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Editorial: Data analytics in sustainable city planning

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Editorial on the Research Topic

Data analytics in sustainable city planning

Cities across the globe are facing unprecedented challenges that are reshaping them in terms of planning and governance. Population growth, climate change, and socio-economic inequalities are placing immense pressure on urban systems and applications that call for a transition toward more sustainable, inclusive, and resilient urban development. Central to this transformation is the application of advanced data analytics, which illuminates hidden patterns, forecasts future risks, and supports evidence-based decision-making across the full spectrum of urban governance.

The Data Analytics in Sustainable City Planning Research Topic brings together pioneering research to explore *how data-driven tools and methods support the design and management of cities* that are not only efficient, but also equitable and adaptable. This Research Topic reflects a broadening of scope in *how cities utilize data from single-purpose monitoring tools to integrated systemic platforms*. One of the most significant advancements is in the area of urban modeling where remote sensing, Geographic Information Systems (GIS), and 3D visualization technologies are being used to model and simulate complex environmental processes. For example, models that study heat in cities help design better green spaces to cool neighborhoods and support long-term environmental sustainability.

Predictive analytics play an increasingly central role in sustainable city planning. By applying machine learning algorithms to large-scale and multi-source datasets, cities are able to forecast dynamic phenomena such as traffic congestion, crime incidents, and flood risk. These anticipatory insights are crucial for proactive urban management, allowing for early interventions and resource optimization. Alongside this, the emergence of Digital Twins marks a shift from reactive to real-time urban governance. As a result, cities such as Singapore, Los Angeles, and Amsterdam improve these models to manage infrastructure across sectors including transportation, water supply, energy distribution, and public space usage. These digital ecosystems enable planners to test policy scenarios, monitor service performance, and respond adaptively to changing conditions.

The integration of socio-demographic data into geospatial models enables researchers to identify and analyse disparities in urban vulnerability. For instance, spatial mapping of heat exposure in Indian cities such as Delhi and Bengaluru has informed the more equitable allocation of cooling infrastructure. These equity-oriented approaches ensure that sustainability initiatives are not only technically robust but also socially inclusive. Indeed, they support policymakers in targeting resources toward the most vulnerable populations and thereby addressing persistent inequalities in urban service delivery.

The role of participatory digital platforms is a critical dimension of the sustainable planning discourse. Cities are increasingly turning to the use of GIS tools and e-planning applications to facilitate community involvement in the urban design process. These tools democratize access to data and decision-making and enable citizens to co-create solutions for their neighborhoods. Such participation enhances the legitimacy and responsiveness of urban policy especially in contexts where historically marginalized groups have been excluded from formal planning mechanisms. Yet, these advances underscore the growing urgency of ethical data governance. As cities collect and analyse vast amounts of personal and behavioral data, questions of privacy, consent, and accountability become ever more noticeable. Past missteps, such as the lack of transparency in data-sharing partnerships in cities like Portland and Toronto, highlight the need for inclusive governance frameworks that safeguard public trust!

One of the key contributions to this Research Topic comes from a comparative study of enduring smart city data platforms with a focus on the UK's Urban Observatories and the US Smart Columbus Operating System (Wolf et al.). The paper highlights the importance of long-term institutional commitment, interoperability, and public value in building resilient data infrastructures for urban management. Drawing from these two mature initiatives, the authors underscore the need for flexible data governance frameworks, sustained funding, and active community engagement to ensure data platforms not only serve immediate operational needs but evolve into lasting public assets. These lessons offer a strategic framework for future cities seeking to integrate data analytics into sustainable and inclusive urban development.

In a complementary context, Hansen et al. analyse the evolution of Smart City initiatives in Thailand, highlighting the role of data in driving innovation, responsiveness, and inclusivity. Using platforms like Traffy Fondue (an application that enables citizens to report local issues in real time), the study shows how integrating environmental sensors, citizen feedback, and digital governance tools significantly improve municipal performance. Notably, the research underscores that these digital infrastructures also foster participatory governance by embedding residents more directly in decision-making processes. As Thailand's urban centers expand, these insights offer a replicable model for other emerging economies seeking to build data-literate and community-centered smart cities.

Xia et al. provide a comprehensive review of the relationship between urban renewal and sustainable public space development by highlighting key trends, obstacles, and future directions. It discusses how modern urban renewal increasingly incorporates sustainability through green infrastructure, adaptive reuse, and community-centric design, aiming to enhance liveability while preserving cultural heritage. Besides, this study emphasizes the need for inclusive planning approaches that prioritize long-term ecological and social benefits, and offers insights into how cities can transform public spaces to foster resilience, equity, and environmental health in urban environments.

In a more technical contribution, Xing et al. introduce a novel approach for assessing the physical disorder of

architectural façades using deep learning and space syntax analysis. By processing street-level imagery through neural networks and evaluating spatial accessibility using syntactic metrics, the authors develop a multiscale index that can detect deterioration at the building, street, and city levels. This index enables urban planners to identify and prioritize areas in need of intervention, facilitating data-informed renewal strategies that enhance walkability and public perception. The study exemplifies how cutting-edge technologies are able to generate actionable insights for maintaining the integrity of urban environments.

Taken collectively, this Research Topic signals several critical directions for the future of data-informed urban planning. A notable trend is the convergence of once-siloed smart city applications into comprehensive, multi-domain Digital Twins, made possible by advances in AI, IoT, and platform interoperability. There is also a growing shift toward equity-centered analytics which embed socio-economic and demographic data into planning tools to ensure fair distribution of urban resources. At the same time, the expansion of urban data systems brings ethical considerations to the forefront for transparent and community-centered data governance. Finally, the success of these initiatives depends not only on technological capacity but on human potential. This means, cities must invest in training professionals who possess both analytical expertise and an understanding of civic values.

As urban systems grow in complexity and interdependence, this Research Topic reinforces the idea that data analytics, if guided by principles of ethics, inclusion, and accountability, has the capacity to serve as a transformative lever for sustainable city-making. We encourage researchers, city leaders, policymakers, and technologists to build upon these findings by advancing the real-world implementation of predictive models, exploring the use of generative AI in urban simulation, embedding participatory planning practices into formal governance structures, and institutionalizing frameworks that uphold data transparency and public trust.

In sum, while cutting-edge technologies are vital in addressing the complex challenges of 21st-century urban life, they are only part of the equation. The true sustainability of future cities will be shaped not just by the brilliance of their innovations, but by the boldness of their vision, the inclusivity of their planning, and the resilience of their communities. Data and analytics offer us the tools—but it is our shared values, ethical leadership, and collective commitment that will determine whether our cities become thriving hubs of opportunity for all, or mirrors of deepening inequality. The future is not something we inherit—it's something we build, together.

Author contributions

SP: Writing – original draft, Writing – review & editing. GK: Writing – review & editing, Writing – original draft. MA-k: Writing – original draft, Writing – review & editing. MY: Writing – original draft, Writing – review & editing.

Conflict of interest

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