TeMA

**Journal of
Land Use, Mobility and Environment**

DOAJ   anvur Rivista scientifica di classe A - 08/F1   Scopus   WEB OF SCIENCE

2009

2025

NEW CHALLENGES FOR XXI CENTURY CITIES

Multilevel scientific approach to impacts of global warming on urban areas,
energy transition, optimisation of land use and emergency scenario

Vol.18 n.1
April 2025

TeMA Journal was established with the primary objective of fostering and strengthening the integration between urban transformation studies and those focused on mobility governance, in all their aspects, with a view to environmental sustainability. The three issues of the 2025 volume of TeMA Journal propose articles that deal with the effects of Global warming, reduction of energy consumption, immigration flows, optimization of land use, analysis and evaluation of civil protection plans in areas especially vulnerable to natural disasters and multilevel governance approach to adaptation.

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. The articles are included in main scientific database as Scopus (from 2023), Web of Science (from 2015) and the Directory of Open Access Journals (DOAJ). It is included in Sparc Europe Seal of Open Access Journals, and the Directory of Open Access Journals.

TeMA
Journal of
Land Use, Mobility and Environment

NEW CHALLENGES FOR XXI CENTURY CITIES:
Multilevel scientific approach to impacts of global warming on urban areas,
energy transition, optimisation of land use and emergency scenario

1 (2025)

The cover image shows a composition of two photos of the Temple of Serapis in Pozzuoli (Italy). Giuseppe Mazzeo took them in January 2009 and March 2025. At the top, the 2009 image shows the temple flooded, with the pavement not visible. In the down, the 2025 image shows the temple's pavement dry and exposed. The Temple of Serapis is one of the leading visual indicators of the bradyseism phenomenon in the Phlegraean Fields. The bradyseism phase, highlighted by comparison, started in the first years of this century, as shown by the data published by the National Institute of Geophysics and Volcanology (INGV) on the website dedicated to the phenomena (https://www.ov.ingv.it/index.php/il-bradisismo).

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. The articles published on TeMA are included in main international scientific database as Scopus (from 2023), Web of Science (from 2015) and the *Directory of Open Access Journals* (DOAJ). TeMA Journal has also received the *Sparc Europe Seal* for Open Access Journals released by *Scholarly Publishing and Academic Resources Coalition* (SPARC Europe). 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

NEW CHALLENGES FOR XXI CENTURY CITIES:
Multilevel scientific approach to impacts of global warming on urban areas, energy transition, optimisation of land use and emergency scenario

1 (2025)

Contents

REVIEW NOTES

TeMA

REVIEW NOTES
Urban strategies, programmes and tools

Digitalization in urban planning:
a framework to realize smart cities

Annunziata D'Amico

Department of Civil, Building and Environmental Engineering
University of Naples Federico II, Naples, Italy
e-mail: annunziata.damico@unina.it
ORCID: https://orcid.org/0009-0005-5481-8064

Abstract
Starting from the relationship between urban planning and mobility management, TeMA has gradually expanded the view of the covered topics, always remaining in the groove of rigorous scientific in-depth analysis. This section of the Journal, Review Notes, is the expression of continuously updating emerging topics concerning relationships between urban planning, mobility and environment, through a collection of short scientific papers written by young researchers. The Review Notes are made of four parts. Each section examines a specific aspect of the broader information storage within the main interests of TeMA Journal. In particular, the Urban strategies, programmers and tools section presents presents the different strategies and tools that guide the digitalization of urban planning.
The contribution explores how innovation is increasingly important in the current definition of urban planning processes. The policies and programs needed to support the transition towards smart cities, more efficient, sustainable and citizen-oriented, are outlined.
The analysis illustrates the key strategies and main programs implemented by the European Union and other International Organizations to promote the digital transformation of cities to make them "smart" and sustainable. Concrete examples are presented of cities that have successfully implemented these strategies, addressing challenges such as climate change and resource management, demonstrating how digitalization can create more liveable and resilient urban spaces.

Keywords
Smart cities; Sustainable; Urban strategies; Tecnologies; Digitalization.

1. Policy framework to support smart cities

Digital transformation has been a priority for the European Union (EU) in recent decades, starting with the adoption in 2010 of a ten-year *Digital Agenda for Europe*, which identified for the first time the key enabling role of ICTs (Information and Communications Technology) in achieving Europe's economic and social goals. In 2020, a second five-year digital strategy, *Shaping Europe's digital future*, was adopted, which recognises how profoundly digital technologies are changing our lives and sets three main objectives up to 2025:

– technology at the service of people;

– a fair and competitive economy;

– an open, democratic and sustainable society.

In complementarity with the support for the digital transformation of cities and communities, EU financial support, including through the *Digital Europe Programme*, has supported the development of smart city initiatives (EC, 2023).

In particular, over the last decade, there has been an acceleration of digitalization and technology-based applications, Europe has witnessed a significant surge in smart city initiatives, reflecting a growing emphasis on harnessing data and innovative technologies to improve decision-making and citizen well-being. "These smart services can help to better manage resources like energy or water, to monitor and reduce local traffic and pollution or in the work towards greener ways to light and heat buildings. They can also mean a more interactive and responsive city administration, engagement and participation of citizens in decision and policy-making, safer public spaces and meeting the needs of an ageing population and people with disabilities" (EC, 2024a).

A smart city is an entity that uses ICTs effectively, to integrate the requirements of its urban community, in terms of energy and other utilities (production, distribution and use), environmental protection, mobility and transport, services for citizens (healthcare, education, emergency services, etc.) and with proper regard for security, both of individuals and their personal data, and use it as a driver for economic and social improvements. This would also increase the deployment of smart technologies and solutions in rural communities, contributing to the development of businesses and creating conditions for making smart communities attractive to the population (Rolling Plan for ICT standardisation, 2024).

The urban environment directly affects the quality of life of citizens. For this reason, it is essential to combat negative factors, such as traffic and polluting emissions, in order to transform cities into more liveable and attractive places, and new technologies can help in this transformation process.

The implementation of data spaces and digital twins at the local level emerges as an innovative approach with great potential for the development of smart cities. However, while the benefits of smart city projects are significant, public administrations face several challenges in implementing and managing these processes of change.

The European Commission defines smart cities as "a place where traditional networks and services are made more efficient with the use of digital solutions for the benefit of its inhabitants and business" (EC, 2025), where even the city administration is more interactive and responsive, public spaces are safer and the needs of its inhabitants are better met.

The European Commission is supporting the digital transformation of cities and communities through the development of various tools and services as well as the setup of community-based governance. An example of exchange of good practices started in 2019 with the *Living.in.eu movement*, founded by a group of city networks and other city representative groups (such as Open and Agile Smart Cities (OASC), Eurocities and European Network of Living Labs (ENoLL) (EC, 2023). It is a city-led collaborative platform for cities and communities to accelerate their citizen-centred digital transformation. It enables cities and regions to work together on societal challenges using digital, open and interoperable solutions.

Another European support tool is the *European Digital Infrastructure Consortium* (EDIC) a legal and policy tool designed to help Member States accelerate and simplify the setup and implementation of large-scale, multinational IT projects. The tool, for example, enables simulation and visualization of projects of urban planners that address real world challenges such as air pollution, congestion, energy grid optimization, water and waste management.

Among the services promoted by the European Commission, there is also *The Smart Communities Network*, a EU-wide community of organisations representing cities and municipalities from all 27 EU Member States that can support local communities in their early stages of digital transformation.

It aims to improve their connectivity and operational efficiency in urban governance in an increasingly digital world. The purpose of the Smart Communities Network is to facilitate collaboration among organisations, associations, and initiatives throughout the EU, with a shared goal of enhancing digital capabilities within local public authorities.

From the merger of two platforms, the "Marketplace of the European Innovation Partnership on Smart Cities and Communities (EIP-SCC Marketplace)" and the "Smart Cities Information System (SCIS)", "The Smart Cities Marketplace" was born, which aims to bring together cities, industries, investors, banks, researchers and many other smart city actors, developing common goals aimed at improving the quality of life of citizens, increasing the competitiveness of European cities and industry and achieving European energy and climate objectives (EC, 2025). The initiative, supported by the European Commission, supports cities of all sizes in the development of sustainable projects by providing free information, technical assistance, advice and matchmaking funding.

The Technical Support Instrument (TSI) is the EU programme that provides tailor-made technical expertise to EU Member States to design and to implement reforms at the national level, with an emphasis on the green and digital transitions. The TSI also supports the preparation and implementation of Recovery and Resilience Plans or National Smart Cities Strategies. Initiated in 2021, the TSI is the successor of the Structural Reform Support Programme (SRSP). Since 2017, both programmes have helped design, develop and implement over 1800 reform projects in 27 Member States.

In the context of EU multilevel governance, the European Commission in 2021 published the *Proposal for a European Interoperability Framework for Smart Cities and Communities* (EIF4SCC, 2021) establishing that interoperability is a prerequisite for electronic communication and information exchange between different actors and therefore is a necessary condition to achieve and further develop Smart Cities and Communities in Europe.

In response to urban challenges and the consequences of climate change that require an immediate transformation of urban and territorial planning strategies, EU encourages new approaches to research and innovation. EU Missions are a novelty of the Horizon Europe research and innovation programme for the years 2021-2027. Among the 5 missions scheduled there is "100 Climate-Neutral and Smart Cities by 2030".

The Cities Mission will engage local authorities, citizens, businesses, investors, regional and national authorities to achieve 100 smart and climate-neutral cities by 2030. At the same time, the Cities Mission ensures that these cities serve as hubs of experimentation and innovation to enable all European cities to follow suit by 2050. In total, 100 EU cities and 12 cities from Horizon Europe associated countries have been selected to participate in the mission in April 2022 and are currently testing innovative cross-sectoral approaches (EC, 2024b).

In the global panorama, there are numerous international initiatives and programs launched that actively contribute to the promotion and diffusion of smart cities.

The Organisation for Economic Co-operation and Development (OECD) is an international organisation plays an important role in promoting smart cities through research, analysis and policy formulation. In 2019, the OECD launched the *Smart Cities and Inclusive Growth Programme* to assess and measure the performance of

smart cities and how they contribute to inclusive growth and well-being. The programme analyses the potential of artificial intelligence (AI) and machine learning (ML) technologies to increase the ability of smart cities to anticipate people's needs and improve urban planning and management.

The *United for Smart Sustainable Cities* (U4SSC) initiative is a global UN collaboration, coordinated by the International Telecommunication Union (ITU), the United Nations Economic Commission for Europe (UNECE) and the United Nations Human Settlement Programme (UN-Habitat) and supported by 16 other UN agencies and programmes, to help cities and communities become smarter and more sustainable.

U4SSC is currently working on several thematic groups including (but not limited to) city platforms, lessons learned from building urban economic resilience at city level during and after COVID-19, artificial intelligence in cities, enabling people-centred cities through digital transformation, digital wellbeing, etc., accelerate digital transformation in cities and achieve the Sustainable Development Goals (SDGs) (Rolling Plan for ICT standardisation, 2024).

An international event that supports innovation and digitalization for a "better urban world" is the *Smart City Expo World Congress.*

Held in Barcelona since 2011, the Smart City Expo World Congress is the world's largest and most influential event for cities and urban innovation.

Each year, it brings together leaders from global businesses, governments and organizations to lead cities towards a better future with the aim of collectivizing urban innovation and enabling cities to address the critical challenges they face today.

2. Examples of smart and digital cities

Cities represent the core of human development, crucial engines of innovation, culture, and economic growth. Still, the quickening pace of city growth presents substantial difficulties in ensuring equitable provision of public services and safeguarding the quality of life within our urban landscapes.

In recent years, there has been growing global attention and effort for urban development, especially for the smart and sustainable transformation of cities, using digital technologies and innovative approaches to address growing challenges such as climate change, resource scarcity and urbanization pressures. Every city plays a crucial role in facilitating knowledge exchange and driving innovation, developing solutions and transformation paths towards smart and sustainable urban spaces.

Digitalization in urban planning is transforming the way cities are conceived and managed. Using data and digital technologies, we move from static to dynamic and interactive planning. Tools such as Geographic Information Systems (GIS), 3D models and simulations allow us to analyze future scenarios, optimize land use and predict the impact of new infrastructure. AI analyzes large amounts of data to identify patterns and trends, supporting evidence-based decisions.

The Internet of Things (IoT) connects sensors and devices, monitoring traffic, pollution and energy consumption. Digital apps and platforms improve communication between citizens and administration, facilitating civic participation.

Digitalization is opening up new perspectives for urban transformation, enabling the creation of smarter, more sustainable and citizen-oriented cities. Many are the measures and tools adopted by cities around the world to promote digitalization in urban organization and planning processes, in line with the national and international political guidelines of each country.

Below are some examples of strategies and tools adopted by some cities, European and non-European, to address urban challenges and at the same time exploit new technologies to create smarter and more sustainable cities.

Dìenmark – *Digital Growth Strategy 2025*

In 2019, the Government of Denmark introduced a "*National Artificial Intelligence Strategy Plan*", which aims to promote the development and integration of AI in Danish cities. This initiative not only identifies current challenges and priority areas for action but also defines the necessary policy instruments. The main goals of this strategy are:
- developing a common ethical and human-centred basis for AI;
- prioritising and support research in AI;
- encouraging the growth of Danish businesses by developing and using AI;
- ensuring that the public sector uses AI to offer world-class services for the benefits of inhabitants and society.

Denmark has also adopted the "*Digital Growth Strategy 2025*", which is a joint vision of the Danish government, in collaboration with various industries and sectors, trade associations and social partners, thus contributing to the digital transformation processes at the national level (U4SSC, 2024a).

Denmark's capital and most populous metropolis, Copenhagen, with approximately 1.5 million inhabitants, is committed to improving the quality of life of its citizens. To this end, the city has adopted a smart city model focused on carbon neutrality, aiming to create a more liveable and environmentally friendly urban environment. The AI adoption in the city of Copenhagen is largely governed by the National Strategy for AI. One of the projects initiated by the city of Copenhagen, for example, helps reduce energy consumption in buildings and ensure carbon savings. The project uses the ability of artificial intelligence to predict heating and ventilation requirements to enable monitoring of energy consumption and management of the indoor climate of buildings.

Vienna (AUSTRIA) – *Smart City Vienna Framework Strategy 2019 – 2050*

In June 2014, the Vienna City Council adopted the "*Smart City Vienna Framework Strategy*", which sets a cornerstone for the future development of the city. The Framework Strategy was further updated in 2019, building on existing strategic orientations and goals, and presents a long-term vision of the future, outlining perspectives up to 2050.

The target areas of the strategy include the radical conservation of resources, the contribution to the quality of life and social inclusion and the focus on innovation and digitalisation as central levers for sustainable development. Furthermore, new topics such as adaptation and management of the consequences of climate change, circular economy and consumption-based use of materials have been integrated (Smart City Wien, 2019).

The framework strategy outlines possibilities for achieving the objectives, but deliberately avoids concrete packages of measures, thus allowing for flexible ways of achieving them.

The mission of Smart City Vienna is to ensure a high quality of life for all Viennese while conserving resources through far-reaching social and technical innovations. A total of seven key objectives have been defined:
- quality of life;
- social inclusion;
- reduction of per capita greenhouse gas emissions;
- reduction of local final energy consumption per capita;
- careful and efficient use of resources;
- innovative capacity;
- digitalization.

PORTUGAL – *Action Plan for Digital Transition*

In April 2020, Portugal approved its "Action Plan for Digital Transition", acting under three pillars:
- Capacity Building and digital inclusion of people;
- Digital transformation of businesses;
- Digitalisation of public administration.

The European Commission supported the Portuguese authorities aiming to define the National Smart Cities Strategy, to foster the development of smart cities that provide people-centred, inclusive, sustainable and interoperable services to citizens and businesses -throughout the national territory.

Thanks to the European Funding Programme TSI (Technical Support Instrument), the project will establish a framework and a governance model for the common good, enabling the acceleration of innovation, optimising associated public expenditure and improving decision-making (National Smart Cities Strategy Factsheet Portugal, 2022).

Wyndham (MELBOURNE) – *Smart City Strategy 2019-2024*

Located in the outer western suburbs of metropolitan Melbourne, Wyndham is a city that is maximising the benefits associated with the use of technology, data and innovation to undertake a purposeful and planned transformation into a "smart city".

Wyndham City has already demonstrated commitment to its Smart City vision through several strategic documents, embodied by the "*Wyndham 2040 Community Plan*". This Smart City Strategy outlines approaches and priorities to citizen issues and local challenges, including issues around transportation and congestion, the environment and more generally how the city functions and operates. The "Smart City Strategy 2019-2024" and "Smart City Implementation Plan" expand on this and highlights the prioritisation placed on the future of transport, environmental challenges and driving modern local services.

In consultation with the community, key stakeholders, elected officials and staff, six strategic themes, supported by priority actions, have been identified to guide the City's efforts to meet smart city needs (Transport, Environment and Sustainability, Data Driven, Partnership and Collaboration, Citizen-Centric).

In its journey to becoming a smart city, the city has embraced technology and innovation by implementing them in many innovative projects including the creation of "Smart Parking", the implementation of "Smart Sensors", or the creation of "Smart Co-working Hubs". The city is looking to the future and preparing to use innovation to solidify its transformation into a smart city, such as by placing "Smart Traffic Lights" to reduce congestion and regulate traffic flow in real time and in response to actual demand. The city also plans to pilot "Urban ('Living') Labs" to understand impacts, test policies, drive economic growth and achieve better outcomes for the city (Smart City Strategy 2019-2024).

The City of Wyndham's planning and delivery of projects also integrates the principle of "20-minute neighbourhoods" promoted by Plan Melbourne 2017-2050, aiming to connect people locally within 20 minutes of walking, cycling or public transport to key services.

Hong Kong (CHINA) – "*Smart City Blueprint*" plan

Hong Kong, a major global financial hub and a special administrative region of China, established a strategic plan in 2017, the "Smart City Blueprint for Hong Kong", to build Smart Mobility, Smart Living, Smart Environment, Smart People, Smart Government and Smart Economy.

Hong Kong has integrated AI as a key tool in its smart city strategy, using it to address critical issues such as climate change, population aging and urban management.

The initiatives launched aim to bring benefits and convenience to the public, so that residents can better experience the benefits of smart cities and innovation and technology (I&T) in their daily lives. For example, AI implementations installed in the city include sensor networks for energy monitoring and disaster preparedness. These facilities have also been used to improve the safety of seniors and provide continuous community connections. Additionally, the city is experimenting with robotic assistance and is using AI for more participatory governance and better traffic management (U4SSC, 2024b). Furthermore, to facilitate the healthy development and use of AI in Hong Kong, several government departments and independent organizations have formulated and launched guiding principles for AI. For example, The Office of the Privacy Commissioner for Personal Data (PCPD) has issued "The Guidance on Ethical Development and Use of AI" in August 2021. Another adoption of the city was "The Ethical AI Framework" providing guidance to IT planners, system analysts, system architects and data scientists to understand the ethical principles and practices of AI.

3. Conclusion

In recent decades, cities have been trying to respond and combat growing urban governance challenges, including but not limited to economic inclusiveness, increasing resource consumption, environmental deterioration, seamless and convenient mobility, increasing housing needs, new physical infrastructure, and city resilience.

In this context, digitalization and the use of AI represent frontier technologies that can be leveraged in decision-making processes to help address the various urban challenges that cities around the world experience. These technologies, leveraging advanced algorithms and citizen data analysis, enable the automation of decision-making processes at a speed and scale previously unimaginable.

Anyway, to build smart cities, it is not possible to simply implement new technologies, as has often happened in the past, but it is necessary to build a regulatory framework that takes into account the pre-existing technological context in the territory and in society.

City management, planning and the creation of liveable communities are at the threshold of a new age led by the adoption of new technologies and the use of advanced data analytics to improve operations, decision making and services. However, like all new technologies, they bring risks and pitfalls, which is why the successful implementation of AI must ensure parallel efforts and compliance with certain principles, for example, in terms of compliance with laws and regulations, or full compliance with the regulatory framework on data privacy in force at national or supranational level, or the guarantee of better security, explainability and transparency of the mechanisms. Only in this way can planning be done effectively, ensuring reliability and trust.

Comprehensive digitalization permeates all areas of life. This raises many new questions, such as the transparent and careful handling of large amounts of data, the ethical and moral limits of using digital achievements such as artificial intelligence, and the distribution of opportunities and benefits of new technologies. Nevertheless, it is essential to highlight how digital technologies offer new tools to find innovative solutions to many future urban problems, create new opportunities for participation, or simply make life more pleasant.

City administrators have a wide range of tools at their disposal to encourage and incentivize the implementation of digitalization in urban planning processes. Knowledge exchange at local, regional and international levels will help to further develop these new technologies to create more competitive, resilient and smart cities.

References

EC (2023). D06.02 In-depth report of organisational and cultural interoperability issues and practices in place within public administrations related to the four use cases. Retrieved from: https://interoperable-europe.ec.europa.eu/sites/default/files/inline-files/In-depth%20report%20on%20organisational%20and%20cultural%20interoperability%20issues%20and%20practices%20in%20place%20within%20public%20administrations_vFINAL.pdf

EC (2024a). *Smart Cities and Communities.* Retrieved from: https://digital-strategy.ec.europa.eu/en/ policies/smart-cities-and-communities

EC (2024b). *EU missions – 100 climate-neutral and smart cities.* European Commission: Directorate-General for Research and Innovation. Publications Office of the European Union. https://data.europa.eu/doi/10.2777/85010

EC (2025). *Smart cities.* Retrieved from: https://commission.europa.eu/eu-regional-and-urban-development/topics/cities-and-urban-development/city-initiatives/smart-cities_en

EIF4SCC (2021). Proposal for a European Interoperability Framework for Smart Cities and Communities. Publications Office of the European Union. https://data.europa.eu/doi/10.2799/816559

National Smart Cities Strategy Factsheet Portugal (2022). *National Smart Cities Strategy*. Retrieved from: https://reform-support.ec.europa.eu/publications-0/national-smart-cities-strategy-factsheet-portugal_en

Rolling Plan for ICT standardisation (2024). *Smart and sustainable cities and communities (RP2024).* Retrieved from: https://interoperable-europe.ec.europa.eu/collection/rolling-plan-ict-standardisation/smart-and-sustainable-cities-and-communities-rp2024

Smart City Wien (2019). *Smart City Wien Rahmenstrategie 2019–2050. Die Wiener Strategie für eine nachhaltige Entwicklung.* ISBN 978-3-903003-52-1 Retrieved from: https://smartcity.wien.gv.at/wp-content/uploads/sites/ 3/2019/10/Smart-City-Wien-Rahmenstrategie-2019-2050.pdf

U4SSC (2024a). *Copenhagen, Denmark. Case study of the U4SSC Guiding principles for artificial intelligence in cities.* ISBN 978-92-61-38131-8 Retrieved from: https://u4ssc.itu.int/publications/

U4SSC (2024b). *Hong Kong, China. Case study of the U4SSC Guiding principles for artificial intelligence in cities.* ISBN 978-92-61-38111-0 Retrieved from: https://u4ssc.itu.int/publications/

Author's profile

Annunziata D'Amico

She is an engineer, Ph.D. student in Civil Systems Engineering at Department of Civil, Building and Environmental Engineering of University of Naples Federico II. Currently, her Ph.D. research concerns the topic of MaaS and soft mobility in urban systems for children, to encourage walkability and more sustainable and active mobility.

Author's profile