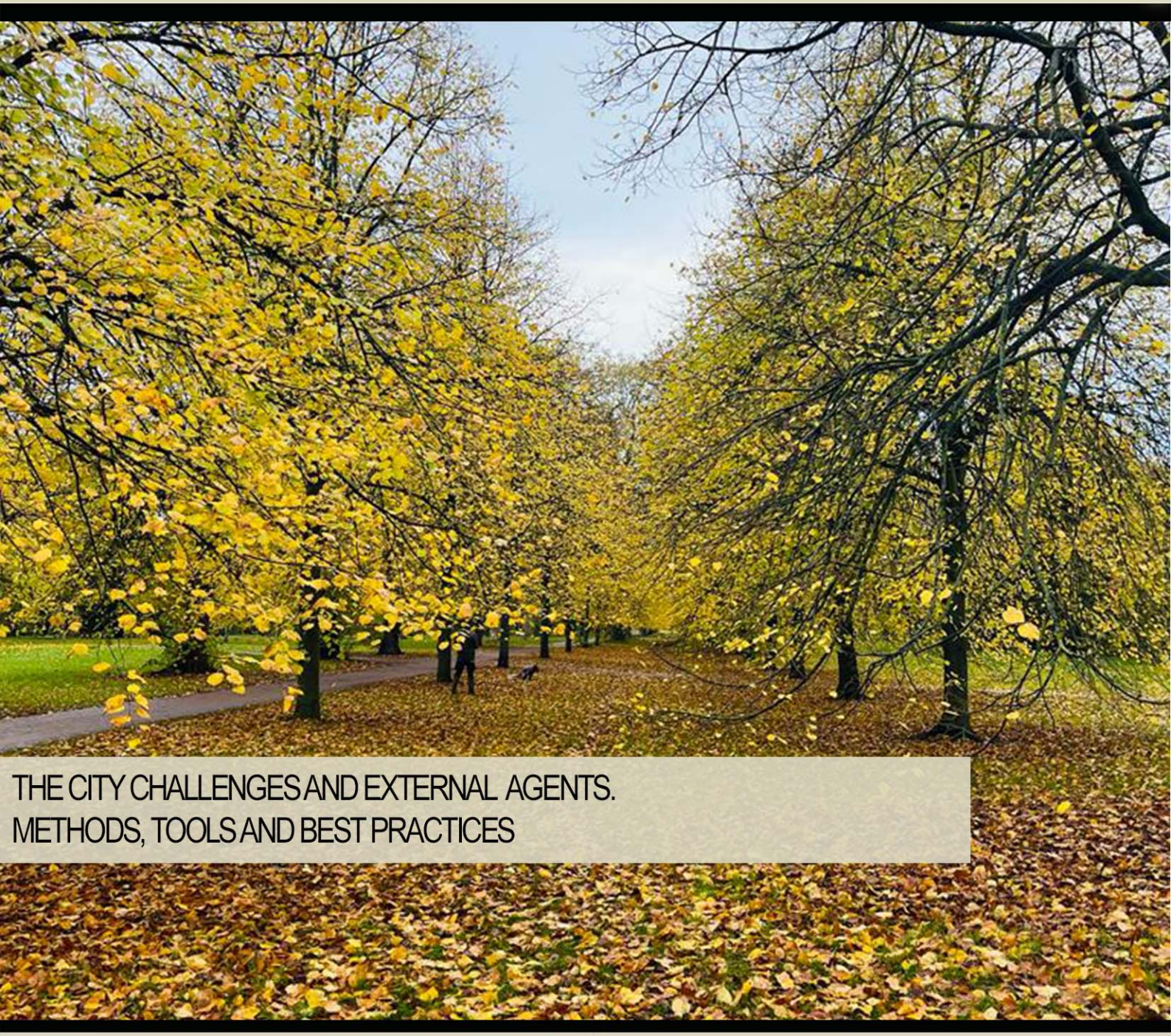
TeMA

Journal of Land Use, Mobility and Environment

The climatic, social, economic and health phenomena that have increasingly affected our cities in recent years require the identification and implementation of adaptation actions to improve the resilience of urban systems. The three issues of the 16th volume will collect articles concerning the challenges that the complexity of the phenomena in progress imposes on cities through the adoption of mitigation measures and the commitment to transforming cities into resilient and competitive urban systems.

TeMA is the Journal of Land Use, Mobility and Environment and offers papers with a unified approach to planning, mobility and environmental sustainability. With ANVUR resolution of April 2020, TeMA journal and the articles published from 2016 are included in the A category of scientific journals. From 2015, the articles published on TeMA are included in the Core Collection of Web of Science. It is included in Sparc Europe Seal of Open Access Journals, and the Directory of Open Access Journals.



THE CITY CHALLENGES AND EXTERNAL AGENTS. METHODS, TOOLS AND BEST PRACTICES

Vol.16 n.3 December 2023

print ISSN 1970-9889 e-ISSN 1970-9870
University of Naples Federico II

TeMA Journal of Land Use, Mobility and Environment

THE CITY CHALLENGES AND EXTERNAL AGENTS. METHODS, TOOLS AND BEST PRACTICES

3 (2023)

Published by
Laboratory of Land Use Mobility and Environment
DICEA - Department of Civil, Architectural and Environmental Engineering
University of Naples "Federico II"

TeMA is realized by CAB - Center for Libraries at “Federico II” University of Naples using Open Journal System

Editor-in-chief: Rocco Papa
print ISSN 1970-9889 | online ISSN 1970-9870
Licence: Cancelleria del Tribunale di Napoli, n° 6 of 29/01/2008

Editorial correspondence
Laboratory of Land Use Mobility and Environment
DICEA - Department of Civil, Architectural and Environmental Engineering
University of Naples "Federico II"
Piazzale Tecchio, 80
80125 Naples
web: www.serena.unina.it/index.php/tema
e-mail: redazione.tema@unina.it

The cover image shows a view of Hyde Park in London (United Kingdom) during the autumn season.
The photo was taken by Enrica Papa in November 2023.

TeMA. Journal of Land Use, Mobility and Environment offers researches, applications and contributions with a unified approach to planning and mobility and publishes original inter-disciplinary papers on the interaction of transport, land use and environment. Domains include: engineering, planning, modeling, behavior, economics, geography, regional science, sociology, architecture and design, network science and complex systems.
With ANVUR resolution of April 2020, TeMA Journal and the articles published from 2016 are included in A category of scientific journals. From 2015, the articles published on TeMA are included in the Core Collection of Web of Science. TeMA Journal has also received the *Sparc Europe Seal* for Open Access Journals released by *Scholarly Publishing and Academic Resources Coalition* (SPARC Europe) and the *Directory of Open Access Journals* (DOAJ). TeMA is published under a Creative Commons Attribution 4.0 License and is blind peer reviewed at least by two referees selected among high-profile scientists. TeMA has been published since 2007 and is indexed in the main bibliographical databases and it is present in the catalogues of hundreds of academic and research libraries worldwide.

TeMA
Journal of
Land Use, Mobility and Environment

THE CITY CHALLENGES AND EXTERNAL AGENTS. METHODS, TOOLS AND BEST PRACTICES

3 (2023)

Contents

REVIEW NOTES

TeMA Journal of Land Use, Mobility and Environment

TeMA 3 (2023) 631-637
print ISSN 1970-9889, e-ISSN 1970-9870
DOI: 10.6092/1970-9870/10317
Received 10th October 2023, Available online 30th December 2023

www.tema.unina.it

REVIEW NOTE – Town Planning International Rules and Legislation

Urban planning and GeoAI in smart city policies

Federica Gaglione

Department of Engineering,
University of Sannio, Benevento, Italy
e-mail: fgaglione@unisannio.it
ORCID: https://orcid.org/0000-0002-7067-7784

Abstract

Starting from the relationship between urban planning and mobility management, TeMA has gradually expanded the view of the covered topics, always following a rigorous scientific in-depth analysis. This section of the Journal, Review Notes, is a continuous update about emerging topics concerning relationships among urban planning, mobility, and environment, thanks to a collection of short scientific papers written by young researchers. The Review Notes are made up of five parts. Each section examines a specific aspect of the broader information storage within the main interests of the TeMA Journal. In particular: the Town Planning International Rules and Legislation. The growing attention in the last period to the smart city in the academic and political world has occurred as a response to the environmental sustainability objectives set by the European Union. The complementarity between new technologies and components of the urban system should be the starting point for the formulation of new forms of organization of urban life, but this still constitutes a critical issue in many territorial contexts today. In this direction, the contribution of this review note illustrates on the one hand current technologies such as Geospatial Artificial Intelligence (GeoAI): to achieve the objectives of smart cities and on the other to outline within the sheets, instead, the European policies on smart city and artificial intelligence to have a cognitive and operational framework on the topic.

Keywords

Urban sustainability; Smart city; Geospatial Artificial Intelligence (GeoAI).

How to cite item in APA format

Gaglione, F. (2023). Urban planning and GeoAI in smart city policies. *TeMA - Journal of Land Use, Mobility and Environment*, 16 (3), 631-637. http://dx.doi.org/10.6092/1970-9870/10317

1 Urban planning and the smart city

Cities are increasingly involved in having to face "major challenges" such as climate change, the energy efficiency of urban areas, the limited availability of resources and the rapid urbanization of urban centers (Orsetti et al., 2022; Lu et al., 2021). These challenges have led to calls for new paradigms and approaches in spatial planning and management, including that of smart cities (Ullah et al., 2021). The growing attention in the last period to smart cities in the academic and political world has occurred as a response to environmental sustainability objectives (Letaifa, 2015). Although the topic originated 20 years ago in a book entitled "The Technopolis Phenomenon: Smart Cities, Fast Systems, Global Networks" (Gibson et al., 1992), even today in scientific literature it is difficult to find an agreed definition of what makes a city "intelligent". For example, Ramaprasad et al. (2017) defined a smart city as a useful and multidisciplinary approach to improving the quality of life of its inhabitants and the organization of the complexity of urban life supported by information technology infrastructure and its ability to manage information and resources. In turn, Batty et al. (2012) stated that a smart city could be described as a city that uses information and communication technologies (ICT) to improve the functionality of the city. Instead, Li et al. (2020) describes that a smart city is a city that uses digital technology in the interest of improving its operations and management in addressing the problems plaguing the modern city. Kitchin (2015) highlights that the smart city as a city that has a large sensor network and can leverage big data analytics to improve the functioning of the city. Caragliu et al. (2013) describes that it is a city that invests in human and social capital and traditional (transport) and modern (ICT) communication infrastructures fuel sustainable economic growth and a high quality of life, with careful management of natural resources, through participatory governance. In this brief excursus it is highlighted that the definitions range from purely technological visions to more holistic visions based on sustainability and urban planning. Although today there is no univocal definition, the dimensions in which a "smart" city operates are widely shared (Albino et al., 2015). A smart city moves on six different characteristics which are: smart economy (competitiveness), smart people (social and human capital), smart governance (participation), smart mobility (transport and ICT), smart environment (natural resources) and smart living (quality of life) Giffinger et al. (2007). In recent years, the studies of the scientific literature of reference to have on the one hand tried to define the characteristics that can be useful to make a city "smart" through improvement interventions on the different territorial contexts and on the other the studies have concentrated on measuring each dimension of the smart city that could be useful in classifying smart cities (Deren et al.,2021). However, the lack of a common vision of the term "smart city" means that it remains a vague and ambiguous concept, with inconsistent use in different contexts (Abadía et al., 2022). The numerous initiatives developed in national and international operational practice on smart cities give priority to the issues of sustainability, efficiency, and quality of life (Raspotnik et al., 2020). These ideas and initiatives vary depending on the different geographical and socioeconomic contexts. The IESE Cities in Motion report prepared by IESE Business School highlighted that on key factors such as human capital, social cohesion, governance, mobility, technology, and sustainability. The first three cities in the world that are moving in this direction are London, New York and Paris. in Italy, ICity Rank 2022 estimated the level of digitalization in public administration where even some smaller centers and medium-sized citizens have been able to improve. The ranking sees Florence in first place, followed by Milan. The difficulties that still arise today can be anchored on two fundamental aspects. The first aspect is linked to the high number of initiatives developed under the name of Smart City to define new forms of organization of the complexity of urban life (Gargiulo & Papa, 2021), but which in turn have found difficulties in implementing solutions all within the current plan instruments making it often become solely a city "slogan" also due to the difficulties of management and administration of the different territorial contexts. A second aspect for which the smart city has had great difficulties in its creation is due to a lack of technical-scientific support that could guide public administrations in the use of technology based on big data, software, hardware, platforms, and information systems. The complementarity between new technologies and components of the

urban system (structures, activities, actors) was to represent the premise of the Smart City paradigm where inhabitants and users of the city take on an active role also as "detectors" and "disseminators" of data and information (Papa et al., 2016). In this direction, the contribution of this review note illustrates on the one hand current technologies such as Geospatial Artificial Intelligence (GeoAI): to achieve the objectives of smart cities and on the other to outline within the sheets, instead, the European actions on smart cities and artificial intelligence to have a cognitive and operational framework on the topic.

2 Geospatial Artificial Intelligence (GeoAI)

Over the past decade, rapid advances in geospatial technologies, information, and communications technologies (ICT) and computational power as well as the exponential growth of urban big data is now a fertile field of collaboration between urban planning, cities intelligent and GeoScience (Lazzeretti et al., 2023). In recent years, the growing presence of big data has been due to notable advances in Earth observation (EO), wireless sensor networks (WSN), Internet and communications technologies (ICT), social media platforms and in wireless technologies that have allowed the creation of enormous volumes of unstructured data at different spatial, temporal and social scales (Batty, 2013). Big Data complements traditional, authoritative types of information, such as remote sensing imagery census data, that have historically been used to simulate, plan, design, and manage cities. The high number of Big Data as well as recent developments in computational algorithms, such as Artificial Intelligence (AI) have led to the rebirth of this scientific field in the recent period (Razavi, 2021; Zhu, 2020). Artificial intelligence has also entered the field of spatial analysis known as Geospatial Artificial Intelligence (GeoAI), opening yet another field in quantitative research. Above all, the potential in the field of territorial planning allows us to better analyse, visualize, manage, and simulate the ways in which users use, experience, perceive and navigate urban spaces; strengthen collaboration and public engagement efforts in the planning, design and management of cities; better inform land use, transportation and environmental policies (Mahmood, 2022). GeoAI is based on two methodological approaches to planning: the top-down approach, based on knowledge, and the bottom-up approach, based on data. The second relies on Machine Learning (ML) techniques and has become the conventional methodology in GeoAI thanks to its ability to define future smart city scenarios as precise as possible (Li & Hsu, 2022). In the field of machine learning, deep learning models, such as Convolutional Neural Networks (CNNs), have gained popularity due to their robust feature extraction and precise projection capabilities. GeoAI could use a whole series of methodological and technical tools that science and geographic information systems have to offer. Over the last few years, GIScience applications, developed in the management of different territorial contexts towards smart cities, combine GIS with the use of statistical techniques, their real and functional integration has allowed us to support the design and evaluation of decision-making alternatives, giving rise to a whole series of tools called Spatial Decision Support Systems (SDSS) or Planning Support Systems (PSS) (Gordon et al., 2021; Thomas, 2002). Spatial Decision Support Systems have been deployed to address short-term spatial problems, while Planning Support Systems (PSS) have been developed as platforms aimed at addressing long-term strategic planning tasks. Spatial Decision Support Systems (SDSS), over the years, have faced challenges related to planning based largely on spatial optimization methodologies and GIS-based spatial multi-criteria solutions (Gaglione & Etigo, 2022). Spatial optimization uses mathematical programming optimization techniques to structure and find solutions to problems where the spatial arrangement (model) is crucial. Instead, multi-criteria decision support systems combine spatial and non-spatial data with subjective and objective elements for measurement and visualization in a GIS environment in an interactive system to assist decision makers in effectively and efficiently evaluating spatial alternatives.
In letteratura scientifica ci sono diversi esempi significativi relativi alla smart city. The study carried out by Melkonyan et al., (2022) developed a decision support tool in the context of urban mobility policies based on a Multi-Criteria Decision Aid (MCDA) for the definition of resource allocations at the micro, meso level and

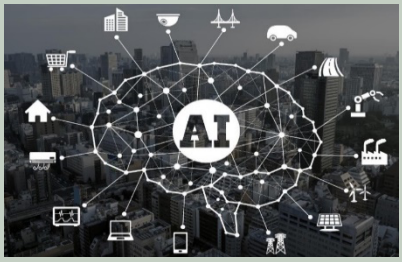
macros. In this way, a series of future urban scenarios useful for the definition of smart and sustainable cities are adequately addressed. The goal of the tool is to help transport administrators improve the efficiency of transport provision while improving environmental and energy indicators (Cottrill & Derrible, 2015). Instead, Moghadam & Lombardi's (2019) study developed an MC-SDSS tool derived from a GIS-based scenario planning and visualization tool through an extension of ArcGIS, to help stakeholders develop a planning strategy. urban energy planning improves the energy performance of residential building stock, reduce carbon emissions and achieve long-term sustainability objectives. The study by Huang et al. (2022) built a CloudIEPS, an energy internet planning platform based on digital twin, is introduced, which further proves the important role of digital twin technology through energy internet planning cases. This change inevitably increases the level of complexity of the decision space in optimization models, requiring a different question of structure formulation, as well as traditional solution techniques used for various planning tasks. In turn, GeoAI today offers great opportunities to SDSS methods by allowing quantitative research to gradually move from the use of small datasets to the use of large data sources, such as smartphones, smart card transactions and IoT allowing it to be able to address simultaneously and contextually multiple geospatial problems that afflict smart cities. Indeed, the complexity of smart city problems requires a cross-approach that not only integrates both inductive and deductive methodologies, but also informs and is informed by theory (Papa et al., 2015). Considering these considerations, in many territorial contexts numerous institutional and organizational obstacles still emerge which explain the limited usability of these tools. The use of technologically advanced techniques requires high knowledge and skills which are not well consolidated within territorial planning. The major critical issues that arise today are the lack of technical-scientific support from the academic world as well as scholars to support urban planning and the objectives of the smart city. Artificial Intelligence (GeoAI) can be a valid aid in the smart cities of the twenty-first century by acting as that connecting element between urban planning and the scientific domains of Big Data, geographic information science and systems and data science known as field geospatial (Liu & Biljecki, 2022; Gao, 2021). GeoAI can address both technical-instrumental problems and sociopolitical and regulatory issues that accompany the discipline of urban planning and that the present and future city must face, thus laying the foundations for improving the efficiency of urban services and functions; improve the quality of life of all citizens, especially for the most vulnerable groups of the population and contribute to the production of spatial data and information. Many academics have made tremendous efforts over the years to bridge the historical gap within the planning discipline between planning based on urban design and policy-based urban planning with the goal of wanting to reconcile these different fields. GeoAI can be a first step towards collaboration between academics in the field, designers and scholars of other disciplines.

Smart cities and communities

Over the years, the European Union has played a leading role on the topic of smart cities. Europe's goal has been to integrate physical, digital and human systems into traditional networks and services to better use energy resources and reduce emissions for the benefit of citizens and businesses. Cities are the main drivers of the EU economy, opening effective pathways to economic growth and jobs. Several EU policies have been introduced to promote more sustainable, healthier, and competitive urban areas, while addressing climate challenges. The initiatives in which Europe is trying to place its investments move along four frontiers: (i) energy saving in cities; (ii) the smart cities market; (iii) Scalable cities; (iv) Horizon Europe mission on smart and climate-neutral cities. On the first point, Europe began working in 2008 through the Covenant of Mayors for Climate and Energy aimed at bringing together local and regional authorities to implement climate and energy objectives on their territory. Currently, the community includes nearly 11,000 signatories working to develop sustainable energy and climate action plans in a joint effort to keep global temperature rise below 1.5°C, reduce emissions of greenhouse gases by 55% until 2023. Given the numerous difficulties and critical issues presented in the different territorial contexts in May 2022, the Pact launched the Cities Energy Savings Sprint Covenant to accelerate energy savings within the REPowerEU plan. Europa has developed the Cities Energy Saving

Toolkit, which provides cities with quick and easy measures they can take in an emergency to prepare for the coming winter. To make these initiatives practical in the short term, the toolkit includes City Reports: testimonials from cities that have already adopted these types of measures, sorted by sectors: (i) transport; (ii) lighting; (iii) heating and cooling; (iv) involve citizens and local stakeholders. On the second point regarding the smart city market, it aims to serve as a hub for crucial practical knowledge, capacity building support and finance facilitation. The hub operates in areas such as sustainable urban mobility, districts and the built environment, attention to the citizen and integrated infrastructures and processes in the field of energy, information and communication technologies and transport. Through the "Explore-Shape-Deal" process, 130 projects were developed with financing opportunities for over 615 million euros. The Smart Cities Market is home to the group of 120 scalable cities, participating in 18 Smart Cities and Communities flagship projects, funded by Horizon 2020 with around €420 million. Regarding the scalable cities, they are divided into 48 lighthouse cities and 72 "fellow" cities. The lighthouse cities experiment and implement the most advanced and innovative solutions, while the fellow cities follow the lead of the former, committing themselves to replicating already widespread solutions. Finally, the proposed mission "100 climate-neutral cities by 2030" aims to promote system innovation along the urban investment value chain, focusing on multiple sectors such as governance, transport, energy, construction, and recycling. With the help of digital technologies, the mission aims to ensure that participating cities serve as innovation hubs that enable all European cities to follow suit by 2050. The mission funds a budget of EUR 70 million in about user-centric shared zero-emission mobility in urban areas and positive clean energy district (PED) digital twin. The mission also offers networking opportunities, enables the exchange of good practices between cities and supports citizen participation. These initiatives have certainly strongly promoted the creation of operations on a local scale, understanding after a long time that to achieve great results you must start from the bottom. At the same time, the disadvantages of smart city strategies at the local level have been significant for small and medium-sized cities that compete for resources with larger, better-equipped cities; therefore, they are less likely to be able to receive or afford the funding needed for smart city projects. In turn, in most territorial contexts the existing infrastructure may be old and antiquated, hindering the realization of the vision of smart cities just as pilot projects in this field and small-scale developments do not necessarily guarantee effective adoption at a global level citizen. Within the spectrum of "local strategy" there are different opinions. Some argue that strategic regional planning could be a useful tool for smart cities because it would allow higher-level policies to be harmonized and coordinated with low-level ones, but at the same time, small-scale smart city pilot programs enable the achievement of achievable in the short term and provide a platform to evaluate the feasibility of specific city solutions and services.

Plan on Artificial Intelligence



While on the one hand, European smart city initiatives are trying to develop strategies and measures to improve urban contexts with the use and support of technologies. At the European level, as part of the European Strategy for Artificial Intelligence, the European Commission published on 21 April the proposal for a regulation on the European approach to Artificial Intelligence [COM (2021) 206 final], which proposes the first framework European legal framework on AI. The proposal assesses the risks of Artificial Intelligence, with the aim of safeguarding the values and fundamental rights of the EU and the safety of users; to this end, a new coordinated plan on Artificial Intelligence 2021 [COM (2021) 205 final] is also envisaged, which simultaneously strengthens the adoption of AI and investment and innovation in the sector across the EU. The plan encouraged Member States to develop national strategies. Turning strategy into action, the Coordinated Plan on Artificial Intelligence developed in 2021 envisages, first, accelerating investment in AI technologies to promote a resilient economic and social recovery aided by the adoption of new digital solutions; second, act on AI strategies and programs by implementing them in a comprehensive and timely manner to ensure that the EU fully benefits from the benefits of first-mover adoption; third, align AI policy to remove fragmentation and address global challenges. To this end, the updated plan establishes four key sets of strategic objectives, supported by concrete actions also indicating the possible financing mechanism. In particular, the first strategic objective involves establishing the enabling conditions for the development and diffusion of AI in the EU; through capturing, sharing and sharing strategic information, harnessing the potential of data and advancing critical IT infrastructure. The second strategic objective is to make the EU the place where excellence thrives from lab to market to bring innovations from lab to market. Testing and testing facilities (TEFs), European Digital Innovation Hubs (EDIHs) and the European "AI-on-demand" platform will play a key role in facilitating widespread deployment and deployment of AI technologies. The third strategic goal is to ensure that AI works for people and is a force for good in society. This third line focuses primarily on nurturing talent and improving the supply of skills needed to enable a thriving AI ecosystem, in turn, developing the policy framework to ensure trust in AI systems and ultimately promoting the vision of EU on sustainable and trustworthy AI in the world. The objective framework, on the other hand, aims to build strategic leadership in high-impact sectors to strengthen the EU's position on a global scale. The review proposes joint actions in seven sectors. These sectors are environment, health, a strategy for robotics in the world of AI, public sector, transport, law enforcement, migration and asylum, and agriculture. In turn, Europe has allocated 1 billion euros per year to AI through the Digital Europe and Horizon Europe programs. Furthermore, the European Union Commission has published

the long-awaited proposal for the regulation of artificial intelligence. The proposal sets out a comprehensive regulatory framework that bans certain uses of AI, heavily regulates high-risk uses, and lightly regulates less risky AI systems. At present the strategy has been developed by 19 out of 27 countries, which have adopted specific national strategies. The remaining national strategies are ongoing and expected to be published shortly. The prospects of intelligent urban technologies will therefore be able to allow from the expansion of infrastructure capacity to the generation of new services, as well as the reduction of emissions to public involvement, from the minimization of human errors to the improvement of decision-making and from the support of sustainable development to the improvement the performance of commercial enterprises and cities. In turn, artificial intelligence, with its technology, algorithms and learning capabilities, can be a useful vehicle for automating decision-making and problem-solving processes; which in return could reform urban transformations and support the development of smarter cities.

References

Abadía, J. J. P., Walther, C., Osman, A. & Smarsly, K. (2022). A systematic survey of Internet of Things frameworks for smart city applications. *Sustainable Cities and Society*, *83*, 103949. https://doi.org/10.1016/j.scs.2022.103949

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

Batty, M. (2013). Big data, smart cities and city planning. *Dialogues in human geography*, *3*(3), 274-279. https://doi.org/10.1177/2043820613513390

Batty, M., Axhausen, K.W., Giannotti, F., Pozdnov, A., Bazzani, A., Wachowiez, M., Ouzounis. and Portugali, Y. (2012), "Smart cities of the future", The European Physical Journal Special Topics, Vol. 214 No. 1, pp. 476-481. https://doi.org/10.1140/epjst/e2012-01703-3

Caragliu, A., Del Bo, C. & Nijkamp, P. (2013). Smart cities in Europe. In *Creating Smart-er Cities* (pp. 65-82). Routledge.

Cottrill, C. D. & Derrible, S. (2015). Leveraging big data for the development of transport sustainability indicators. *Journal of Urban Technology*, *22*(1), 45-64. https://doi.org/10.1080/10630732.2014.942094

COM/2018/795 final.Communication from the commission to the european parliament, the european council, the council, the european economic and social committee and the committee of the regions coordinated plan on artificial intelligence. Retrivied from: https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A52018DC0795

COM/2021/206 final. Proposal for a regulation of the european parliament and of the council laying down harmonised rules on artificial intelligence (artificial intelligence act) and amending certain union legislative acts. Retrivied from: https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:52021PC0206

Deren, L., Wenbo, Y. & Zhenfeng, S. (2021). Smart city based on digital twins. *Computational Urban Science*, *1*, 1-11. https://doi.org/10.1007/s43762-021-00005-y

Gaglione, F. & Etigo, D. A. A. (2022). Accelerate urban sustainability through European action, optimization models and decision support tools for energy planning. *TeMA-Journal of Land Use, Mobility and Environment*, *15*(2), 325-334. https://doi.org/10.6093/1970-9870/9240

Gao, S. (2021). *Geospatial artificial intelligence (GeoAI)*. New York: Oxford University Press.

Gargiulo C. & Papa R. (2021). Chaos and chaos: the city as a complex phenomenon. *TeMA - Journal of Land Use, Mobility and Environment*, *14* (2), 261-270. https://doi.org/10.6093/1970-9870/8273

Gibson, D. V., Kozmetsky, G. & Smilor, R. W. (Eds.). (1992). *The technopolis phenomenon: Smart cities, fast systems, global networks*. Rowman & Littlefield. Publishers, Inc: Lanham, MD, USA, 1992.

Giffinger, R., Fertner, C., Kramar, H., Kalasek, R., Pichler-Milanovic, N. & Meijers, E. J. (2007). Smart cities. Ranking of European medium-sized cities. Final Report. https://doi.org/10.34726/3565

Gordon, S. N., Murphy, P. J., Gallo, J. A., Huber, P., Hollander, A., Edwards, A. & Jankowski, P. (2021). People, projects, organizations, and products: Designing a knowledge graph to support multi-stakeholder environmental planning and design. *ISPRS International Journal of Geo-Information*, *10*(12), 823. https://doi.org/10.3390/ijgi10120823

Huang, W., Zhang, Y. & Zeng, W. (2022). Development and application of digital twin technology for integrated regional energy systems in smart cities. *Sustainable Computing: Informatics and Systems*, *36*, 100781. https://doi.org/10.1016/j.suscom.2022.100781

Kitchin, R. (2015). Making sense of smart cities: addressing present shortcomings. *Cambridge journal of regions, economy and society*, *8*(1), 131-136. https://doi.org/10.1093/cjres/rsu027

Lazzeretti, L., Innocenti, N., Nannelli, M. & Oliva, S. (2023). The emergence of artificial intelligence in the regional sciences: a literature review. *European Planning Studies*, *31*(7), 1304-1324. https://doi.org/10.1080/09654313.2022.2101880

Letaifa, S. B. (2015). How to strategize smart cities: Revealing the SMART model. *Journal of business research*, *68* (7), 1414-1419. https://doi.org/10.1016/j.jbusres.2015.01.024

Li, W. & Hsu, C. Y. (2022). GeoAI for large-scale image analysis and machine vision: Recent progress of artificial intelligence in geography. *ISPRS International Journal of Geo-Information*, *11*(7), 385. https://doi.org/10.3390/ijgi11070385

Li, W., Batty, M. & Goodchild, M. F. (2020). Real-time GIS for smart cities. *International Journal of Geographical Information Science, 34* (2), 311–324. https://doi.org/10.1080/13658816.2019.1673397

Liu, P. & Biljecki, F. (2022). A review of spatially-explicit GeoAI applications in Urban Geography. *International Journal of Applied Earth Observation and Geoinformation*, *112*, 102936.

Mahmood, H. (2022). Strategic foresight to applications of Geospatial Artificial Intelligence (GeoAI) to achieve disaster-related sustainable development goals. https://hdl.handle.net/20.500.12870/5172

Melkonyan, A., Gruchmann, T., Lohmar, F. & Bleischwitz, R. (2022). Decision support for sustainable urban mobility: A case study of the Rhine-Ruhr area. *Sustainable Cities and Society*, *80*, 103806. https://doi.org/10.1016/j.scs.2022.103806

Moghadam, S. T. & Lombardi, P. (2019). An interactive multi-criteria spatial decision support system for energy retrofitting of building stocks using CommuntiyVIZ to support urban energy planning. *Building and Environment*, *163*, 106233. https://doi.org/10.1016/j.buildenv.2019.106233

Orsetti, E., Tollin, N., Lehmann, M., Valderrama, V. A. & Morató, J. (2022). Building resilient cities: climate change and health interlinkages in the planning of public spaces. *International journal of environmental research and public health*, *19* (3), 1355. https://doi.org/10.3390/ijerph19031355

Papa, R., Galderisi, A., Majello, M. C. V. & Saretta, E. (2015). Smart and resilient cities. A systemic approach for developing cross-sectoral strategies in the face of climate change. *TeMA-Journal of Land Use, Mobility and Environment*, *8* (1), 19-49. https://doi.org/10.6092/1970-9870/2883

Papa, R., Gargiulo, C. & Battarra, R. (2016). *Città Metropolitane e Smart Governance: Iniziative di successo e nodi critici verso la Smart City* (Vol. 1). FedOA-Federico II University Press.

Ramaprasad, A., Sánchez-Ortiz, A. & Syn, T. (2017). A unified definition of a smart city. In *Electronic Government: 16th IFIP WG 8.5 International Conference, EGOV 2017, St. Petersburg, Russia, September 4-7, 2017, Proceedings 16* (pp. 13-24). Springer International Publishing.

Raspotnik, A., Grønning, R. & Herrmann, V. (2020). A tale of three cities: the concept of smart sustainable cities for the Arctic. *Polar Geography*, *43* (1), 64-87. https://doi.org/10.1080/1088937X.2020.1713546

Razavi, S. (2021). Deep learning explained: Fundamentals, explainability, and bridgeability to process-based modelling. *Environmental Modelling & Software*, *144*, 105159. https://doi.org/10.1016/j.envsoft.2021.105159

Thomas, M. R. (2002). A GIS-based decision support system for brownfield redevelopment. *Landscape and Urban Planning*, *58*(1), 7-23. https://doi.org/10.1016/S0169-2046(01)00229-8

Ullah, F., Qayyum, S., Thaheem, M. J., Al-Turjman, F. & Sepasgozar, S. M. (2021). Risk management in sustainable smart cities governance: A TOE framework. *Technological Forecasting and Social Change*, *167*, 120743. https://doi.org/10.1016/j.techfore.2021.120743

Zhu, H. (2020). Big data and artificial intelligence modeling for drug discovery. *Annual review of pharmacology and toxicology*, *60*, 573-589. https://doi.org/10.1146/annurev-pharmtox-010919-023324

Author's profile

Federica Gaglione

She is an engineer, PostDoc research fellow at Department of Engineering, University of Sannio, Benevento, Italy. She received her Ph.D. in Civil Systems Engineering at the University of Naples Federico II. The research topics addressed in recent years refer to accessibility to proximity services for vulnerable groups of the population. From August to December 2019, she served as a Visiting Researcher at the University of Aberdeen (UK) and from July to September 2022 Visiting Researcher at the University of Edinburgh (UK) carrying out research on urban accessibility in the context of climate change and sustainability, leveraging geographic big data through GIS and programming languages.