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Digital Metropolis

WORKING PAPER

Projects for Metropolitan Digital Transition

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Barcelona Supercomputing Center
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DIGITAL METROPOLIS - WORKING PAPER: Projects for Metropolitan Digital Transition.

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Table of contents

1. Introduction

Digital transition has become a strategic axis to address contemporary challenges in metropolitan areas, ranging from institutional fragmentation to socio-spatial inequality and climate vulnerability. This guide offers a framework for identifying projects that accelerate this transition from a systemic perspective, focused on generating public value. Its purpose is to strengthen local capacities to design, prioritize, and implement digital initiatives with transformative impact, integrating technological innovation, social inclusion, and territorial sustainability.

More than a mere adoption of technologies, digitalization entails a redesign of metropolitan governance by promoting data-driven, transparent, collaborative, and people-centered management. This guide builds on the collective analysis of international experiences and is framed within global commitments that promote ethical and context-sensitive digitalization.

1.1. Context of transformation

Digitalization is reshaping how territories are understood and governed. In metropolitan environments marked by functional complexity, territorial diversity, and multiscalar interdependence, digital tools offer a unique opportunity to transform planning, management, and civic engagement models. From interoperable platforms and urban sensors to artificial intelligence and open data, emerging technologies enable problem anticipation, actor coordination, and service personalization.

However, this transformation is not neutral. It requires robust institutional capacities, enabling regulatory frameworks, and a strategic vision that aligns digital innovation with social cohesion, institutional efficiency, and urban sustainability.

1.2. Alignment with Global Agendas

Innovation and digital transition projects in metropolitan areas must be guided by the main multilateral agendas:

- **2030 Agenda and the Sustainable Development Goals (SDGs)**: Digitalization contributes transversally to several goals, with particular relevance to SDG 11 (inclusive, safe and resilient cities), SDG 9 (infrastructure and innovation), and SDG 16 (effective and accountable institutions).

- **Pact for the Future (UN, 2024)**: Emphasizes the need to leverage technology as a global public good, ensuring equity, inclusion, and digital rights in a context of multiple global crises.

Global Digital Compact (UN, 2024): Acknowledges that the accelerated development of technology presents both opportunities for sustainable development and critical risks regarding privacy, algorithmic governance, and concentration of power, requiring international cooperation and ethical regulation.

1.3. Guiding Principles

Metropolitan innovation and digital transition projects must be guided by the following strategic principles:

- **Public value as a measure of success:** Technologies must deliver tangible benefits to citizens, improve quality of life, and strengthen institutional trust.
- **Multilevel and polycentric governance:** Digital transition requires coordination across levels of government, sectors, and territories, recognizing the functional interdependence of metropolitan areas.
- **Digital territorialization:** Technological solutions must adapt to the local context—its capacities, gaps, and aspirations—avoiding generic or centralized approaches.

2. Strategic Objectives

Projects for metropolitan innovation and digital transition must be guided by strategic objectives that ensure territorial relevance, transformative capacity, and alignment with public value. These objectives provide a framework to structure technological interventions that address real challenges, strengthen metropolitan governance capacities, and reduce structural inequalities through an integrated and adaptive digital governance approach.

2.1. Address structural metropolitan challenges through digital solutions

Every project should connect technology to key metropolitan challenges such as fragmented mobility, housing deficits, inefficient waste management, uncoordinated spatial planning, or climate risks. To ensure maximum impact, these technological interventions must be grounded in well-defined, precise problem statements and clear objectives. This will ensure that solutions are targeted, measurable, and aligned with real urban needs. Digital solutions must be designed as instruments for improving urban conditions, not as ends in themselves. Technologies such as artificial intelligence, digital twins, and geospatial analytics should be leveraged to produce robust evidence, anticipate scenarios, and enhance the quality of public decision-making.

2.2. Strengthen adaptive and collaborative governance structures

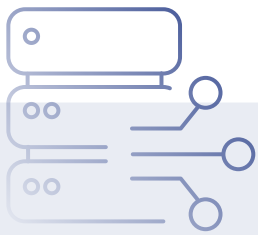
Project design and implementation must incorporate flexible governance frameworks that can respond to rapidly evolving technological landscapes. Institutional arrangements should promote coordination among governmental levels, private sector actors, academia, and civil society. Metropolitan digital projects are cross-sectoral by nature, involving diverse experts across urban governance. Their deployment requires clearly defined roles, decisional power, and dependencies, supported by iterative dialogue among all stakeholders. Political interoperability and multilevel governance are essential to support co-created initiatives with democratic legitimacy, technological transparency, and robust accountability mechanisms.

2.3. Promote digital equity and technological inclusion across the metropolitan territory

Projects must be developed with a territorial justice approach that actively reduces digital divides between and within metropolitan municipalities. This includes prioritizing investment in areas with low connectivity, limited access to devices, or insufficient digital literacy. Initiatives should incorporate public digital infrastructure, inclusive training programs, and targeted strategies for historically excluded populations, ensuring a fair and universal digital transition.

2.4. Develop data infrastructure and interoperable systems

Projects must incorporate the development of secure, open, and technically interoperable data infrastructure as a key enabler. Shared platforms across municipalities and sectors, adoption of data quality and management standards, and regulatory frameworks that ensure ethical use, privacy, and digital sovereignty are essential. Metropolitan digital observatories and predictive analytics systems should become structural tools for evidence-based decision-making.



3. Data, Infrastructure, and Capacity Considerations

Metropolitan innovation and digital transition projects require a solid technical and organizational foundation from the early design phase. The effectiveness, scalability, and sustainability of these initiatives depend on three interdependent pillars: reliable data systems, robust technological infrastructure, and institutional capacities aligned with the digital transformation agenda. These elements must be integrated throughout the project lifecycle, from planning to implementation and evaluation.

3.1. Data

Data is the critical asset underpinning intelligent, anticipatory, and equitable metropolitan governance. Every project must ensure:

Open, secure, and ethical standards: The adoption of interoperable formats and ethical data governance principles enables cross-system data reuse, operational coherence, and information integrity across jurisdictions.

Legal frameworks for personal data protection: Clear regulations must govern the collection, storage, and processing of sensitive information, particularly when deploying technologies like artificial intelligence or big data in public service delivery.

Federated data governance architectures: A distributed data management model is recommended, allocating responsibilities and capabilities across municipalities and metropolitan entities to support shared, democratic, and functional data governance while avoiding excessive centralization.

3.2. Infrastructure

A reliable, adaptable, and service-oriented digital infrastructure is essential for metropolitan- scale transformation. Projects should prioritize:

Interoperable platforms: Systems must be designed to communicate across local, regional, and national levels to support integrated service management in areas such as mobility, health, land use, emergency response, and environmental monitoring.

Scalable and distributed technologies: Strategic deployment of public cloud and edge computing optimizes data processing capacity, reduces latency, and enhances the responsiveness of urban digital systems.

Advanced connectivity in key nodes: The implementation of 5G networks and Internet of Things (IoT) technologies should focus on strategic urban locations such as transport hubs, hospitals, industrial zones, and underserved neighborhoods to ensure real-time services and territorial inclusion.

3.3. Capacity

Digital transformation is not solely a technological endeavor; it is also institutional and human. Project sustainability depends on:

Continuous and cross-sectoral capacity building: Technical staff, policymakers, and community stakeholders must be trained in areas such as data analytics, algorithmic governance, cybersecurity, and digital planning tools.

Intermunicipal technical teams: Structuring metropolitan-level teams enables collaborative management of shared infrastructure, supports joint innovation efforts, and ensures coherent project operation across jurisdictions.

Standardized protocols and implementation guidelines: Common technical manuals, monitoring tools, and adaptive frameworks enhance project alignment, facilitate performance tracking, and allow for flexible responses to emerging needs and lessons learned.

4. Institutional Arrangements and Governance

Metropolitan innovation and digital transition require a robust institutional framework to ensure territorial coherence, operational sustainability, and democratic legitimacy. Digital transformation is not limited to technology adoption; it entails reconfiguring decision-making structures, strengthening coordination mechanisms, and enabling adaptive governance models. The following components form the institutional backbone necessary to support effective and sustained metropolitan-scale projects:

4.1. Multilevel and Adaptive Governance

Digital projects must be embedded within a governance structure that integrates multiple levels of decision-making including local, metropolitan, regional, and national. A multilevel approach aligns policies, mobilizes resources, and ensures coordinated implementation across jurisdictions. This requires a governance architecture that combines institutional clarity with adaptability to technological and regulatory change. Mechanisms must support interjurisdictional collaboration, data exchange, and operational flexibility without compromising political continuity or technical accountability.

4.2. Metropolitan Digital Coordination Nodes

Effective deployment of projects hinges on specialized technical units with a clear metropolitan mandate. These coordination nodes function as operational hubs responsible for digital planning, standard harmonization, platform integration, and technical assistance across municipalities.

Their role is to manage interoperability, support less-equipped jurisdictions, and ensure that projects are driven by a shared long-term strategy rather than fragmented local efforts or electoral cycles. Such structures enhance institutional efficiency, scalability, and consistency across the metropolitan system.

4.3. Digital Participation Mechanisms and Civic Oversight

The legitimacy of digital initiatives relies on their openness to public participation and oversight. Innovation and digital transition processes must embed inclusive mechanisms that empower citizens to shape, monitor, and evaluate projects throughout their lifecycle. Key tools include digital participatory budgeting, collaborative prioritization platforms, traceable algorithmic consultations, and citizen-led digital audit panels. These mechanisms strengthen democratic control and improve project quality by integrating collective intelligence into institutional design.

4.4. Strategic Partnerships with Knowledge and Supercomputing Institutions

The technical complexity of metropolitan digital projects requires structured partnerships with scientific institutions, universities, and supercomputing centers. Collaborating with expert entities enables public administrations to access advanced analytical capabilities, validate technological solutions, foster local talent development, and accelerate applied innovation. These partnerships should be formalized through cooperation agreements, joint initiatives, and hybrid governance models that embed technical expertise into public decision-making processes.

5. Pilot Project Ideas

This report presents a set of pilot projects designed to support digital transition processes in metropolitan areas, drawing upon key technologies that are already being implemented globally in urban management. Tools such as Artificial Intelligence (AI), the Internet of Things (IoT), Geographic Information Systems (GIS), 3D visualization, multichannel mobile platforms, and digital twins are transforming how cities plan, make decisions, deliver services, and engage with their residents.

These technologies should not be viewed as fixed solutions, but rather as flexible and interoperable enablers that can be adapted to the specific needs and characteristics of each territory. Depending on their priorities, institutional capacities, and urban challenges, metropolitan areas can integrate these tools to strengthen various dimensions of urban governance. For example, a resilient planning project could combine AI-based predictive models, IoT-connected environmental sensors, and 3D visualization platforms to anticipate climate impacts, map high-risk areas, and design coordinated responses. Likewise, mobile applications can facilitate equitable and continuous access to public services, while a digital twin can simulate urban expansion scenarios to inform long-term investment decisions.

The pilot projects proposed in this chapter enhance metropolitan governance by fostering inter-institutional collaboration through interoperable systems and shared data usage. They improve metropolitan planning by enabling multiscale analysis of spatial variables and impact simulations based on evidence. They modernize public service delivery through the integration of digital mechanisms that optimize resources, automate processes, and increase operational efficiency. They strengthen climate resilience by enabling real-time monitoring, risk anticipation, and adaptive planning. And they expand citizen participation by offering accessible, inclusive, and transparent digital platforms for information access, consultation, and co-creation.

The structure of this report combines conceptual explanations of each technology, practical recommendations for implementation in metropolitan contexts, and real-world case studies from cities across different global regions. In doing so, it provides a practical, context- sensitive, and outcome-oriented guide for metropolitan authorities, technical teams, stakeholders, and public policy makers committed to leading a digital transformation that is effective, inclusive, and people-centered across metropolitan areas.

5.1. Artificial Intelligence (AI) Project

Artificial Intelligence (AI) is reshaping how metropolitan areas plan, manage, and anticipate their development. Far from being merely an emerging technology, AI acts as a strategic enabler for implementing more efficient, adaptive, and people-centered metropolitan projects. By harnessing the power of advanced analytics across vast datasets, AI reveals hidden patterns, automates processes, simulates scenarios and supports real-time decision-making.

In metropolitan systems, characterized by territorial diversity and overlapping local authorities, AI provides tools to address shared challenges such as traffic congestion, insecurity, service inequality, and climate vulnerabilities. AI-powered solutions allow metropolitan governments to anticipate risks, allocate resources strategically, and improve residents' quality of life in an equitable manner.

There is high potential for AI in metropolitan projects with strong public value, including:

- **Predictive mobility systems** that dynamically adjust traffic signals and routing.
- **Algorithms to prioritize social services** for high-risk individuals or neighborhoods.
- **Urban planning simulators** to forecast development impacts and growth scenarios.
- **Intelligent environmental monitoring platforms** that detect pollution or public health risks.
- **AI models for predictive care** of elderly or vulnerable populations.

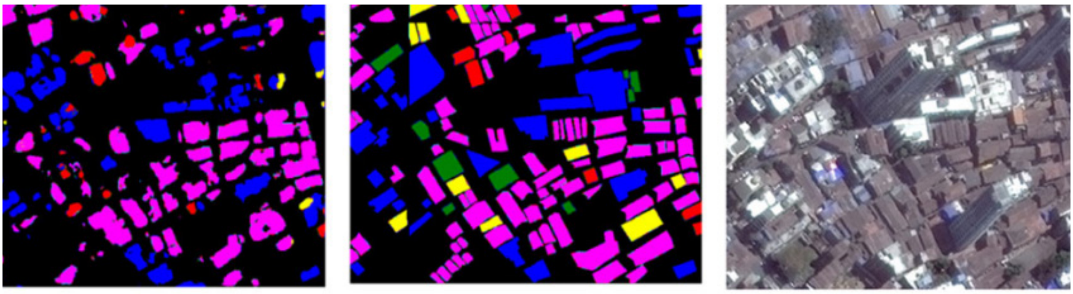
To effectively implement these initiatives, a supportive infrastructure must be in place:

- Reliable territorial data (sensors, administrative records, satellite imagery).
- Cloud or on-premises data processing platforms.
- Skilled technical teams to design, validate, and monitor AI models.
- Legal and ethical frameworks to protect rights and ensure territorial equity.

AI is not a substitute for public decision-making; it enhances it. When deployed transparently, inclusively, and in alignment with public interest, AI can significantly boost the legitimacy and effectiveness of metropolitan governance. Thus, AI-based metropolitan projects must be integrated with broader digital governance strategies, digital literacy efforts, and interinstitutional coordination mechanisms.

Recommendations for Implementing Metropolitan Projects with Artificial Intelligence (AI)

- **Develop a metropolitan AI roadmap** that aligns all municipalities, establishes ethical principles, defines interoperability criteria, and outlines mechanisms to assess the impact of each project on collective well-being.
- **Identify strategic use cases** with direct benefits for residents, such as mobility, public health, safety, or land-use planning, where AI can significantly improve the efficiency and targeting of public services.
- **Invest in institutional capabilities** for algorithmic governance, including training interdisciplinary teams capable of designing, adapting, and overseeing AI-driven solutions.
- **Ensure data quality and fairness** for training AI models by promoting inter-municipal agreements on data collection standards, privacy protection, and responsible data sharing.
- **Foster applied innovation ecosystems** through collaborative pilot projects with universities, research centers, startups, and civic networks, enabling the validation of solutions and the scaling of successful models across the metropolitan region.



INSPIRING CASE NO.1

Sunny Lives – Urban Heat Vulnerability Mapping with AI[1]

Location: **Delhi, India**

Implemented by: **SEEDS, Chintan, and Microsoft**

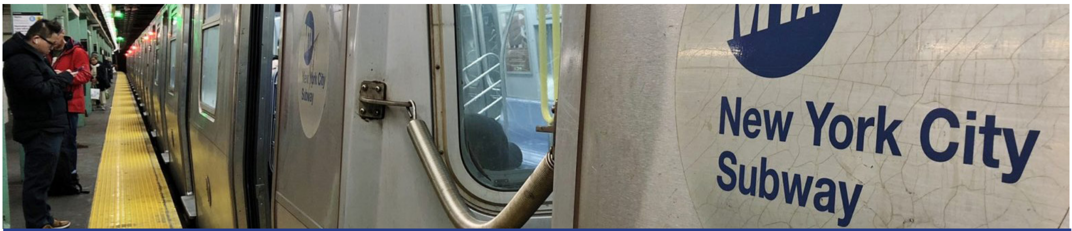
In Delhi, where extreme heat waves are increasingly threatening urban life, the Sunny Lives project offers an innovative solution to reduce climate vulnerability in informal settlements. Led by the NGO SEEDS, in collaboration with Chintan and Microsoft, the initiative applies artificial intelligence to accurately map thermal exposure at the building level in underserved neighborhoods, home to highly exposed populations such as waste pickers and residents without access to climate-resilient infrastructure.

The project's AI model integrates satellite-derived surface temperature data, climatic variables, and geospatial information on building materials and vegetation coverage. Through machine learning algorithms, it generates hyperlocal risk maps identifying households most at risk of extreme heat. These maps have been partially incorporated into Delhi's 2025 Heat Action Plans (HAPs) and have guided targeted interventions such as the installation of reflective roofing and strategic urban greening in high-risk zones.

What makes Sunny Lives particularly valuable is its ability to combine high territorial granularity with scalable and accessible technology. By leveraging open data, remote sensing, and AI, the model is not only technically robust but also socially inclusive. It stands as a successful example of cross-sector collaboration between civil society, the tech industry, and public planning institutions.

This initiative illustrates how metropolitan areas can adopt AI-driven tools to enhance climate resilience and promote territorial equity. Its methodology is adaptable to other cities in the Global South facing similar risks, serving as an inspiring reference for a just, climate-informed digital transition.

[1] https://www.seedsindia.org/portfolio/ai-for-humanitarian-action-with-microsoft/



INSPIRING CASE NO.2

TrackInspect – AI-Based Predictive Maintenance in the New York City Subway[2]

Location: **New York City, USA**

Implemented by: **Metropolitan Transportation Authority (MTA) and Google Public Sector**

New York City's subway system, one of the world's largest and busiest, serves over 3.7 million daily passengers. Ensuring safe and uninterrupted service requires efficient infrastructure maintenance. In response, the Metropolitan Transportation Authority (MTA), in partnership with Google Public Sector, developed TrackInspect, a pioneering AI-powered solution for predictive rail defect detection.

The system utilizes Google Pixel smartphones mounted on trains to collect data on audio, vibration, and geolocation during daily operations. These data streams are processed in the cloud using AI algorithms that detect anomalies indicative of track defects. Notably, 92% of the system's alerts have been validated by human inspectors, confirming its high accuracy. The solution has significantly reduced manual inspection workloads, enhancing operational efficiency while minimizing safety risks for millions of commuters.

One of TrackInspect's key strengths is its low-cost implementation, relying on commercially available devices instead of expensive proprietary sensors. The system is also designed to complement rather than replace human oversight, promoting a "collaborative AI" approach that augments institutional control while increasing monitoring capacity.

This case demonstrates how AI can be scaled into metropolitan infrastructure projects without requiring extensive investments or complex systems. It reinforces the principle that impactful innovation can begin with common tools, strong public-private collaboration, and a strategic vision for technology in service of urban well-being.

The *Sunny Lives* case in Delhi and *TrackInspect* in New York illustrate two distinct yet complementary approaches to applying artificial intelligence at the metropolitan scale, each delivering tangible impact on urban quality of life.

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[2] https://www.mta.info/press-release/mta-and-google-public-sector-announce-preventive-track-maintenance- pilot-program

Comparative Table: Key Lessons from Two Metropolitan AI-Based Projects

Aspect	Sunny Lives (Delhi, India)	TrackInspect (New York City, USA)
Objective	Identify urban heat vulnerability zones at the building level	Detect subway track defects before they become critical
Core Technology	AI + Satellite imagery + GIS	AI + Mobile sensors (audio, vibration, geolocation)
Application Scale	Building-level analysis in informal settlements	Full deployment in the metropolitan subway system
Urban Impact	Supports climate action planning and territorial equity	Enhances safety and operational efficiency in mass transit
Technical Accessibility	High: uses open data and replicable tools	High: uses commercially available smartphones
Governance Model	Civil society–tech sector–local government collaboration	Public–private partnership (MTA and Google Public Sector)
Key Lessons	AI enables climate resilience and hyperlocal planning	AI supports low-cost predictive maintenance of critical infrastructure

The cases of Sunny Lives in Delhi and TrackInspect in New York demonstrate the potential of artificial intelligence to address critical urban challenges at the metropolitan scale. Both show how accessible, targeted solutions can generate actionable data, anticipate risks, and improve decision-making, whether in climate vulnerability or the operation of complex infrastructure. These experiences underscore the importance of designing AI projects that are ethical, collaborative, and aligned with the public interest.

Lessons learned from the cases of Delhi and New York (AI):

- **Targeted territorial application:** Deploy AI in specific areas or among populations where it can deliver direct, measurable impact.
- **Field validation with local stakeholders:** Ensure that models are tested against real urban conditions and verified by those who live or work in the target territories.
- **Horizontal scalability:** Design solutions that can be replicated across other municipalities within the metropolitan area without relying on unique conditions or exceptional resources.

5.2. Internet of Things (IoT) Project

The Internet of Things (IoT) enables physical objects such as cameras, traffic lights, environmental sensors, or wearable devices to connect to the internet and generate real-time data about urban dynamics. In metropolitan contexts, this creates a distributed sensory network that transforms the urban environment into an intelligent system capable of monitoring, anticipating, and managing public services with greater precision and responsiveness.

For metropolitan areas, which often span multiple jurisdictions and exhibit diverse urban, peri-urban, and rural dynamics, IoT provides a crucial foundation for integrated governance. It enables local and regional governments to better understand intermunicipal mobility patterns, detect environmental risks such as air pollution in industrial zones, and identify service disparities like street lighting or waste collection in underserved neighborhoods. By connecting infrastructure to data flows, IoT supports more responsive, equitable, and resource-efficient urban management.

In practical terms, IoT-based metropolitan projects can support:

- **Smart mobility systems** that adjust traffic flows based on congestion levels.
- **Real-time environmental monitoring** to manage air quality and noise pollution.
- Automated street lighting and irrigation systems to optimize energy and water use.
- **Smart waste bins that signal collection needs**, reducing overflow and operational costs.
- **Telecare devices for vulnerable populations**, ensuring safety and health follow-up.

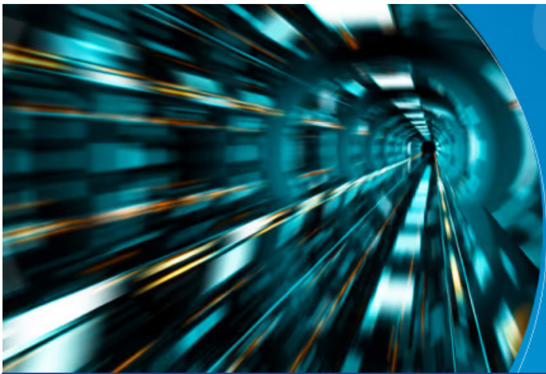
To effectively implement these initiatives, a supportive infrastructure must be in place:

- **Deployment of physical devices** (sensors, cameras, meters) strategically distributed across the territory.
- **Robust connectivity infrastructure**, such as LoRaWAN, 4G/5G, or NB-IoT networks.
- **Digital platforms** for data integration, processing, and visualization (e.g., smart dashboards, urban operation centers).
- **Interoperability standards and cybersecurity protocols** to ensure safe, reliable, and ethical data usage.

Beyond technical infrastructure, the deployment of IoT must be guided by principles of territorial equity and digital inclusion. Sensor networks should benefit all parts of the metropolitan region, not just city centers or high-income zones. Moreover, citizen participation is essential: communities must be empowered to interpret and engage with sensor data, particularly in projects related to public health or environmental stewardship.

Recommendations for Implementing Metropolitan IoT Projects

- Develop a metropolitan-scale smart sensor master plan, harmonizing the deployment, operation, and maintenance of IoT devices across municipalities, with a focus on key sectors such as mobility, safety, environment, and public health.
- Consolidate shared digital platforms to integrate data captured by sensors, ensure interoperability across agencies and jurisdictions, and enable real-time decision-making at the regional level.
- Enable smart public service management (e.g., traffic signals, lighting, waste, parks) using connected devices that optimize resource use and improve metropolitan operational efficiency.
- Strengthen local capacities in connectivity, cybersecurity, and infrastructure maintenance to guarantee the safe and sustainable functioning of deployed networks.
- Foster's citizen participation and community ownership of IoT solutions through collaborative environmental monitoring initiatives and accessible care devices for vulnerable populations.



Driving Singapore's Progress with Technology: Pit Stops for Smarter, Faster Services

INSPIRING CASE NO.3

Smart Nation Sensor Platform – IoT for Intelligent Urban Management in Singapore[3]

Location: **Singapore**

Implemented by: **GovTech – Government of Singapore**

As part of its national Smart Nation strategy, the Government of Singapore has deployed one of the world's most advanced urban sensor platforms: the Smart Nation Sensor Platform (SNSP). Developed by the GovTech agency, this IoT infrastructure enables real-time data collection and analysis on urban conditions, transforming public spaces into a sensor-based, interconnected system that supports metropolitan-scale management.

The SNSP integrates thousands of sensors installed on lamp posts, traffic poles, public transport stations, and government buildings. These devices collect information on pedestrian and vehicular flows, air quality, noise levels, temperature, and public space occupancy. All data are centralized on an interoperable platform that facilitates visualization, analysis, and multi- agency use.

One of the platform's most notable achievements is its ability to enhance urban and regional decision-making. For example, it enables dynamic street lighting based on human presence, adaptive traffic signal control according to real-time congestion, and instant alerts on critical air quality changes. It has also significantly strengthened urban operations centers, allowing for faster, more coordinated responses to emergencies and large-scale events.

Singapore's experience offers key lessons for other metropolitan regions: early standardization of sensors and communication protocols ensures interoperability and scalability; sustained investment in connectivity and cybersecurity fosters institutional trust; and a shared data architecture among agencies enables an integrated territorial perspective.

[3] https://www.tech.gov.sg/technews/our-enhanced-smart-nation-vision-paving-the-way-for-a-new-digital-era

Beyond its technological dimension, SNSP stands out for its strategic and collaborative governance approach. It is a global benchmark in how the Internet of Things can transform urban governance, enable intelligent public services, and support a metropolitan digital transition that is sustainable, inclusive, and people centered. The platform demonstrates how systematic deployment of connected sensors can form the backbone of resilient, anticipatory, and data-informed cities.

INSPIRING CASE NO.4

IoT City Data System – Real-Time Urban and Environmental Management in Seoul[4]

Location: **Seoul, South Korea**

Implemented by: **Seoul Metropolitan Government**

As part of its comprehensive "Smart Seoul" strategy, the Seoul Metropolitan Government has developed an advanced infrastructure of connected sensors through the IoT City Data System. This platform enables the real-time collection, analysis, and visualization of urban and environmental data, enhancing the city's ability to manage public services, monitor environmental conditions, and anticipate territorial risks with greater efficiency and equity.

More than 2,500 sensors are deployed across public spaces, government buildings, and strategic urban corridors. These devices monitor critical variables such as temperature, humidity, noise levels, fine particulate matter (PM2.5), ultraviolet radiation, and noxious gases. The collected data is centralized in an urban operations center that uses artificial intelligence and geospatial analytics to generate alerts, inform policy recommendations, and support operational decision-making.

[4] https://seoulsolution.kr/en/node/9358

One of the key takeaways from this project is that high-density sensor coverage generates hyperlocal data essential for evidence-based public policy. By combining IoT with AI tools, the metropolitan government has strengthened its anticipatory capacity, identifying vulnerable zones and prioritizing interventions such as green corridors or low-emission zones. Continuous collaboration with academic institutions, particularly Seoul National University, has also proven critical in ensuring the technical credibility of the system and facilitating its use across public agencies.

Another important lesson is the value of designing the platform as open and scalable. Its modular and interoperable architecture has allowed for expansion into new domains, including autonomous mobility management and urban energy tracking. Moreover, the project has enhanced institutional transparency through the regular release of environmental data, which in turn has fostered public trust and encouraged informed civic engagement.

The IoT City Data System stands as a leading example of how metropolitan areas can build digital ecosystems that integrate technology, evidence, and governance to improve urban quality of life. Seoul's experience demonstrates that the Internet of Things can do more than optimize public service delivery; it can serve as a cornerstone of a people-centered, territorially inclusive, and climate-resilient digital transition.

Comparative Table: Metropolitan IoT Applications – Key Insights from Singapore and Seoul

Aspect	Smart Nation Sensor Platform (Singapore)	IoT City Data System (Seoul)
Objective	Enable national-scale, real-time urban sensing for data-driven governance	Monitor environmental variables for targeted, anticipatory urban management
Core Technology	IoT sensor network + centralized data architecture + smart lampposts	Environmental sensors + AI + geospatial analytics
Application Scale	Nationwide infrastructure, covering urban and regional nodes	Dense metropolitan network across public buildings and key corridors
Urban Impact	Improves inter-agency coordination, emergency response, and public transparency	Enhances data-informed policies on climate adaptation, mobility, and health

Aspect	Smart Nation Sensor Platform (Singapore)	IoT City Data System (Seoul)
Technical Accessibility	High: standardized architecture and scalable infrastructure	High: modular and open platform designed for future integration
Governance Model	National strategy led by GovTech with cross-agency integration	Metropolitan government collaboration with universities and public agencies
Key Lessons	Interoperability, cybersecurity, and cross-agency data sharing are essential	High-resolution data enables hyperlocal planning and evidence-based policy

The cases of Singapore and Seoul illustrate how metropolitan IoT platforms can enhance urban management by providing real-time data, strengthening evidence-based planning, and increasing territorial resilience. Their complementary approaches, one national and standardized, the other metropolitan and environmentally focused, offer valuable lessons for advancing a more efficient, integrated, and people-centered digital transition.

Lessons learned from the cases of Singapore and Seoul (IoT)

- **Progressive deployment planning:** Begin with well-defined pilot projects and gradually scale the sensor network in alignment with urban priority areas.
- **Combined use of fixed and mobile sensors:** Complement permanent infrastructure with mobile devices to enhance spatial coverage and operational flexibility.
- **Environmental monitoring as input for cross-sector policies:** Leverage real-time data on air quality, noise, and climate to inform decision-making in areas such as mobility, public health, and urban planning.

5.3. Geographic Information Systems (GIS) and 3D Visualization Project

Metropolitan projects based on Geographic Information Systems (GIS) are a strategic tool for advancing territorial digital transitions. These technologies enable the capture, integration, spatial analysis, and representation of complex urban phenomena, providing a solid foundation for multilevel planning, public management, and evidence-based decision- making. When GIS is combined with three-dimensional (3D) visualization models, its impact is significantly enhanced.

Metropolitan governments can simulate future scenarios, assess the spatial effects of policies or infrastructure projects, and communicate more effectively with technical teams, policymakers, and the public. In this sense, GIS-3D projects improve not only technical efficiency but also transparency and inclusivity in planning processes. At the metropolitan scale, these projects consolidate fragmented spatial information across municipalities, produce integrated diagnostics, and support the design of more equitable and sustainable interventions. They are also essential for mapping service access inequalities, analyzing infrastructure gaps, monitoring environmental risks, and supporting climate-resilient strategies. In contexts of institutional fragmentation, a shared metropolitan geospatial system strengthens intermunicipal coordination and avoids duplication of efforts.

Moreover, GIS in metropolitan projects can be integrated with other digital tools such as IoT sensors, digital twins, and open data platforms, generating synergies that enhance digital governance ecosystems. As such, GIS evolves from a technical tool to a core component of institutional transformation, civic participation, and people-centered public policy design.

Application areas for metropolitan GIS projects

- Urban planning and spatial management with multiscale approaches
- Mapping gaps and inequalities in public service delivery
- Climate, environmental, and health risk monitoring
- Project visualization and scenario simulation
- Spatial impact assessment of policies and investments
- Support for participatory planning and public consultation processes

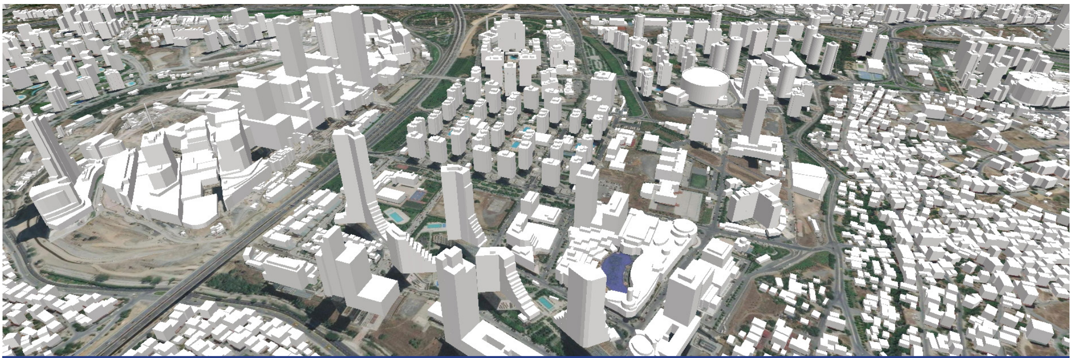
To effectively implement these initiatives, a supportive infrastructure must be in place:

- Specialized software (QGIS, ArcGIS, Cesium, Unity, CityEngine)

- Structured and up-to-date georeferenced data (cadastre, census, infrastructure, satellite imagery)
- Multiscale analysis platforms and interoperability with other data systems
- Intermunicipal technical teams with skills in spatial analysis, modeling, and visual communication
- Common protocols for data exchange, standardization, and metropolitan digital governance

Recommendations for implementing metropolitan GIS and 3D visualization projects

- Design a shared metropolitan geospatial system that consolidates territorial data across municipalities and enables coordinated multiscale decision-making.
- Use 3D visualization to communicate projects and plans, enhancing public understanding and stakeholder engagement in complex urban interventions.
- Apply GIS to detect territorial inequalities and guide public investments, prioritizing underserved or vulnerable areas based on spatial evidence.
- Build institutional capacity in spatial analysis and participatory GIS, incorporating inclusive approaches with attention to gender and territorial diversity.
- Integrate GIS projects with other urban digital platforms, such as IoT sensors, open data portals, and climate monitoring systems, supporting interoperable and territorially focused digital ecosystems.
- Adopt standards in terms of digitisation, GIS and 3D tools to guarantee long-term viability of solutions.



INSPIRING CASE NO.5

Haydarpaşa Urban Visualization Model – Istanbul, Türkiye[5]

Location: **Istanbul, Türkiye**

Implemented by: **Istanbul Metropolitan Municipality and BIMTAŞ**

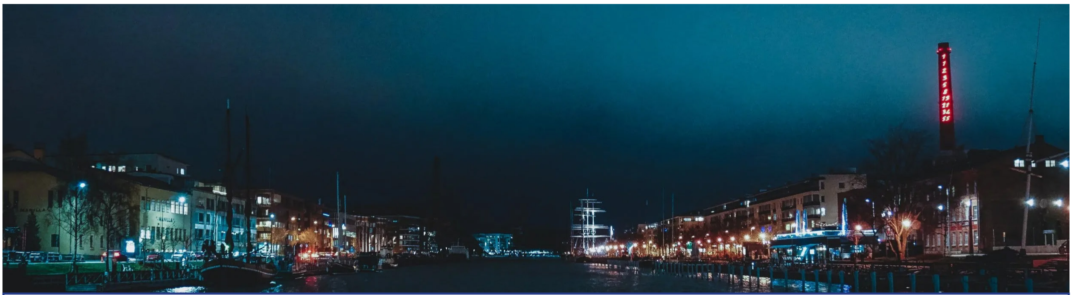
As part of the redevelopment plan for the Haydarpaşa area, the Istanbul Metropolitan Municipality developed a three-dimensional geospatial model to assess the urban implications of various proposals in this historic port zone. Using topographic data, digital elevation models, and high-resolution aerial imagery, the project created a detailed 3D visualization of more than 50,000 buildings across 2,600 hectares. This enabled the analysis of volumetry, building height, projected shadows, and the integration of new developments with existing urban heritage.

The model was used by architects, planners, and technical teams to simulate different scenarios prior to final decision-making, enhancing technical evaluations and preventing downstream conflicts in the approval process. The initiative aligned urban transformation proposals with Istanbul's historical and landscape values, reinforcing trust between public institutions and private actors.

A key achievement was its ability to integrate rigorous technical criteria into transparent consultation processes, reducing review time and avoiding costly design revisions. A central lesson from this case is that a full-scale digital twin is not always necessary; accurate and well-integrated 3D GIS models can deliver substantial planning benefits.

This project serves as inspiration for other metropolitan areas undertaking heritage-sensitive urban renewal, showing how GIS and 3D visualization tools can improve densification strategies, preserve cultural identity, and foster more livable urban environments through context-aware decision-making.

[5] https://isprs.org/proceedings/XXXVIII/1_4_7-W5/paper/Buhur-175.pdf



INSPIRING CASE NO.6

3D Participatory Planning in Turku – Finland[6]

Location: **Turku, Finland**

Implemented by: **City of Turku and University of Turku, in collaboration with Maptionnaire and Sova3D**

To strengthen citizen involvement in urban decision-making, the City of Turku launched an innovative pilot in the Aninkainen district combining GIS with 3D visualization. Using an interactive digital platform, residents were invited to explore future urban design proposals in a three-dimensional virtual environment, accessible from personal devices, and submit geolocated comments on buildings, public spaces, and proposed projects.

The pilot collected more than 450 contributions from 130 participants, which were directly integrated into the technical and planning review process. This approach enabled local authorities to refine their designs based on community insight while promoting a culture of shared responsibility in shaping the urban environment. The experience demonstrated that clear and accessible visual tools increase engagement and lend greater legitimacy to participatory planning.

Among the project's notable achievements were the increased diversity and number of participants compared to traditional consultation formats. Cross-platform compatibility also helped overcome digital and generational barriers. A key takeaway from Turku is that 3D visualization not only enhances project communication, it reshapes how citizens engage with metropolitan planning.

This model offers valuable guidance for cities seeking to democratize urban governance through digitally enabled participation. By showing that urban design is not the exclusive domain of experts, Turku paves the way for more transparent, inclusive, and territorially responsive planning processes.

[6] https://www.maptionnaire.com/blog/using-3d-participatory-planning-to-enrich-community-engagement

Comparative Table: GIS and 3D Visualization Applications in Istanbul and Turku

Aspect	Haydarpaşa Urban Visualization Model (Istanbul, Türkiye)	3D Participatory Planning in Turku (Finland)
Objective	To simulate and assess redevelopment scenarios in a historically sensitive urban area using spatial data and 3D models.	To foster inclusive urban planning by engaging citizens through interactive 3D exploration of proposed developments.
Core Technology	Geographic Information Systems (GIS), Digital Elevation Models (DEM), 3D visualization, aerial imagery.	GIS-based interactive 3D visualization, web mapping, online survey platforms.
Application Scale	District-scale (Haydarpaşa Port Area, ~2,600 hectares) with high-detail visualization of over 50,000 buildings.	Neighborhood-scale (Aninkainen district) pilot for participatory feedback integration into municipal planning.
Urban Impact	Enhanced heritage-sensitive planning; streamlined decision-making processes; reduced conflicts in project validation and urban redevelopment approvals.	Improved democratic participation; broader stakeholder engagement; real-time integration of community feedback into urban design proposals.
Technical Accessibility	Based on standard GIS and 3D software; deployable without real- time sensor infrastructure; relatively low cost for advanced planning needs.	Mobile-compatible, user-friendly tools; accessible to non-specialist users and adaptable to a wide range of planning contexts and technical capacities.
Governance	Led by the metropolitan	Co-implemented by local
Model	municipality (IMM) with technical implementation through BIMTAŞ; used for expert and institutional review.	government and academic partners; includes digital civic engagement as part of the planning workflow.

Aspect	Haydarpaşa Urban Visualization Model (Istanbul, Türkiye)	3D Participatory Planning in Turku (Finland)
Key Lessons	Effective urban planning doesn't require full digital twins; detailed 3D GIS visualizations are sufficient for impact-driven decision-making.	3D tools enhance citizen understanding and trust; digital platforms can democratize planning processes if designed with accessibility in mind.
Transferability to Metros	Highly replicable in metropolitan areas with historical or complex redevelopment needs; scalable across contexts with GIS capacity.	Suitable for metropolitan and district-level governments aiming to integrate participatory methods into digital urban governance strategies.

The cases of Istanbul and Turku illustrate how Geographic Information Systems (GIS) and 3D visualization can drive metropolitan digital transformation through different but complementary approaches: one focused on technical analysis and heritage-sensitive planning, and the other on civic engagement and democratized spatial governance. Both highlight that these technologies do not require complex infrastructures to produce tangible impact. When combined with accessible tools, inclusive methodologies, and strategic vision, they enable metropolitan areas to improve decision-making, strengthen territorial governance, and shape more livable, equitable, and collaborative urban environments.

Lessons learned from the cases of Istanbul and Turku (GIS – 3D):

- **Visual scenario modeling enhances institutional alignment:** The ability to visualize spatial impacts allows diverse government stakeholders to align criteria before approving urban interventions.
- **Visual narratives build public trust:** Showing how a project will transform urban space through understandable representations increases transparency and reduces social resistance.
- **3D models support post-implementation monitoring:** Once projects are implemented, visual models can be reused to track changes and evaluate whether outcomes align with the original plan.

5.4. Urban Digital Twins Project

A digital twin is a dynamic virtual replica of a physical urban environment, such as a city, mobility system, or critical infrastructure, continuously updated in real time through data from sensors, digital platforms, and administrative records. This technology enables the simulation of future scenarios, the anticipation of impacts, and more intelligent, evidence-based decision-making.

In metropolitan contexts, digital twins provide an integrated interface for coordinating institutional actors, visualizing complex datasets, and consolidating diverse urban and territorial variables. Their strategic value is particularly evident in dense, fragmented, or high- risk environments, where inter-municipal coordination and data-driven planning are essential.

Common metropolitan applications include:

- Simulating urban expansion and forecasting service demand
- Modeling climate change impacts (flooding, heat islands, etc.)
- Evaluating transport, land use, and infrastructure policies
- Supporting real-time crisis response (e.g., health emergencies, natural disasters)

The following infrastructure is essential for implementing metropolitan digital twin projects:

- Up-to-date and interoperable geospatial and statistical data (GIS, censuses, sensors, satellite imagery)
- 2D or 3D visualization platforms with dynamic modeling and simulation capabilities
- Data integration systems (IoT devices, sensor networks, administrative flows)
- Robust connectivity, cloud storage, and analytical tools (AI, predictive algorithms), what-if scenario tools)
- Inter-municipal technical teams with skills in spatial analysis, simulation, and digital governance

Recommendations for Implementing Metropolitan Digital Twin Projects

- **Develop integrated digital models** of the metropolitan territory that consolidate real-time or near real-time data on mobility, climate, services, and population, enabling dynamic scenario simulation.
- **Apply digital twins in strategic urban and climate resilience planning**, particularly to anticipate impacts of urban growth, natural hazards, and infrastructure stress.
- **Leverage digital twins as civic engagement and communication tools,** allowing the public and local stakeholders to visualize and discuss urban policy proposals through accessible visual formats.
- **Ensure interoperability with existing platforms (GIS, IoT, AI)** and adopt open standards to support scalability, sustainability, and continuous updating of the model.
- **Foster multi-stakeholder technology partnerships**, linking governments, universities, innovation centers, and the private sector to co-develop digital twins using open technologies, advanced visualization, and responsible AI.

INSPIRING CASE NO.7

Destination Earth (DestinE) – European Union[7]

Destination Earth (DestinE) is a flagship initiative of the European Commission aimed at building a digital twin of the Earth, with urban-scale applications to support climate resilience and disaster preparedness. Launched in June 2024, the program integrates supercomputing infrastructure (EuroHPC), satellite data lakes (Copernicus), and socioeconomic information within a simulation environment developed by ECMWF, ESA, and EUMETSAT. The initial digital twins focus on climate change adaptation and the prediction of extreme events such as heatwaves and urban flooding, operating at sub-kilometric resolutions. These models enable local governments to anticipate impacts and design evidence-based policies.

Its metropolitan application is particularly relevant for multiscale climate planning, allowing cities to forecast extreme events and design more precise, efficient, and evidence-driven territorial adaptation strategies.

In terms of transferability, DestinE offers a replicable architecture for other metropolitan areas, especially those seeking to integrate climate simulations, urban modeling, and adaptive planning using interoperable technologies and open standards.

[7] https://destination-earth.eu/destination-earth/destines-components/destination-earth-service-platform/

INSPIRING CASE NO.8

Dubai Digital Twin ("Dubai Here") – Dubai, United Arab Emirates[8]

The "Dubai Here" platform, led by the Dubai Municipality, represents one of the most advanced efforts in the Arab world to consolidate a functional urban digital twin. Through a public 2D/3D portal, the platform integrates geospatial data on parcels, buildings, infrastructure, services, and urban assets. It is connected to IoT sensors and municipal administrative systems, enabling public, private, and civic actors to access territorial data, monitor assets and visualize planning scenarios in real time. The model supports both transport and public service management and civic engagement in urban decision-making through accessible interactive tools.

In the metropolitan context, this solution facilitates inter-institutional coordination, optimizes shared infrastructure management, and enables more efficient planning across jurisdictions.

Its transferability to other metropolitan areas is high, especially in cities seeking to centralize urban information and provide open interfaces for the collaborative design of policies and projects, simultaneously promoting efficiency, transparency, and participation.

8 https://storymaps.arcgis.com/stories/4ae54ecb2d8e4640b491de1fc319cffc

INSPIRING CASE NO.9

Virtual Shanghai – Shanghai, China[9]

Developed by the Shanghai Institute of Surveying and Mapping in collaboration with the Ministry of Natural Resources, Virtual Shanghai is one of the most detailed digital twins in the world, with spatial accuracy below 3 cm. This hyper-realistic model was built using aerial, terrestrial, portable, and drone-based laser scanning, and also integrates thermal imagery, service networks, interior mapping, mobile sensors, and surveillance data. The digital twin enables authorities to virtually patrol the city, navigate inside buildings, and access real-time information on occupancy, temperature, traffic flow, and events via mobile devices. The solution functions as an urban intelligence tool focused on public safety, tactical planning, and emergency response.

Its metropolitan application is particularly notable in operational and safety management within densely urbanized contexts, offering a technological foundation for integrated response capabilities in critical situations.

Regarding transferability, the Shanghai model provides key insights for metropolitan areas seeking to enhance their monitoring, virtual patrolling, and infrastructure oversight capacities, especially those with specific needs for risk management and high-precision territorial control.

[9] https://cmte.ieee.org/futuredirections/2023/09/01/digital-twins-for-digital-cities-towards-the-cityverse-vii/

Comparative table: Analysis of Metropolitan Digital Twin Projects

Aspect	Destination Earth (EU)	Dubai Digital Twin ("Dubai Here")	Virtual Shanghai (China)
Objective	To model the planet for climate risk anticipation and support urban resilience.	To consolidate an integrated, participatory urban management platform.	To operate a high-resolution tactical tool for urban security and operations.
Core Technology	Supercomputing, satellite data, multiscale simulation.	2D/3D visualization, geospatial data, IoT integration.	3D laser scanning (LiDAR), mobile sensors, hyperrealistic visualization.
Application Scale	Macroregional and multiscale urban.	Metropolitan and intermunicipal.	Microterritorial and operational.
Urban Impact	Supports adaptive planning, disaster prediction, and climate-informed decision-making.	Improves service efficiency, interoperability, and urban transparency.	Enables precision surveillance, emergency response, and tactical oversight.
Technical Accessibility	High technical complexity; requires advanced computing infrastructure.	Moderate, using public platforms and interoperable urban data.	High demand but scalable with investment in sensors and 3D mapping.
Governance Model	Multilevel and collaborative (EU, climate agencies, local governments).	Municipal, with open interface for public, private, and civic actors.	Centralized, led by national agencies for operational purposes.
Key Lessons	Domain integration, data openness, interoperability.	Institutional coordination, citizen engagement, geospatial standardization.	Spatial precision, real- time monitoring, sensor-visual complementarity.
Transferability to Metros	High, as a framework for local climate planning with open, adaptable models.	High, suitable for cities seeking integrated urban data and service management.	Medium-high, ideal for dense urban contexts with tactical oversight needs.

The three cases analyzed illustrate the diversity of specializations and territorial scales that digital twins can adopt in the metropolitan context. Destination Earth operates at a macro and multiscale level, integrating climatic, socioeconomic, and territorial dynamics with high precision to support adaptive planning across large urban regions. Dubai Here focuses on the urban-metropolitan scale, consolidating geospatial, cadastral, and service-related information into an interoperable platform that facilitates both intermunicipal coordination and citizen participation. Virtual Shanghai, in turn, stands out at the micro territorial and operational scale due to its ultra-high spatial resolution (less than 3 cm), providing a hyper realistic replica of the city for security, virtual patrol, and tactical management purposes. This differentiation shows that digital twins are not one-size-fits-all solutions, but rather adaptable platforms tailored to the specific needs of each metropolis according to its context, priorities, and technological capacities.

Lessons learned from the cases of EU, Dubai, Shanghai (Digital Twin):

- **Multiscale interoperability enhances the strategic value of digital twins:** Integrating global, regional, and local data within a unified platform enables the simulation of complex scenarios and supports more accurate, proactive policymaking, particularly in areas such as climate resilience, urban expansion, and risk management.
- **Open and accessible interfaces strengthen metropolitan digital governance:** Interactive portals that provide geospatial information to citizens, private sector stakeholders, and public institutions promote transparency, facilitate inter- institutional coordination, and encourage shared use of territorial intelligence.
- **High spatial resolution boosts operational response capabilities:** Incorporating detailed territorial representations, along with fixed and mobile sensor networks, enables more agile and effective management of critical services such as public safety, traffic control, and emergency response, especially in high-density urban contexts.

INSPIRING CASE NO.10

vCity: Human-Centric Urban Digital Twin Platform[10]

vCity is an innovative, human-centric urban digital twin platform led by the **Barcelona Supercomputing Center (BSC)**. Its aim is to transform how urban policies are designed and implemented by integrating scientific, social, and environmental data into interactive 3D environments. These digital representations enable the simulation, visualization, and understanding of the impacts of public policies on diverse communities, supporting more inclusive, collaborative, and evidence-based planning processes.

Unlike traditional infrastructure-focused models, **vCity** combines artificial intelligence, open data, urban simulation, and advanced visualization to build realistic, accessible, and participatory urban environments.

These tools not only support technical decision- making but also enhance public engagement and multi-stakeholder dialogue, contributing to more democratic and value-driven metropolitan governance.

A key feature of **vCity** is its use of **Living Labs**, real urban environments where digital solutions are co-created and tested in close collaboration with local communities, public authorities, and technical experts. These living laboratories allow the platform to be tailored to the specific needs of each metropolitan territory, fostering localized experimentation and innovation. Currently, the project is being implemented in cities such as **Barcelona, Viladecans,** and **Kobe**, which serve as pilot sites for testing people- centered metropolitan approaches.

[10] https://www.vcity.tech

The **vCity Living Labs** are structured around five strategic thematic areas:

- **Proximity:** Investigates how the spatial organization of urban services (education, health, commerce, transport) can be designed to ensure accessibility and territorial cohesion. The digital twin is used to visualize resource distribution and assess equity at the neighborhood scale.
- **Mobility:** Focuses on the planning and management of urban transport systems by integrating data on traffic, pedestrian pathways, and public transport networks, enabling simulation of infrastructure changes and their impact on daily mobility.
- **Cycling:** Aims to improve cycling infrastructure by modeling scenarios that combine topographic, climatic, and behavioral data, promoting safe and connected networks for active mobility.
- **Sustainability:** Supports the analysis of resource consumption, emissions, and climate change effects, helping to guide mitigation and adaptation strategies with a systemic urban approach.
- **Breathing:** Addresses air quality and its implications for public health, integrating sensor data, atmospheric modeling, and social vulnerability metrics to identify critical zones and guide targeted interventions.

vCity's modular architecture allows it to be adapted across diverse metropolitan environments, making it a versatile tool for local governments seeking to advance a just, sustainable, and people-centered digital transformation. Its interdisciplinary approach strengthens cooperation between scientific institutions, public administrations, and citizens, establishing a new benchmark for the ethical and inclusive use of digital urban technologies.

5.5. Mobile Applications and Multichannel Services Project

In the context of metropolitan digital transition, mobile applications and multichannel platforms play a crucial role in bringing public administration closer to the people. They enable access via any device to institutional information, public services, participatory processes, and communication channels. This technology not only enhances user experience, but also strengthens transparency, efficiency, and inclusion in the relationship between metropolitan governments and citizens.

In metropolitan environments characterized by territorial heterogeneity and institutional fragmentation, a unified and interoperable platform can integrate services across multiple municipalities, ensuring continuous and equitable access. These solutions also help eliminate physical or administrative barriers for vulnerable groups such as elderly people, people with disabilities, or those facing digital exclusion.

Metropolitan projects in this area may include:

- Unified platforms for administrative procedures, payments, appointments, and inquiries.
- Mobile apps for citizen reporting and community alerts.
- Digital channels for customer service and participation in public policymaking.
- Multilingual and accessible interfaces with inclusive functionalities.

To implement these solutions, the following elements are required:

- Interoperable digital architecture across municipalities.
- Accessible and mobile-friendly interfaces with secure authentication.
- Institutional capacities in user-centered design.
- Mechanisms for citizen feedback and continuous improvement.

These tools reinforce people-centered governance by ensuring that technology serves collective well-being through accessible, up-to-date, and territorially responsive solutions.

Recommendations for Implementing Metropolitan Projects with Mobile Applications and Multichannel Platforms

- Design a unified metropolitan digital platform that consolidates procedures, services, citizen participation, and customer support, ensuring access through multiple channels (mobile, web, in-person).
- Apply principles of universal accessibility and usability, incorporating multilingual design, inclusive functionalities, and adaptation to varying levels of digital literacy.
- Establish interoperability frameworks between municipal systems to ensure data traceability, secure authentication, and coordinated responses for intermunicipal services.
- Promote the use of these tools in critical service areas such as health, mobility, safety, and environment, integrating features like notifications, alerts, geolocation, and appointment management.
- Implement permanent mechanisms for citizen evaluation and iterative improvement to tailor platform functionalities to the real needs of diverse population groups within the metropolitan territory.

INSPIRING CASE NO.11

Traffy Fondue – AI-Enabled Civic Reporting Platform (Bangkok & Other Thai Regions)

Developed by NECTEC, Traffy Fondue is an AI-integrated mobile and web application (via LINE) that allows citizens to report urban issues such as potholes, litter, or broken traffic lights through an intuitive interface. The system automatically classifies incoming reports and routes them to the appropriate municipal department, while providing real-time status updates for each submission. To date, the platform has processed over 1.37 million reports across Thailand, with a 77 % resolution rate, including 865,000 in Bangkok alone during recent pilot phases.

Metropolitan Application: Traffy Fondue enables metropolitan-scale civic engagement by centralizing critical infrastructure data and empowering authorities to prioritize interventions more efficiently and location-specifically.

Key Lessons

- AI-powered classification enhances operational efficiency.
- Integration with popular platforms significantly drives citizen adoption.
- Transparent status updates help build public trust.

Transferability: Well-suited to metropolitan areas seeking to implement scalable, low-cost civic reporting systems quickly.

INSPIRING CASE NO.12

NYC 311 – Multichannel Citizen Service Platform (New York, USA)

Managed by New York City's Office of Technology and Innovation, NYC 311 is one of the world's most comprehensive multichannel civic service platforms. Originally launched in 2003 as a non-emergency call center, the system has evolved into a fully integrated digital service accessible via mobile app, website, chatbot, and social media channels. It handles over 3 million citizen requests annually, including issues related to street lighting, noise, sanitation, mobility, and housing.

Metropolitan Application: NYC 311 consolidates the service demands of a diverse and spatially dispersed population and coordinates multiple municipal agencies from a single platform. It simplifies access to public services, democratizes communication channels, and enhances civic participation through open, traceable data.

Key Lessons

- Digital channels must be complemented with offline options (phone, in-person) to avoid excluding underserved groups.
- Citizen-generated data can significantly improve urban planning, provided it is supported by strong validation and interoperability frameworks.
- Automated tools (chatbots, notifications) can enhance efficiency while maintaining a human-centered service experience.

Transferability: Applicable to metropolitan regions aiming to build a more accessible, transparent, and citizen-centric public service ecosystem backed by data intelligence.

Comparative Table – Civic Reporting and Multichannel Platforms

Aspect	Traffy Fondue (Bangkok, Thailand)	NYC 311 (New York, USA)
Objective	Enable citizens to report urban infrastructure issues efficiently using AI and mobile platforms.	Provide a centralized multichannel system for non-emergency civic services and citizen engagement.
Core Technology	Mobile app integrated with AI, LINE platform integration, web interface.	Multichannel digital platform (app, website, phone, chatbot), data dashboard, automation systems.
Application Scale	Nationwide, with major implementation in Bangkok, the platform has processed over 1.37 million reports.	Citywide and borough-wide in New York City, with over 3 million annual requests.
Urban Impact	Increases civic responsiveness; prioritizes issues spatially; improves public service coordination.	Enhances urban management; facilitates interagency coordination; informs urban planning with citizen-generated data.
Technical Accessibility	Low-cost deployment using popular platforms; minimal infrastructure needed.	High technical development; multichannel integration; scalable to other cities with digital ecosystems.
Governance Model	Led by NECTEC with partnerships between NGOs, tech providers, and local government.	Managed by NYC Office of Technology and Innovation; integrated across municipal agencies.
Key Lessons	AI enhances report classification; integration with popular platforms drives adoption; public transparency builds trust.	Combining digital and traditional channels expands inclusivity; open data supports planning; automation boosts efficiency.
Transferability to Metros	Highly transferable for metros seeking low-cost, scalable civic reporting platforms.	Suitable for metros aiming to consolidate service delivery and enhancecitizen-government interaction.

The Traffy Fondue case in Bangkok and the NYC 311 system in New York demonstrate how mobile applications and multichannel platforms can transform the interaction between citizens and metropolitan governments. Both implementations show that by integrating accessible technologies, intelligent automation, and diverse communication channels, it is possible to extend service coverage, enhance operational efficiency, and foster more active and inclusive civic engagement. These initiatives underline that digital transition does not solely rely on major technological investments, but also on people-centered strategies, institutional interoperability, and open governance that leverage collective intelligence at the metropolitan scale.

Lessons learned from the cases Bangkok and New York

- **Partnerships with Existing Digital Platforms Drive Citizen Adoption**

  The integration of Traffy Fondue with widely used apps like LINE facilitated rapid user uptake, demonstrating that leveraging familiar citizen channels is a powerful strategy for expanding the reach of metropolitan digital solutions.

- **User-Generated Data as a Strategic Urban Asset**

  Both NYC 311 and Traffy Fondue show that citizen reports, when systematically collected and analyzed, not only support immediate incident response but also reveal spatial patterns, service gaps, and emerging needs, making them valuable for metropolitan planning.

- **Automation Combined with Traceability Boosts Public Trust**

  Features like automated updates on report statuses (as in Traffy Fondue) and transparent tracking of user requests (as in NYC 311) help build transparency and improve citizens' perception of institutional responsiveness.

6. Policy Recommendations

Metropolitan innovation and digital transition projects generate transformative impact only when supported by robust institutional, regulatory, and operational conditions that ensure their viability, scalability, and sustainability. Practical evidence and institutional learning show that technology adoption alone is insufficient, there must be an enabling environment that supports strategic planning, coordinated implementation, and evaluation based on public value. The following recommendations aim to enhance the capacity of metropolitan governments to design, implement, and sustain digital projects with a territorial, inclusive, and resilient approach.

6.1. Establish Enabling and Adaptive Regulatory Frameworks

Metropolitan digital projects require regulatory environments that clearly govern the use of emerging technologies, safeguard digital rights, and enable inter-institutional collaboration. It is recommended to develop flexible legal frameworks guided by ethical principles, addressing issues such as interoperability, algorithmic governance, agile procurement of digital services, data protection, and equitable access to infrastructure and platforms.

6.2. Consolidate Institutional Structures for Metropolitan Coordination

Effective project design and implementation demand technical units with operational legitimacy and strategic vision. It is recommended to institutionalize metropolitan digital coordination nodes responsible for planning, technical assistance, technological harmonization, and project monitoring. These structures must function under a collaborative, multi-stakeholder governance model that transcends municipal boundaries and interests.

6.3. Ensure Financial Sustainability and Flexible Investment Mechanisms

Project failure is often due to unstable funding. It is essential to create dedicated funds for metropolitan digital innovation, explore multilevel co-financing schemes, and design agile mechanisms that allow investment to adapt to technological change. It is also recommended to incorporate scalability, maintenance, and upgrade clauses in the project design phase.

6.4. Strengthen Technical, Institutional, and Political Capacities

Digital project implementation requires a combination of technical capacities (data management, geospatial analysis, cybersecurity), institutional capacities (interjurisdictional coordination, change management), and political capacities (leadership, negotiation, stakeholder engagement).

Permanent training programs and specialized intermunicipal teams should be established to support complex transformation processes.

6.5. Integrate Digital Participation and Citizen Monitoring Mechanisms

Project quality and legitimacy improve when citizen participation is embedded from the design stage. It is advised to institutionalize digital deliberative processes, continuous feedback systems, and open platforms for citizen oversight and auditing. These tools enhance transparency, shared responsibility, and collective learning.

6.6. Align Digital Projects with Territorial and Urban Planning

Digital initiatives must not operate in isolation. It is crucial to integrate digital innovation with metropolitan strategic plans, sectoral urban policies (mobility, housing, environment), and sustainable development agendas. This alignment ensures territorial coherence, maximizes impact, and avoids duplication of efforts.

6.7. Apply Scalability, Replicability, and Sustainability Criteria from the Outset

Successful projects share structural features: they are based on clear diagnostics, are technically viable, and are designed to scale or adapt to various metropolitan contexts. It is recommended to adopt modular, flexible, and user-centered approaches from the beginning, supported by governance and monitoring structures that allow continuous evolution and adaptation.

6.8. Artificial Intelligence (AI)

Provide tailored guidelines on the trustworthy integration of AI in metropolitan contexts. Incorporate AI in metropolitan projects within shared algorithmic governance frameworks across municipalities, ensuring common standards of ethics, transparency, and traceability.

It is advised to establish metropolitan protocols for data validation and technical auditing of algorithms, and to promote AI applications in areas where aggregated territorial data can enhance predictive models, such as urban mobility, public safety, or health services.

6.9. Internet of Things (IoT)

Design IoT infrastructures at the metropolitan scale through coordinated sensor networks and devices equitably distributed across the territory. Solutions should be developed with a focus on technical and operational interoperability among municipalities, prioritizing areas of high vulnerability or strategic value. Metropolitan consortia are recommended for the joint management of sensor data, technological maintenance, and digital security.

6.10. Geographic Information Systems (GIS) and 3D Visualization

Develop interoperable GIS platforms and 3D visualization systems at the metropolitan level to enable unified integration, analysis, and visualization of territorial data. A common base cartography and spatial data governance framework must be established, connecting municipalities and metropolitan entities to support land-use planning, infrastructure development, and urban equipment distribution. These tools should inform both territorial and sectoral policymaking.

6.11. Urban Digital Twins

Promote digital twins as metropolitan instruments for integrated urban simulation, policy assessment, and emergency management. through shared standards. These standards should define common data models, interoperability protocols, and security requirements, enabling systems across agencies and jurisdictions to exchange information seamlessly. Standardization lowers costs, prevents vendor lock-in, and enables coordinated regional deployment, allowing digital twins to operate as integrated metropolitan platforms rather than isolated pilots. These platforms should be shared among local governments, powered by data from multiple sectors (transportation, environment, infrastructure), and configured using collaborative models to validate multi-actor scenarios.

6.12. Mobile Applications and Multichannel Services

Design mobile applications and multichannel services from a metropolitan perspective, ensuring homogeneous, integrated access for users across the entire urban region. These solutions must facilitate interoperability among local platforms, adopt accessible design standards, and ensure service continuity across municipalities. A modular approach is recommended to allow adaptation to the diverse realities within the metropolitan system.

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