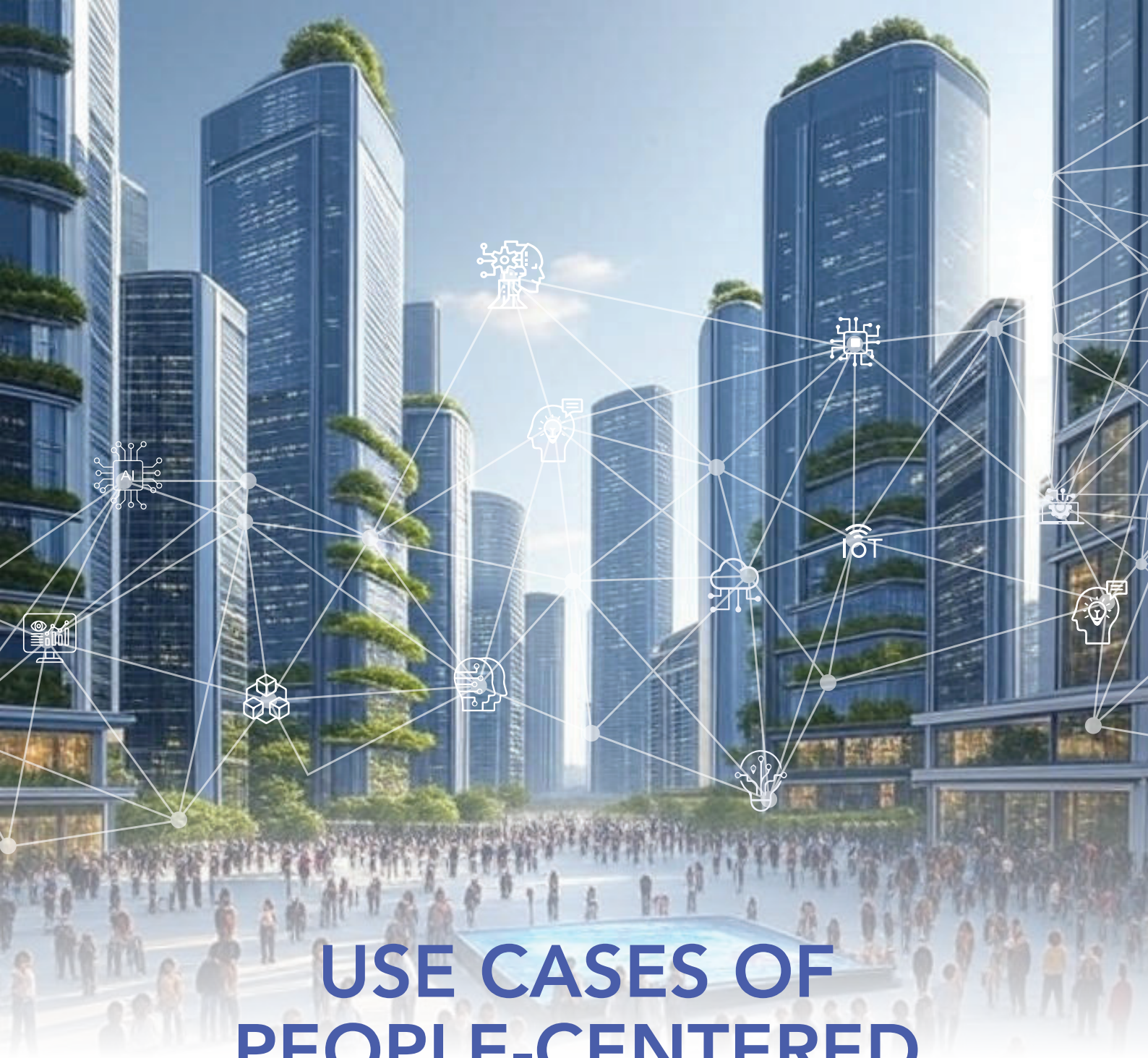

USE CASES OF PEOPLE-CENTERED "CITIVERSE"

Guangzhou Institute for Urban Innovation

The Metaverse Institute

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Foreword

As the world undergoes rapid urban transformation, cities face immense pressure to respond to growing demands on infrastructure, climate resilience, inclusion, social equality and sustainability. In this context, the concept of the *citiverse* - a fusion of '*citizen*' and '*metaverse*' - presents a timely and compelling vision: one in which digital innovation becomes a powerful tool in the service of people and the common good.

At the Global Cities Hub we believe that cities are the best tailored entities – despite their differences in size, population and legacy – to apply the *citiverse* approach. This compilation of good practices unpacks the *citiverse* not as a technological endgame, but as a human-centered framework for the future of urban development. At its heart lies a simple imperative: people must come first. As international organizations, national governments, technology experts, and businesses collaborate on shaping the cities of tomorrow, they must remember that innovation without inclusion is innovation without impact.

Putting people at the center of local digital transformation means more than user-friendly platforms or apps. It means actively designing systems that serve the real needs of residents: needs that range from safety, health, and employment to meaningful participation in civic life. The *citiverse* must balance equity and efficiency, as well as accessibility and transformation. The technology we create and deploy must amplify voices, especially those often left unheard – informal workers, caregivers, youth, and marginalized communities – and support decision-making that is rooted in empathy and justice.

We applaud all the partners who contributed to the work of this initiative: the Guangzhou Institute for Urban Innovation, the Metaverse Institute, and Metropolis. The use cases presented in this compilation — spanning from Buenos Aires to Guangzhou — demonstrate that when technology is purposefully applied with people in mind, it can foster transparency, inclusion, and trust. Initiatives like São Paulo's formalization of informal workers, Bogotá's care blocks, and Tampere's ethical AI framework are not just projects. They are real world examples of how to build digital futures that are responsive to human needs.

As we navigate this new era of digital transformation, let us remember that cities are not just collections of data points or smart infrastructure. They are living, breathing communities built by and for people. The success of *citiverse* depends on our capacity to use sophisticated technologies, and on our ability to stay grounded in human dignity, shared values, and collective well-being.

For this to happen, decision-makers, whether in city halls, national governments or international organizations, must treat people not merely as recipients of innovation but as co-creators of it. States can develop better national plans and regulations if they include local and regional governments (LRGs) from the inception phase. Multilateral cooperation can be a more powerful enabler of this transformation, if and when it brings local realities into global policy frameworks. This is where LRGs play a key role. They are closest to citizens' everyday experiences, and they understand the local effects of global challenges. When empowered to lead and included in global dialogues, LRGs bring legitimacy, insight, and pragmatism to smart city agendas and *citiverse* developments.

We recommend this compilation as a source of inspiration and good practices to all stakeholders who wish to co-create a future where technology uplifts, empowers, and connects, a future which is smart, just, inclusive, and profoundly human.

The Global Cities Hub

Introduction

The rapid urbanisation of our planet tests the limits of infrastructure, equity, and sustainability. As cities grapple with complex challenges—from climate resilience to inclusive growth—traditional planning approaches fall short. The future demands strategies that harness digital innovation purposefully, placing human needs at the core while advancing global sustainability.

The "Citiverse" (merging CITIzen and metaVERSE) embodies this vision: a collaborative global ecosystem where cities, innovators, and communities co-create human-centred digital solutions. It transcends technology as an end in itself, focusing instead on leveraging data, AI, IoT, and immersive platforms to build equitable, resilient, and thriving urban futures. By uniting diverse stakeholders, the Citiverse accelerates shared learning, scales proven innovations, and turns the promise of the metaverse into tangible progress.

Drawing on the Guangzhou Award for Urban Innovation, Metropolis, and the Metaverse Institute, this document showcases how cities are deploying digital tools—digital twins, AI, blockchain, and geospatial systems—to achieve the UN Sustainable Development Goals (SDGs). These cases demonstrate that when technology serves people first, cities become more inclusive, efficient, and sustainable.

Several of the use cases presented here were discussed during a Thought Leaders' Workshop in Guangzhou, 3-6 June 2025. The workshop was co-sponsored by Metropolis – the World Association of Major Metropolises – and the Guangzhou Institute for Urban Innovation. It involved use cases and site visits from industry, civil society and local governments. Many of the key takeaways and conclusions were discussed during the workshop.

Finally, this document is intended to be a living document to which we intend to add new use cases, new findings and new takeaways. Those wishing to contribute can do so by sending an email to: citiverse@guangzhouaward.org

The "Citiverse" embodies this vision: a collaborative global ecosystem where cities, innovators, and communities co-create human-centred digital solutions

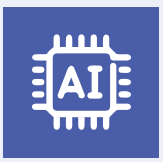
Some of the digital tools most commonly used in these use cases presented in this document


Cloud Computing


Block Chain

Internet of Things


Data Visualization



Artificial Intelligence


Digital Twin

Buenos Aires, Argentina: Ciudad 3D – A Tool for Urban Development

Start Date of the Initiative: 2023

Basic City Data

- Population size: 3,120,612
- Surface Area (sq.km): 200
- Population Density (people/sq.km): 15,150
- GDP Per Capita (U.S.$): 13,858.2 (2024)
- Main Source of Prosperity: Service, Transport and Tourism

Buenos Aires, the vibrant capital of Argentina, is located on the southeastern coast of South America. With over 3 million residents, it is the largest city in the country and serves as its economic, cultural, and political hub. The city covers an area of 200 square kilometres and faces various urban development challenges, including the need for streamlined processes and improved transparency.

In 2021, Buenos Aires launched the Ciudad 3D initiative, aimed at transforming urban development within the city. Ciudad 3D is a digital platform that provides three-dimensional representations of urban development across various neighbourhoods. Its primary goal is to offer comprehensive information about building plans, construction procedures, land use, and tax calculations, while simplifying the application of the Urban Code—a set of regulations governing urban planning and development in Buenos Aires.

This initiative is groundbreaking as it introduces innovative technologies into urban development, representing a novel approach in Argentina. It signifies a paradigm shift in the use of digital tools for urban planning and emphasises transparency and citizen accessibility to information. The city employs an open-source model, making the platform's source code available for others to build upon.

Ciudad 3D has already achieved significant progress, notably reducing approval times for construction projects and increasing website traffic from 6,000 to over 13,000 users. It empowers city residents to better understand their environment. It assists architects, planners, and designers, ultimately improving the efficiency of the urban development process and contributing to a higher quality of life in the city. The city aims to build upon this success to create a "metaverse" city, where predictive and knowledge-generating urbanism becomes a practical reality.

This initiative represents a digital revolution in urban development for Buenos Aires. Its innovative use of 3D technology and commitment to transparency highlight the potential for technology to transform urban planning and development. This initiative aligns particularly with Sustainable Development Goals (SDGs) 9 (Industry, Innovation, and Infrastructure), 11 (Sustainable Cities and Communities), and 16 (Peace, Justice, and Strong Institutions).

São Paulo, Brazil:
A Smart Tool to Assist Informal Vendors

Start Date of the Initiative: 2019

Basic City Data

- Population size: 12.3000
- Surface Area (sq.km):17.000
- Population Density (people/sq.km): 24.821
- GDP Per Capita (U.S.$): 13,996 (2024, state level)
- Main Source of Prosperity: Public Power - Government

Tô Legal's primary goal is to simplify and expedite the process of obtaining authorisations and permits for individuals providing services informally in public spaces and on sidewalks. São Paulo, with a population exceeding 12 million, is a central hub for job seekers and income opportunities. Many people find work in the informal sector. This system creates a pathway for those unable to enter the formal job market to work legally.

By recognising informality, Tô Legal fosters entrepreneurship and encourages many informal sector workers to transition into the formal economy gradually. It does this by making it easier for informal vendors to apply for permits and use them flexibly. Additionally, Tô Legal enhances transparency, improves efficiency, uses geographic information systems (GIS) for location monitoring, and reduces corruption through better payment control.

Tô Legal was designed as a gateway for individuals who need to work legally but may lack the qualifications, education, or experience necessary for formal employment. This smart electronic system, funded and utilised by the city of São Paulo, enables citizens currently working illegally and insecurely on the streets to formalise their activities over time.

The system enables users to apply for permits, select appropriate streets for vending, find information about other vendors in the area and their offerings, update their registrations, and pay municipal fees online. What traditionally required at least seven days, including visits to municipal offices and extensive paperwork, can now be completed in just one hour online.

Civil servants can easily access information about permits and authorisations, streamlining inspection procedures and significantly enhancing transparency and accountability.

Tô Legal exemplifies how a city can embrace informality and support low-income earners in transitioning to the formal economy. Furthermore, it contributes to the city of São Paulo's achievement of Sustainable Development Goals: SDG 1 (No Poverty), SDG 8 (Decent Work and Economic Growth), and SDG 11 (Sustainable Cities and Communities).

Guangzhou, China: Integrated and Smart Neonatal Health Management System – Empowering Mothers, the Family, and the Community

Start Date of the Initiative: 2020

Basic City Data

- Population size: 18,734,000
- Surface Area (sq.km): 7,434.4
- Population Density (people/sq.km): 2,530
- GDP Per Capita (U.S.$): 23,052 (2024)
- Main Source of Prosperity: Advanced Manufacturing Industry, High-technology Industry

Guangzhou, the third largest city in China, has a rapidly growing population of over 18 million, with approximately 160,000 newborns each year. It's common for 60 to 80 per cent of these newborns to develop jaundice. While jaundice is often a benign condition, it can sometimes indicate serious underlying diseases. Due to a lack of knowledge and experience, parents usually rush to hospitals without consulting community care providers. Conversely, some parents may fail to recognise the symptoms in time, which can lead to morbidity or even mortality.

Upon being discharged from the hospital after a successful delivery, parents are told how to monitor their baby's bilirubin levels. The system, presented as an online platform, provides guidance and explains the significance of different jaundice levels. Once the newborn's bilirubin data is logged, the system automatically generates an evaluation of jaundice and offers specific recommendations, including directions to the nearest health facility.

The system also integrates data from families, community health centres, district children's hospitals, and tertiary hospitals into a comprehensive knowledge base on growth conditions for children up to the age of 18. Enhanced by AI, it analyses trends and correlations between health challenges and various factors, including social determinants of health and well-being. Since its launch in 2020, the proportion of newborns with elevated bilirubin levels nearly halved, from 19.91% in 2018 to 10.78% in 2022, while the incidence of severe jaundice dropped from 0.57% to 0.30%. By emphasising prevention rather than treatment, this initiative optimises healthcare resources. It particularly aligns with Sustainable Development Goals (SDGs) 3 (Good Health and Well-being), 9 (Industry, Innovation, and Infrastructure), and 16 (Peace, Justice, and Strong Institutions).

Bogotá, Columbia:
Bogotá's Manzanas del Cuidado (Care Blocks)

Start Date of the Initiative: 2023

Basic City Data

- Population size: 7,834,167
- Surface Area (sq.km): 1,776
- Population Density (people/sq.km): 21,276
- GDP Per Capita (U.S.$): 12,117 (2022)
- Main Source of Prosperity: Service Industry

Launched in 2020 under Mayor Claudia López, Bogotá's Care Blocks represent an innovative model of care-centered urban development aimed at addressing the structural inequities of unpaid care work, which disproportionately impact women. The initiative integrates digital tools into the city's social and spatial infrastructure, providing decentralized, accessible, and data-Central to the Care Blocks' operation is a suite of digital platforms allowing caregivers to access a wide range of services, including educational programs, legal and psychological counseling, health support, and employment resources, both in person and remotely. This hybrid model enhances access and flexibility, particularly benefiting women with limited mobility or time due to caregiving responsibilities.

The initiative employs a robust data management system for monitoring service usage, disaggregating data by gender, age, location, and service type. This evidence-based approach fosters dynamic policy adjustments, targeted resource allocation, and continuous service improvement, enhancing operational efficiency while promoting transparency and accountability.

Since their inception, Care Blocks have delivered over 230,000 services, positively impacting more than 488,000 women by supporting their educational, vocational, mental, and physical health needs, and facilitating entry into the labor market. By alleviating the time burden of unpaid care work, the initiative empowers women to seek personal and professional growth, contributing to economic empowerment and social mobility.

Governance of the Care Blocks involves municipal leaders, civil society, feminist organizations, and service users, ensuring responsiveness to community needs. The digital governance framework prioritizes privacy, consent, and non-discrimination, setting a standard for ethical use of AI in urban contexts. Public accountability is ensured through open dashboards and transparent resource allocation, demonstrating that technological advancements must coincide with social responsibility.

The Care Blocks have been included in Bogotá's Urban Master Plan (POT), ensuring that care services are recognized as integral to urban development rather than peripheral programs. The POT mandates the creation of 45 Care Blocks by 2035, emphasizing territorial equity and aligning with the 15-minute city paradigm, which prioritizes accessibility to core services within walkable distances.

International acclaim for the Care Blocks includes the 2023 Guangzhou International Award for Urban Innovation and recognition at global forums like the World Government Summit. Partnerships with institutions such as the Inter-American Development Bank have reinforced the program's expansion and sustainability. This model illustrates the transformative potential of embedding digital tools in inclusive urban policy to redefine care as a shared public responsibility, offering valuable insights for urban planners and policymakers aiming to foster gender equity and resilient urban development. It aligns with global frameworks like the New Urban Agenda and the Sustainable Development Goals, particularly SDG 5 (Gender Equality) and SDG 11 (Sustainable Cities and Communities).

European Digital Infrastructure Consortium: Local Digital Twin and Citiverse

Start Date of the Initiative: 2023

Basic City Data

- Population size: 250,640
- Surface Area (sq.km): 523
- Population Density (people/sq.km): 474
- GDP Per Capita (U.S.$): *Not Applicable
- Main Source of Prosperity: Health and industry

The European Digital Infrastructure Consortium (EDIC) is a groundbreaking initiative aimed at developing a unified framework for Local Digital Twins and the broader concept of the Citiverse across Europe. Its primary goal is to empower European cities to leverage advanced digital models and immersive virtual environments for enhanced urban planning, service delivery, and citizen engagement. This initiative seeks to standardise data sharing, interoperability, and ethical guidelines for digital twins, thereby creating a cohesive digital infrastructure that benefits all member states.

By fostering the development and adoption of Local Digital Twins, the EDIC promotes innovation in urban governance and strengthens the European Union's position as a leader in digital transformation. It encourages collaboration among cities, research institutions, and industry players, facilitating the exchange of best practices and the co-creation of new digital solutions. This collaborative approach enhances efficiency in resource allocation, reduces redundant efforts, and accelerates the deployment of smart city technologies.

The EDIC's vision for a Citiverse serves as a gateway for cities to build a shared virtual space that mirrors the physical urban environment. This digital replica, powered by real-time data, enables urban planners to simulate various scenarios, test policy interventions, and visualise the impact of development projects before implementation.

in interactive virtual environments. What traditionally required extensive manual data collection, isolated departmental efforts, and limited public consultation can now be achieved through integrated digital platforms, significantly reducing time and costs.

Policy makers and urban planners can easily access real-time information about urban infrastructure, environmental conditions, and citizen needs, streamlining decision-making procedures and significantly enhancing transparency and accountability.

The European Digital Infrastructure Consortium exemplifies how a unified approach to digital transformation can empower cities to address complex urban challenges and improve the quality of life for their citizens. Furthermore, it supports the European Union in achieving Sustainable Development Goals: SDG 9 (Industry, Innovation, and Infrastructure), SDG 11 (Sustainable Cities and Communities), and SDG 17 (Partnerships for the Goals).

* European Digital Infrastructure Consortium (EDIC): As a policy framework, EDIC does not have a GDP per capita, and "Basic City Data" does not apply in this case.

Tampere, Finland CitiVerse: A Human-Centric Metaverse for Sustainable Urban Living (2040 Vision)

Start Date of the Initiative: 2024

Basic City Data

- Population size: 183,161
- Surface Area (sq.km): 161.88
- Population Density (people/sq.km): 1,131.48
- GDP Per Capita (U.S.$): $43,339 (2025)
- Main Source of Prosperity: Natural Gas and Petrochemical, Oil Refining, Fishing and Seafood

Tampere, Finland—winner of the 2023 World Smart City Award (Enabling Technologies)—is pioneering the CitiVerse, a revolutionary metaverse strategy blending digital and physical urban life. Partnering with The Metaverse Institute in the UK, Tampere is building a self-sustaining, inclusive digital ecosystem anchored in:

- Happiness – Enhancing quality of life for work, leisure, and community
- Equality – Ensuring universal access to digital/physical services
- Governance – Empowering citizens in decision-making via meta-town halls
- Sustainability – Carbon-negative, zero-waste urban regeneration
- Health & Well-being – Safe, green, and responsive public spaces

Key Innovations

- **AI & IoT Platform:** Europe's most advanced urban data hub, enabling real-time decisions (e.g., traffic optimisation, maintenance alerts).
- **Citizen Co-Creation:** Gamified apps reward feedback; projects like SURE save €7.5M annually.
- **Ethical AI Framework:** Co-developed with EU cities to ensure responsible metaverse governance.

Human-Centric AI and Future Trajectories

Over the past seven years, Tampere has successfully developed numerous AI & insight-enabled urban services that benefit residents, city staff, and local businesses. These solutions, crafted with a human-centric and purpose-driven approach, leverage Tampere's extensive data and IoT platform, advanced analytics toolkit, and intelligent algorithms. The impact of these innovations is clear: safer streets, enhanced safety for older people and children in playgrounds, more intelligent business decisions, optimised resource allocation, and smoother event management. The strategic use of technology has also opened up new avenues for citizen engagement, including gamified apps that reward residents for providing feedback on public matters.

Global Recognition & Impact

Tampere's "AI & Insight-Enabled Urban Services" won acclaim for:

- **Scalable Smart Solutions:** No-code tools for rapid app development (e.g., lighting anomaly detection).
- **Human-Centric Design:** Services like elderly safety monitors and playground analytics.
- **CitiVerse Foundations:** Digital residency, meta-Oscars, and participatory legislation.

Advancing the UN Sustainable Development Goals, Tampere's CitiVerse directly delivers on:

- SDG 9 (Industry, Innovation & Infrastructure): IoT/AI-driven smart city platforms
- SDG 10 (Reduced Inequalities): Inclusive digital residency programs
- SDG 11 (Sustainable Cities): Carbon-negative, zero-waste urban planning
- SDG 16 (Peace & Justice): Transparent, participatory governance
- SDG 17 (Partnerships): Cross-border collaboration on ethical AI

Bontang, Indonesia: Geospatial-Based Persons with Disabilities Card and Services

Start Date of the Initiative: 2024

Basic City Data

- Population size: 183,161
- Surface Area (sq.km): 161.88
- Population Density (people/sq.km): 1,131.48
- GDP Per Capita (U.S.$): 22,970
- Main Source of Prosperity: Natural Gas and Petrochemical, Oil Refining, Fishing and Seafood

Bontang, Indonesia, is an industrial hub located on the island of Borneo and is home to over 180,000 people. While the city enjoys economic growth, it struggles with a significant challenge: ensuring the rights and well-being of individuals with disabilities. For many years, Bontang has faced issues with the quality and accessibility of data regarding its citizens with disabilities. This data was often inaccurate, outdated, and stored in tabular formats without precise location information, leading to a lack of accountability and transparency. As a result, individuals with disabilities did not have equal access to essential services and programs designed to support them.

To tackle this issue, the Geospatial-Based Persons with Disabilities Card and Services initiative was launched in 2021. This program aims to empower and protect individuals with disabilities by collecting, mapping, and managing data through geospatial technology. Previously, data collection and verification were conducted through several levels—from the city to districts, sub-districts, and communities—in an inefficient process. Furthermore, the manually collected data were compiled into tables that lacked precise location details.

With the introduction of this initiative, trained local volunteers use smartphones to survey individuals with disabilities in Bontang, entering real-time data about their locations, disabilities, needs, and identities. This live data feeds into a publicly accessible WebGIS disability dashboard. Unique e-disability cards are then issued to individuals, linked to the digital database. The system helps residents with disabilities access various services and programs, including assistive devices, daily necessities, financial assistance and training.

The initiative has already produced substantial outcomes. Internally, it has improved the performance of social welfare services for individuals with disabilities and enhanced the integration of government services and public policies for this group. This initiative represents a transformative effort in Bontang to secure the rights, protection, and inclusivity of individuals with disabilities, aligning particularly with Sustainable Development Goals 1 (No Poverty), 10 (Reduced Inequalities), and 11 (Sustainable Cities and Communities).

Moscow, Russia:
Digital Twin – An Up-to-Date 3D Model of the City

Start Date of the Initiative: 2019

Basic City Data

- Population size: 13 149 803
- Surface Area (sq.km): 2,511
- Population Density (people/sq.km): 5,236
- GDP Per Capita (U.S.$): 24,274
- Main Source of Prosperity: IT sector, Trade Industry, Construction Industry, Manufacturing Industry

The Digital Twin is a flagship project of the Moscow Government. This is an exact 3D copy (photogrammetric model) of the Moscow territory with all buildings, structures, engineering and transport communications. The digital twin helps to choose the areas for the construction of residential and social facilities, including housing, under the renovation program. The Digital Twin's extensive information layers enable the calculation of loads on engineering networks, social facilities, and transportation systems in future city districts.

To keep the 3D model of Moscow up to date, more than 12 million photographs are taken annually from different angles from the ground and air. More than 6 thousand analytical layers supply the photogrammetric model with data on all key sectors of urban life. Over 2,000 management decisions are made annually using the Digital Twin.

Unveiled in 2024, a 3D model of VDNKh, a landmark exhibition park in Moscow, recreates over 80 objects and 400 exhibits with meticulous detail, ensuring the unique appearance of each building is faithfully preserved in this metaverse experience. Two guiding principles shaped the development of MetaVDNKh: ensuring broad accessibility and delivering the highest quality graphics. Residents throughout Russia can enjoy online strolls through VDNKh in a gamified mode, as the metaverse is accessible on any computer to every user.

As instructed by the Mayor of Moscow, Sergey Sobyanin, the Digital Twin should become the foundation of a digital master planning system in the coming years. This system will enable the forecasting of Moscow's development, and the optimal and integrated addressing of issues related to engineering, social, and transportation infrastructure.

eThekwini, South Africa: eThekwini Strat Hub – Leveraging Digital Tools and Data to Enhance Operational Efficiencies and Improve Service Delivery

Start Date of the Initiative: 2023

Basic City Data

- Population size: 3,500,000
- Surface Area (sq.km): 2,291
- Population Density (people/sq.km): 6,800
- GDP Per Capita (U.S.$): 8,460
- Main Source of Prosperity: Food, Automotive, Chemicals and Manufacturing

With a population of 3.5 million, eThekwini, also known as Durban, is South Africa's third most populous city. For many years, the municipality made decisions based on instincts rather than data-driven insights. This approach resulted in operational inefficiencies, misallocation of resources, and ultimately, poor service delivery.

Recognising this issue, the city launched an innovative data platform called the "Strategic Hub" (Strat Hub) in 2021. This integrated platform combines data visualisation, digitisation, automation, and cloud data warehousing, utilising digital tools to enhance operational efficiencies and improve service delivery. It creates a space where policymakers, businesses, and residents can access critical insights for informed decision-making.

Partnerships are essential to this initiative. The local government acknowledged that it lacked the necessary resources and skills to drive such innovation on its own, leading to the principle of co-creation. By leveraging a network of private, academic, civil society, and community partners, the city has significantly enhanced its capacity for innovation, allowing it to respond more effectively to residents' needs while developing tailored solutions to local challenges.

The Strat Hub serves as a "single source of truth" by centralising data and analytics tools aimed at fostering data-driven decision-making across the municipality. The goal is to instigate a gradual yet significant change in strategic planning and operational decisions over the next few years. This multi-layered initiative involves a profound shift from traditional manual processes to digitised and automated systems, optimising existing operations to extract value from data, supported by technical resources like Power Apps for service digitisation and automation. Currently, various dashboards provide real-time analytics on key performance indicators across domains such as road safety, health, disaster response, and water infrastructure. For instance, real-time geolocation data enhances the city's response to service requests, optimises waste collection routes, and improves disaster response tools.

The platform has evolved from its initial aim of integrating city-level data to addressing the critical need for cloud data warehousing and digitisation. By promoting collaboration across departments and directly addressing departmental pain points, the initiative has successfully overcome resistance stemming from data silos and traditional mindsets. It aligns particularly with Sustainable Development Goal 11 (Sustainable Cities and Communities) and Sustainable Development Goal 16 (Peace, Justice, and Strong Institutions).

Rotterdam, The Netherlands: Envisioning a Digital Future for the City and Citizens – Integrating with the Sustainable Development Goals

Start Date of the Initiative: 2023

Basic City Data

- Population size: 663,900
- Surface Area (sq.km): 324.14
- Population Density (people/sq.km): 2,048.18
- GDP Per Capita (U.S.$): 55,664.84
- Main Source of Prosperity: Port Industry

Rotterdam, a city renowned for its innovation and forward-thinking approach, is actively shaping its digital future through a comprehensive vision on the impact of digital transformation. Having published its initial vision, "Rotterdam in transformation," in October 2024, the city is now embarking on an ambitious journey to integrate the "Citiverse" concept into its forthcoming vision, slated for release by the end of 2027. This proactive engagement aims to identify and define the fundamental building blocks of a citizen-centric digital urban environment.

The City of Rotterdam recognised the profound implications of digital transformation on its urban landscape and the daily lives of its citizens. The "Rotterdam in transformation" vision served as a crucial first step, acknowledging these shifts. Building on this foundation, the city is now moving towards a deeper integration of the Citiverse – an evolving concept representing the convergence of the physical and digital city, offering immersive and interactive experiences for residents, businesses, and visitors. By leveraging digital tools to enhance urban planning, public services, and citizen engagement, Rotterdam is building a more liveable and responsive city for all.

To ensure a robust and comprehensive approach to defining these essential building blocks, Rotterdam partnered with The Metaverse Institute, leveraging their expertise in cutting-edge digital technologies. The collaborative process involved a multi-faceted approach:

- International Contextualization: Initial efforts focused on understanding global best practices and emerging trends in digital urban development and metaverse concepts. This provided a crucial international perspective on what constitutes effective and ethical digital transformation for cities.

- Multi-Stakeholder Workshop: A highly interactive workshop was organised, bringing together a diverse range of stakeholders. This inclusive approach ensured that perspectives from various sectors, including urban planning, technology, community organisations, and citizens, were considered in identifying key elements for the Citiverse.
- Key Stakeholder Interviews: A series of in-depth interviews was conducted with pivotal stakeholders. These targeted discussions enabled a deeper exploration of specific challenges, opportunities, and priorities related to the Citiverse concept within Rotterdam's unique context.

This rigorous and inclusive process led to the initial drafting of a set of foundational building blocks for Rotterdam's Citiverse. These draft building blocks are currently being shared with a broader audience to gather valuable feedback. This iterative process of seeking input underscores Rotterdam's commitment to co-creating its digital future with its citizens and partners. In the coming years, Rotterdam plans to further elaborate on these building blocks through dedicated research and pilot experiments. These practical explorations will provide deeper insights into their meaning, feasibility, and ultimately, their impact on the overall Citiverse vision. The outcomes will form the bedrock for the new vision document, empowering Rotterdam to create a truly connected, innovative, and citizen-centric digital future that is intrinsically linked to achieving the broader agenda of sustainable development.

Kampala, Uganda: Smart Waste Emptying Service

Start Date of the Initiative: 2023

Basic City Data

- Population size: 3,846,102
- Surface Area (sq.km): 189
- Population Density (people/sq.km): 9,352
- GDP Per Capita (U.S.$): 2,655
- Main Source of Prosperity: Tourism

Kampala, the capital city of Uganda, has a resident population of approximately 1,738,000. However, this number can swell to over 4,000,000 during the day as people commute from surrounding areas for work, business, and various activities. More than 60% of the city's residents live in informal housing, and only 10% to 15% of the town is connected to the formal sewerage system. Nearly 90% of the population relies on on-site sanitation models, making waste-emptying services essential for many.

Accessing these emptying services has been challenging for several reasons. Users previously had to visit municipal offices in person to apply, and services were offered on a first-come, first-served basis. This system was burdensome and often unfair to the poorest segments of the population. Despite having proof of payment, the reliability and timeliness of the services were frequently lacking. Additionally, the emptying services were largely unregulated, leading to the improper discharge of sludge into the environment, which posed health and environmental hazards.

In light of these challenges, the Weyonje App was developed and introduced. Citizens can use the app on their mobile phones to order and pay for emptying services, which are monitored using blockchain technology until the sludge is successfully delivered to a regulated dumpsite. For those without smartphones, especially residents of poor informal settlements, the Village Health Team (VHT) can request the service on their behalf through the Weyonje Village Health Team Application.

The app ensures that faecal sludge is safely transported and managed at the treatment plant. Data from the app feeds directly into the city's data management dashboard, allowing officials to track progress and identify gaps in the emptying service.

The Weyonje App is assisting Kampala in achieving Sustainable Development Goals (SDGs), particularly SDG 3 on good health and well-being, SDG 6 on clean water and sanitation, and SDG 10 on reduced inequalities.

Dubai, United Arab Emirates: Smart System for Infrastructure & Utilities Land Services

Start Date of the Initiative: 2023

Basic City Data

- Population size: 3,331,000
- Surface Area (sq.km): 35
- Population Density (people/sq.km): 762.6
- GDP Per Capita (U.S.$): 47,792
- Main Source of Prosperity: industry, trade, tourism, creative industry,

Dubai, a city in the United Arab Emirates with over 3 million residents, is renowned for its striking architecture and rapid development. To efficiently accommodate its growing population, the city has introduced an innovative system aimed at fully digitising and expediting the approval process for infrastructure projects. This innovation is transforming the planning and delivery of road, utility, and public service projects in Dubai.

In the past, obtaining approvals for infrastructure projects was a time-consuming and resource-intensive process. The Dubai Municipality is responsible for overseeing city services, including land planning and allocation, and receives hundreds of project requests each year from government entities such as the Roads and Transport Authority (RTA). The manual approval process involved extensive paperwork, in-person meetings, and complex coordination among various departments, often taking up to 30 days to complete. During this time, valuable staff resources were tied up with administrative tasks, delaying project implementation and obstructing the municipality's strategic vision.

To tackle these challenges, the innovative system was developed in-house and implemented in three phases. Phase 1 involved automating the approval process for road projects. RTA engineers can now directly upload road plans instead of relying on paper documents. The system automatically overlays these plans onto Dubai's digital cadastral maps, identifying affected land parcels, providing ownership details, and calculating compensation values. Approvals that previously took 30 days are now completed in just 2 days, requiring minimal staff involvement. Phase 2 integrated the system with RTA's existing No Objection Certificate (NOC) permit system for road works, streamlining the approval process across various government entities. Phase 3 expanded the system to facilitate the digital allocation of land for utilities and public services. Government entities can now request land online, with the system providing available site options that meet their requirements. Users can select a site and submit their application digitally.

The implementation of this innovative system has brought significant benefits to all stakeholders. By fully digitising what was once a manual approval process, the system enables a 100% paperless workflow, eliminating delays and inefficiencies associated with handling physical documents. Furthermore, it reduces the administrative workload for municipality staff, allowing them to focus on higher-level analysis and planning. Government entities using the system have reported increased satisfaction levels.

This initiative exemplifies how digital transformation within government services enhances efficiency, aligning with several Sustainable Development Goals (SDGs), including SDG 9 (Industry, Innovation, and Infrastructure), SDG 11 (Sustainable Cities and Communities), and SDG 16 (Peace, Justice, and Strong Institutions).

Conclusion

The Citiverse initiative presents a transformative vision for urban development, demonstrating that through innovative digital solutions, we can navigate the complexities of urbanisation while prioritising human-centric values.

The Citiverse initiative presents a transformative vision for urban development, demonstrating that through innovative digital solutions, we can navigate the complexities of urbanisation while prioritising human-centric values. The cases of Buenos Aires and São Paulo illustrate how cities can harness technology not merely as tools for efficiency but as instruments for social equity and inclusion. These examples highlight the profound impact that thoughtful integration of digital resources can have in addressing both immediate urban development challenges and broader societal issues, such as the integration of informal workers into the formal economy.

In Buenos Aires, the Ciudad 3D initiative is a significant leap toward reimagining urban planning, creating a more transparent and accessible framework for citizens to engage with their city's development. This approach fosters a culture of participation and accountability, where residents are empowered to contribute to discussions about their environment and governance. The ability to visualize urban changes through a digital platform not only enhances understanding but also builds trust between the government and its citizens, establishing a foundation for collaborative city-building efforts. As Buenos Aires aspires to evolve into a "metaverse" city, it sets a powerful example for other urban centers about the potential of technology to enhance lives, improve communication, and foster community involvement.

Similarly, in São Paulo, the Tô Legal initiative demonstrates an innovative response to the complexities of informality in the urban workforce. By simplifying the permit process for informal vendors, the city acknowledges the essential role that these workers play in the local economy while providing them with the necessary tools to transition smoothly into the formal sector. This not only legitimizes countless livelihoods but also significantly contributes to the overall urban economy, alleviating poverty, and reducing inequality. The application of geographic information systems (GIS) in this project offers valuable insights into urban dynamics, enabling more informed decision-making processes that benefit both vendors and the municipality.

Bogotá's Care Blocks tackle the pressing issue of "time poverty" experienced by caregivers, many of whom juggle low-paying jobs alongside daily caregiving responsibilities. This initiative addresses a significant challenge faced by many societies: the dynamics of the caring economy and shows how a city can begin the make a substantial difference.

Guangzhou's integrated approach to neonatal healthcare is proving to be beneficial by preventing newborns from becoming seriously ill. This strategy is not only saving money for the healthcare system but also reducing stress for parents. It illustrates the potential of the citiverse in healthcare, seamlessly connecting prevention with treatment, convenience, and affordability.

Success hinges on solving human problems, as seen in initiatives like Sao Paolo and Kampala; digital tools are enablers, not solutions. Each of the use cases presented here directly advances 2–3 Sustainable Development Goals (SDGs), emphasizing that technology must align with global aims such as climate action in Tampere and reduced inequality in Bontang. Collaboration is essential, with examples like Rotterdam's multi-stakeholder workshops, eThekwini's public-private "Strat Hub," and the EU-wide digital twins by EDIC illustrating how partnerships can unlock scale. Data democratization is crucial as well, demonstrated through geospatial dashboards in Bontang, open-source platforms in Buenos Aires, and real-time city analytics in Moscow,

all of which foster trust and inclusivity. Lastly, ethics guardrails are fundamental; Tampere's framework for ethical AI and Dubai's transparent land services highlight how governance can ensure that technology benefits everyone.

As we look to the future, it is essential to underscore the importance of collaboration among diverse stakeholders, including city governments, private sector innovators, academic institutions, and community organizations. The Citiverse thrives on this collaborative spirit, where knowledge sharing and collective problem-solving become the norm. In this digital age, cities that prioritize a people-centered approach to urban planning and development will not only achieve their sustainability goals but also cultivate thriving communities that are resilient to the challenges of climate change, economic shifts, and social inequalities.

Finally, embracing the principles of the Citiverse aligns with the UN Sustainable Development Goals, illustrating the critical role of innovative urban initiatives in promoting sustainable growth and equitable access to opportunities. As cities worldwide continue to evolve, the examples set forth in this paper inspire a new wave of urban governance—one where technology is used as a powerful ally in the service of humanity. By putting people at the centre and facilitating a dialogue between technology and community needs, we can ensure that urbanisation leads to prosperous, inclusive, and sustainable futures for all. As we advance, let us strive to further expand and implement these transformative solutions, turning the abstract promise of the metaverse into concrete benefits for urban dwellers across the globe.

These cases are not isolated triumphs - they are building blocks for a collaborative urban future. The Citiverse offers a blueprint to accelerate learning by sharing failures and successes across borders, and to co-create ethical frameworks and standards going forward. As cities embrace their digital futures, the Citiverse becomes the nexus where technology serves humanity, turning the metaverse from a buzzword into a force for equity, sustainability, and hope.

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