceedings of the 14th Annual International Conference on Digital Government Research*, Quebec City, QC, Canada, 17–20 June 2013; pp. 65–71.
- [38] Panori, A., Kakderi, C., Komninos, N., et al., 2021. Smart Systems of Innovation for Smart Places: Challenges in Deploying Digital Platforms for Co-Creation and Data-Intelligence. *Land Use Policy*. 111, 104631.
- [39] Bibri, S.E., 2021. The Core Academic and Scientific Disciplines Underlying Data-Driven Smart Sustainable Urbanism: An Interdisciplinary and Transdisciplinary Framework. *Computational Urban Science*. 1(1), 1.
- [40] Najafzadeh, M., Yeganeh, A., 2025. AI-Driven Digital Twins in Industrialized Offsite Construction: A Systematic Review. *Buildings*. 15(17), 2997.
- [41] Yang, H., Liu, H., Yuan, X., et al., 2025. Synergizing Intelligence and Privacy: A Review of Integrating Internet of Things, Large Language Models, and Federated Learning in Advanced Networked Systems. *Applied Sciences*. 15(12), 6587.
- [42] Baud, I., Pfeffer, K., Sydenstricker-Neto, J., et al., 2016. Knowledge Management in Urban Governance; Building Adaptive Capacity through ICT-GIS-Based Systems in the Global South. *Development, Environment and Foresight*. 2, 2336–6621.
- [43] Setälä, H., Bardgett, R., Birkhofer, K., et al., 2014. Urban and Agricultural Soils: Conflicts and Trade-Offs in the Optimization of Ecosystem Services. *Urban Ecosystems*. 17(1), 239–253.
- [44] Webb, R., Bai, X., Smith, M.S., et al., 2018. Sustainable Urban Systems: Co-Design and Framing for Transformation. *Ambio*. 47(1), 57–77.
- [45] Zhu, C., Dong, B., Li, S., et al., 2021. Identifying the Trade-Offs and Synergies among Land Use Functions and Their Influencing Factors from a Geospatial Perspective: A Case Study in Hangzhou, China. *Journal of Cleaner Production*. 314, 128026.
- [46] Mehmood, R., Yigitcanlar, T., Corchado, J.M. (Eds.), 2024. *Smart Technologies for Sustainable Urban and Regional Development*. MDPI: Basel, Switzerland.
- [47] Abusaada, H., Elshater, A., 2021. Competitiveness, Distinctiveness and Singularity in Urban Design: A Systematic Review and Framework for Smart Cities. *Sustainable Cities and Society*. 68, 102782.
- [48] Angelidou, M., 2014. Smart City Policies: A Spatial Approach. *Cities*. 41, S3–S11.
- [49] Aslam, M., Ansari, Y.M., 2024. Digital Governance and Smart Cities: Leveraging Technology for Urban Administration. In: Gopinath, T., Choudhary, G. (Eds.). *Urban Local Governance in India: Dynamics, Challenges, and Innovation*. Abhishek Publication: Chandigarh, India. pp. 245–267.

- [50] Datta, A., Odendaal, N., 2019. Smart Cities and the Banality of Power. *Environment and Planning D: Society and Space*. 37(3), 387–392.
- [51] Punter, J., 2007. Developing Urban Design as Public Policy: Best Practice Principles for Design Review and Development Management. *Journal of Urban Design*. 12(2), 167–202.
- [52] Castelnovo, W., Misuraca, G., Savoldelli, A., 2016. Smart Cities Governance: The Need for a Holistic Approach to Assessing Urban Participatory Policy Making. *Social Science Computer Review*. 34(6), 724–739.
- [53] Lartey, D., Law, K.M., 2025. Artificial Intelligence Adoption in Urban Planning Governance: A Systematic Review of Advancements in Decision-Making, and Policy Making. *Landscape and Urban Planning*. 258, 105337.
- [54] Ordóñez, C., Threlfall, C.G., Kendal, D., et al., 2019. Urban Forest Governance and Decision-Making: A Systematic Review and Synthesis of the Perspectives of Municipal Managers. *Landscape and Urban Planning*. 189, 166–180.
- [55] Sallis, J.F., Bull, F., Burdett, R., et al., 2016. Use of Science to Guide City Planning Policy and Practice: How to Achieve Healthy and Sustainable Future Cities. *The Lancet*. 388(10062), 2936–2947.
- [56] Popescu, A.I., 2020. Long-Term City Innovation Trajectories and Quality of Urban Life. *Sustainability*. 12(24), 10587.
- [57] Kasraian, D., Maat, K., van Wee, B., 2019. The Impact of Urban Proximity, Transport Accessibility and Policy on Urban Growth: A Longitudinal Analysis over Five Decades. *Environment and Planning B: Urban Analytics and City Science*. 46(6), 1000–1017.
- [58] Omweri, F., 2024. A Systematic Literature Review of E-Government Implementation in Developing Countries: Examining Urban-Rural Disparities, Institutional Capacity, and Socio-Cultural Factors in the Context of Local Governance and Progress towards SDG 16.6. *International Journal of Research and Innovation in Social Science*. 8(8), 1173–1199.
- [59] Praharaj, S., Han, H., 2019. Cutting through the Clutter of Smart City Definitions: A Reading into the Smart City Perceptions in India. *City, Culture and Society*. 18, 100289.
- [60] Smith, M., Neupane, S., 2018. Artificial Intelligence and Human Development: Toward a Research Agenda. Available from: <http://hdl.handle.net/10625/56949> (cited 10 January 2026).
- [61] Merodio Gómez, P., Ramírez Santiago, A., García Seco, G., et al., 2022. Ethics in the Use of Geospatial Information in the Americas. *Technology in Society*. 69, 101964.
- [62] Sui, D.Z., 2011. Legal and Ethical Issues of Using Geospatial Technologies in Society. In: Nyerges, T.L., Couclelis, H., McMaster, R. (Eds.). *The SAGE Handbook of GIS and Society*. Sage Publications Ltd.: Los Angeles, LA, USA. pp. 504–528.
- [63] Aaltonen, V., 2022. Ethics and Safety of Community-Based Geospatial Data Processes in the Resilient Urban South [Master’s Thesis]. University of Turku: Turku, Finland.
- [64] Bibri, S.E., 2018. Backcasting in Futures Studies: A Synthesized Scholarly and Planning Approach to Strategic Smart Sustainable City Development. *European Journal of Futures Research*. 6(1), 13.
- [65] Leszczynski, A., 2016. Speculative Futures: Cities, Data, and Governance beyond Smart Urbanism. *Environment and Planning A: Economy and Space*. 48(9), 1691–1708.
- [66] Meijer, A., Bolívar, M.P.R., 2016. Governing the Smart City: A Review of the Literature on Smart Urban Governance. *International Review of Administrative Sciences*. 82(2), 392–408.