OECD

Issues Note

Artificial Intelligence for Advancing Smart Cities

5th OECD Roundtable on Smart Cities and Inclusive Growth

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Introduction

Artificial Intelligence (AI) is rapidly becoming a key tool for decision-making in cities. From traffic control and energy management to housing policy and citizen services, AI enables cities to process vast streams of real-time data and act with greater precision, speed, and foresight. However, integrating AI into public policy decisions also raises critical questions about governance, ethics, equity, and accountability. Without careful ex ante analysis, cities risk adopting technologies that might inadvertently entrench inequalities or compromise privacy.

Better understanding how AI plays out in social and institutional contexts in cities helps policymakers ensure that these tools serve the public good.

In this context, this issues note aims to support policy dialogue and facilitate international knowledge exchange between national and local policy makers on how AI could help better plan, manage and govern smart cities, drawing on the expertise of OECD member countries. The note seeks to highlight how cities are currently using AI for advancing smart cities and, in turn, sustainable urban development, as well as identify the challenges and limitations they face. The final goal of this note is to support city governments in adopting AI to ensure that their investments in AI drive resilience and good governance.

This issues note builds on desk research examining how AI can help address key urban development challenges, such as urban mobility, housing, land use, social inclusion, environmental preservation, economic development, governmental efficiency, urban resilience and safety. A set of cities has been selected as 'light case studies' to showcase good practices, based on interviews with local officials. The analytical framework guiding these case studies focuses on two main dimensions: (i) the overall urban context in terms of objectives and challenges; and (i) AI assets for urban development (including data, models, infrastructure, and skills), enabling conditions for AI diffusion (including governance financial arrangements, stakeholders engagement), and associated risks and benefits.

This 'Issues Note' supported the discussion during the 5th OECD Roundtable on Smart Cities and Inclusive Growth on 27 October 2025, and was subsequently revised with key insights from the Roundtable

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1 The case for AI in advancing smart cities

Smart cities are on the frontline of global and local challenges

Cities are increasingly at the centre of global challenges. Although they cover only 3% of the earth's land surface (UNEP, 2022[1]), they host more than half of the world's population and in some countries this share is over 90% such as in Belgium (98%) and Japan (92%) (OECD/European Commission, 2020[2]; UN, 2018[3]). This concentration of people and activity puts cities under pressure. Cities are responsible for around 70% of global CO_2 emissions (World Bank, 2023[4]), mainly due to industrial activity, energy use and fossil fuel-based transport. Yet, cities are also among the most exposed to climate impacts, including heatwaves, flooding and other natural hazards. And despite their large contribution to climate change, they are also the main opportunity to dealing with it (Bulkeley, 2013[5]). Cities are also losing population, between 2001-21 across OECD countries, 21% of metropolitan midsize (TL3 regions) and 10% of metropolitan large experienced population shrinkage; in the EU 40% of cities with fewer than 250 000 habitants lost population between 2011 and 2021 (OECD, 2025[6]). At the same time, cities face deep-rooted inequalities, including in housing, mobility and access to basic services. However, density, connectivity and institutional capacity also make cities key arenas for testing and scaling solutions that improve quality of life and inclusion.

This dual role as sources of global challenges and platforms for their solutions makes cities critical arenas for addressing the most pressing challenges of the 21st century. Cities play a crucial role in achieving the Sustainable Development Goals (SDGs). They manage critical policy domains, work closest to people's daily lives and can serve as testbeds for experimenting solutions that could later be scaled up nationally (OECD, 2020[7]). They provide essential services such as education, transport, waste management, healthcare, public safety and access to green spaces. Cities are also engines of economic activity and social transformation. They generate about 80% of global GDP (World Economic Forum, 2022[8]) and are drivers of innovation and cultural change. When empowered, they can pilot digital and smart solutions such as integrated mobility platforms, artificial intelligence (AI)-driven health and safety systems, or participatory planning.

However, cities face specific challenges. Urban governments must deal with rising demands for affordable housing, integrated public transport, reliable utilities and public safety, while also reducing greenhouse gas emissions and adapting to climate risks. Despite such mounting needs, many city administrations face fiscal constraints. In 2021, central governments in OECD countries collected 52.6% of total public revenues, while subnational governments collected only 29.7% (with 19.5% going to regions and 10.2% to local governments) (OECD, 2025[9]). Nonetheless, subnational governments accounted for about 38.3% of total public expenditure and 55.1% of total public investment in OECD countries in 2023 (OECD, 2025[10]).

City administrations are therefore under growing pressure to deliver more with limited resources while implementing innovative and resource-efficient approaches to planning and policy. The dual

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role of cities as both a source and a solution to global challenges underlines the urgent need for adequate resources and effective use of smart technologies to turn the concentration of people and activity into a lever for inclusive and sustainable development.

In this context, smart cities are becoming increasingly central to urban strategies. Defined as "cities that leverage digitalisation and engage stakeholders to improve people's well-being and build more inclusive, sustainable and resilient societies" (OECD, 2021, p. 8[11]), smart cities harness the opportunities of the digital transition, including AI, cloud computing and Big Data, to deliver better services and improve living conditions for millions of residents (Box 1). For example, during the COVID-19 pandemic, AI, the Internet of Things (IoT) and Big Data played a critical role in managing health risks and sustaining essential urban functions. More broadly, the integration of these technologies into urban systems has reinforced the relevance of smart cities as platforms to advance long-term resilience, sustainability and inclusive growth. Looking ahead, the strategic use of digital tools can help cities accelerate the shift to climate neutrality, reduce inequalities and strengthen preparedness for future shocks.

Box 1. A glossary of smart city-related digital tools

- **AI system**: a machine-based system that, for explicit or implicit objectives, processes the input data it receives to generate outputs – such as predictions, content, recommendations or decisions – that can influence physical or virtual environments. AI systems vary in their levels of autonomy and adaptiveness after deployment.
- **Big Data**: are information assets characterised by high volume, velocity and variety, which require specific technology and analytical methods to transform them into value.
- **Big Urban Data:** encompasses large and heterogeneous datasets generated within urban environments through the continuous operation of digital infrastructures, sensors, mobile devices, social media, and administrative systems. It is a subset of Big Data that is specific to cities and is characterised by the above-mentioned often expanded to include veracity (data reliability) and value (usefulness for decision-making).
- **Blockchain**: is a shared ledger of transactions between parties in a network, not controlled by a single central authority.
- **Cloud computing**: it can be understood as a service model for computing services based on a set of computing resources that can be accessed in a flexible, elastic, on-demand way with low management effort.
- **Data:** refers to recorded information in structured or unstructured formats, including text, images, sound and video. Data can be in any format, including analogue formats like paper, but the rise of digital technologies has enabled the growth and policy relevance of digital data, i.e. information stored by a computer in binary format. Almost every aspect of the digital environment, including a website or a banner advertisement, is data.
- **Data lakes, warehouse and lakehouses:** Model of data storage allowing to integrate, in flexible and scalable ways, large volumes of raw (non-processed) data, i.e. in both structured and unstructured formats, e.g. for big data and real-time analytics. As opposed to data warehouses that operate on a rigid schema (schema-on-write) with structured data that require pre-processing, but could make data analysis simpler, especially for limited volumes of relatively uniform data. The challenges of the data lakes include data swamp, performance issues, and ensuring compliance with data protection legislation. Both models are complementary and increasingly mixed into data lakehouses.

- **Digital technology**: is a collection of technologies centred around digital information processing; it covers cutting-edge fields such as Big Data, AI, cloud computing, the Internet of Things, and blockchain.
- **Edge computing:** Hardware developed "at the edge" of the network, i.e. near the user or data source (such as Internet of Things -IoT- devices or local databases), to reduce the resources needed for data management, improve network performance and connectivity, reduce data processing latency and increase real-time response, and eases compliance with jurisdictional requirements for security and privacy. Typical use cases are billions of IoT devices used in advanced warehouse and inventory management solutions, vision- and sensor-enhanced robotic manufacturing lines, or advanced smart city traffic control systems.
- **Generative AI (GenAI):** is a subset of AI capable of producing original and realistic outputs across modalities such as text, images, and sound.
- **Internet of Things (IoT):** is a network of physical devices, vehicles, appliances, and other physical objects that are embedded with sensors, software, and network connectivity, allowing them to collect and share data.
- **Machine learning**: describes a branch of AI focused on enabling computers and machines to imitate the way that humans learn, perform tasks autonomously, and improve their performance and accuracy through experience and exposure to more data.
- **Personal data**: refers to any information relating to an identified or identifiable individual, i.e. someone who can be identified, directly or indirectly, by reference to an identifier (such as a name, identification number, location data, or online identifier) or to one or more factors specific to that person's physical, physiological, genetic, mental, economic, cultural or social identity. Personal data typically requires more restrictive access regimes than non-personal or certain public sector data.
- **Proprietary data**: refers to data generated or owned by private entities, often corporations, such as industrial data, and that are typically protected by intellectual property rights, including copyrights and trade secrets, or control regimes, including contracts and cyber-criminal law. Several mechanisms enable access and use of proprietary data, e.g. licensing, data sharing agreements, compensation mechanisms, confidentiality safeguards etc. Access and sharing tends to be more restrictive compared to public sector data.
- **Public data**: refers to public-sector information or government data, i.e. data produced or held by public authorities (governments, public agencies). Public data can be released and used under open data policies or open government initiatives. Most OECD countries today have adopted "open by default" approaches that reflects the notion of "public data as a public good", whereby data can be delivered with a purpose, proactively, with a focus on re-use, and in line with user needs and potential contribution to value co-creation.
- **Urban AI:** refers to AI systems trained on urban data and designed to support solutions deployed in city contexts.
- **UrbanistAI**: AI tool to collaboratively design new concepts for public spaces and building designs; assess design solutions with stakeholders and the help of AI agents; and conduct in-person and online polls to select the most desirable ideas.

Source: (OECD, 2024[12]); (OECD, 2022[13]); (OECD, 2022[14]); (Heritier and El Hani, 2024[15]); (IBM, 2023[16]); (Kergroach and Héritier, 2025[17]); (Li et al., 2024[18]); (ISARSOFT, 2023[19]); (IBM, n.d.[20]) ; (De Mauro, Greco and Grimaldi, 2016[21]); (UrbanistAI, n.d.[22]); (OECD, 2014[23]); (OECD, n.d.[24]).

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AI as a strategic tool to address urban challenges

Artificial intelligence (AI) is increasingly embedded in smart city strategies to improve efficiency, resilience and inclusion. AI enables cities to analyse and interpret complex datasets, manage urban systems more effectively, and support adaptive, data-driven governance. AI can support multiple urban functions, for example to:

- Optimise resource use by detecting inefficiencies, forecasting demand and automating energy, water or transport management.
- Strengthen data-informed governance by enabling policymakers to anticipate problems, model scenarios and design adaptive responses.
- Improve public services by enhancing safety, personalising mobility and expanding access to digital assistance and information.
- Reinforce resilience and sustainability through predictive risk management and better environmental monitoring.
- Manage systemic complexity by detecting interdependencies across infrastructures and services, such as links between power supply, healthcare and mobility, to anticipate cascading failures and coordinate responses across agencies.
- Promote inclusive urban development by improving access to information, tailoring services for diverse populations, and supporting participatory planning processes enabled by strong governance and safeguards.

AI in cities is not only a technological challenge, but also a civic and democratic one. Within a short time horizon, the day-to-day delivery of essential services such as energy, water, transport, and waste management will increasingly be determined by algorithmic systems that are neither visible to the public nor situated within the conventional mechanisms of democratic scrutiny. This presents a structural governance risk

When deployed responsibly, AI can also reinforce the productivity, adaptability, equity and sustainability of urban systems (Beroche, Chubinidze and Goelzer, 2023[25]). AI can support cities in addressing critical policy areas, such as:

- *Climate change and environmental management*. AI-driven models can monitor and forecast air quality in real time, enabling targeted traffic restrictions before pollution peaks. Predictive analytics can optimise energy demand, integrate renewable energy generation into local grids and design adaptive cooling strategies to protect vulnerable populations during heatwaves.
- *Social and spatial inclusion*. AI analysis of transport data can identify “mobility deserts,” guiding investment in new routes or shared services. In housing, predictive tools can flag eviction risks or detect discriminatory rental practices, helping authorities act early to protect vulnerable residents.
- *Economic development*. AI can enable advanced data analytics for business intelligence, supporting start-ups and tech clusters, and attracting investment boosting competitiveness and innovation. It can strengthen the labour market by helping match skills with jobs and anticipate future workforce needs. By using predictive modelling, AI can identify high potential business districts and infrastructure needs.

The experience of the city of Mannheim (Germany) suggests that **AI becomes transformative once it is directly integrated into the real planning workflow.** However, this requires a capacity to mainstream academic innovation into standard municipal processes. For example, the city’s ‘Smart Routes’ work shows how AI can be directly embedded into core urban decision systems. The city is using AI models for micro-climate simulation with 3 600 measurement points and a 3D city model reducing simulation time from weeks to seconds, enabling rapid iterative testing of measures such as adding trees or converting

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concrete to green. Mannheim is also using AI to calibrate traffic models with 95% accuracy to anticipate congestion and predict the effects of road closures.

In addition, **AI can offer a tool to reinforce public service delivery, not replace public servants.** Paris (France), for example, is applying AI to enhance the intelligence and responsiveness of several core public service areas such as water management, noise and nuisance monitoring, and urban planning analytics. However, the city considers face-to-face contact between citizens and administration as an irreplaceable public good.

Recent trends in AI adoption and divergences in trajectories in cities

From centralised systems to "urban AI"

Initially introduced in large, centralised projects led by public authorities and major technology firms, first-generation AI applications were managed from a single central platform, designed to anticipate, react and learn continuously. AI systems and decision-making processes were concentrated in a single, top-down platform managed and controlled by one central authority, rather than being distributed or decentralised across multiple actors or smaller systems. An early example of AI deployment is the Rio Operations Centre (ROC), created in 2010–2011 by the city of Rio de Janeiro with IBM (Lyle and Harrison, 2014[26]).[1] The ROC integrated real-time data from more than 30 municipal agencies (including transport, weather and flooding) into a single command platform. Its high-resolution weather forecasting system could anticipate severe rainfall up to 48 hours in advance, improving emergency response co-ordination.

Between 2010 and 2020, AI tools became more accessible to cities as costs declined and commercial solutions expanded. The release of generative AI systems, such as ChatGPT in 2022, further accelerated adoption, allowing a wide range of stakeholders to experiment with AI for urban analysis and service delivery. This shift has led to the notion of "urban AI", which refers to algorithms trained on city-specific datasets to support or enable local solutions (Beroche, 2020[27]). Closely linked to the growth of Big Urban Data, urban AI introduces autonomous, anticipatory and adaptive decision-making into complex urban systems that move beyond human predictability and control.

AI is therefore increasingly recognised as a strategic enabler of smart cities, providing them with the capacity to process and interpret complex and rapidly growing streams of urban data. By coupling sensor networks, IoT devices, satellite imagery, administrative records, and other data sources with advanced analytics and machine learning models, cities can detect patterns, predict trends, and automate decision-making in real time. For example, Lisbon is leveraging AI-driven digital-twin modelling to simulate flood scenarios and plan adaptive infrastructure responses. This is estimated to avoid 20 floods in the two next decades and save more than EUR 100 million in damaged infrastructure and loss of livelihoods (Geospatial World, n.d.[28]). Singapore uses AI to optimise traffic flows, dynamically adjust public transit schedules, and manage energy grids more efficiently (AEA, 2024[29]). Such applications allow urban managers not only to react to challenges such as floods or congestion and pollution, but to anticipate them, direct resources proactively, and refine interventions regularly.

However, the rapid diversification of AI tools creates new governance challenges. Multiple systems, often developed by different public, private and civic actors, may operate in parallel without shared standards or oversight. This can generate data silos, contradictory outputs and "technical debt"[2] from poorly integrated technologies (OECD, 2023[30]). The rise of "shadow AI", understood as unregulated tools deployed outside official frameworks, can also disrupt processes, increase security risks and fragment accountability (Krantz, Jonker and McGrath, 2024[31]). In extreme cases, competing stakeholders could misuse AI to gain influence or control within urban systems. These developments highlight the need for clear governance frameworks, interoperability standards and risk management strategies to ensure that AI strengthens rather than destabilises city operations (Beroche, Chubinidze and Goelzer, 2023[25]).

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At the same time, internationally comparable data on levels of AI adoption across cities remain rare. Cities are not at the core of global AI ranking programmes or measurement initiatives (Box 2). Existing monitoring efforts tend to focus on AI adoption in the business sector, which offers some insights on trends and patterns in the AI transition (Box 3).

Box 2. Measuring AI transition and conditions

Internationally comparable data on AI are scarce, reflecting the complex and multidimensional nature of the AI transition and its novelty. Several initiatives by international organisations, academia, global consultancies or media aim to monitor AI trends on a regular and comprehensive basis and propose international benchmarkings. Among those are the Stanford AI Index **Invalid source specified.**, the IMF AI Preparedness Index **Invalid source specified.**, the Oxford AI Readiness Index **Invalid source specified.**, the Tortoise Media's Global AI Index **Invalid source specified.**, the Latin America AI Index **Invalid source specified.**, the AI and Democratic Value Index **Invalid source specified.**, or the Global Index on Responsible AI **Invalid source specified.**, to name a few. The OECD has also convened an expert group to develop a composite OECD AI Index (OECD, 2025[9]).

These initiatives differ in scope, data and country coverage, as well as in the extent to which metrics are AI-specific. They look at country or (supra-national) regional capabilities for AI development and deployment (adoption), technical performance (Stanford), enabling factors (IMF, Tortoise Media), economic and social impact (Stanford), or AI governance and policies (Oxford AIRI, CAIDP, GCG). In order to compile a comprehensive picture of AI progress, these initiatives combine metrics derived from existing measurement systems, including R&D and innovation surveys, patents applications, bibliometrics, venture capital investments, educational enrolment and attainment, broadband connectivity, etc. They also leverage business and commercial data (e.g. Linkedin, business associations) or opinion surveys.

A common feature of these initiatives is that they do not take a subnational or city perspective on AI measurement.

Source: , **Invalid source specified.**; **Invalid source specified.**, **Invalid source specified.**, **Invalid source specified.**, **Invalid source specified.**, **Invalid source specified.**, **Invalid source specified.**, (OECD, 2025[9]).

Converging evidence on fast but uneven diffusion, and diverging city trajectories

Private and public sources report converging evidence on a fast but uneven deployment of AI in cities

- Based on a survey carried out in the second half of 2024 in 250 cities of different sizes across 78 countries (i.e. estimated to encompass 734.2 million inhabitants and 9% of the world population), Deloitte, ThoughtLab, ServiceNow, and Nvidia (2025[32]) report that 56% of surveyed cities actively use AI, either selectively (38%) or widely (18%), and 35% are piloting or planning to use it. They anticipate AI use to expand exponentially, with the share of cities widely using it nearly tripling over the next three years (from 18% to 48%).
- The Smart City Index (2024[33]), analysing over 5 000 smart city services, infrastructure and initiatives across 50 cities, points to a faster than ever AI adoption, particularly in city administration and mobility, and in cities like Seoul (Korea) that have pioneered the integration of AI into urban infrastructure.

- The Global Observatory of Urban Artificial Intelligence (GOUAI), a project initiated in 2021 by the cities of Barcelona, Amsterdam, and London with the support of UN-Habitat, documents 218 AI initiatives across 74 cities. The Atlas highlights an exponential growth of urban AI initiatives over the past decade, with a large dominance of initiatives for improving city governance and urban services (66%), including chatbots to assist residents, and AI tools to improve internal municipal management processes, the delivery of municipal services, or law enforcement (CIDOB, 2025[34]). Conversely, applications are less common in urban planning, urban security and resilience, and economic development promotion.

Box 3. Industry leads AI developments and business adoption of AI has accelerated with GenAI

Industry has taken the lead of AI developments ahead of academia. Cutting-edge AI models require substantial amounts of data, computing power, skills and financial resources that are not accessible to many actors. The most advanced models now cost hundreds of millions of dollars, and training costs are doubling every nine months for the largest ones **Invalid source specified.**. 2014 marked a tipping point in developments, when industry started releasing more notable machine learning (ML) models, i.e. state of the art models that mark the frontier in ML developments, than academia. In 2024, industry produced 72 notable ML models, while academia was responsible for 3, and 9 resulted from joint industry-science collaborations **Invalid source specified.**. Google (DeepMind), Meta/Facebook, OpenAI and Microsoft account together for more than two-thirds of global industrial AI developments.

AI diffusion accelerated in 2023 and 2024 among businesses, which coincides with the advent of generative AI (Kergroach and Héritier, 2025[17]). Generative AI (GenAI) differs from earlier AI systems because of their lower deployment costs, reduced technical pre-requisites, and enhanced flexibility and modularity (Calvino, Haerle and Liu, 2025 forthcoming[35]). This new generation of AI tailors output to users and contexts across a wide range of domains and sectors. It allows to leverage pre-trained models and experiment on low-code/no-code platforms without advanced technical skills, while predictive AI models require high computing power and deep expertise.

Despite potential and promises for improving competitiveness, sustainability and responsible business conduct, AI uptake has remained uneven. Some places, sectors and firms have been slower in the transition and recent, post GenAI, acceleration has been more driven by leaders escaping the pack than laggards catching up (Kergroach and Héritier, 2025[17]). Top country, region and firm adopters have consolidated their lead, capitalising on their advance using the first generations of AI technologies. Korea, Nordic countries (Denmark, Sweden, Finland), and Belgium are ahead, as well as the most innovative regions, that combine a highly educated and digital-savvy population, efficient research systems, intensive production of intellectual assets (e.g. patents, trademarks) and a large population of innovative firms.

Source: (Calvino, Haerle and Liu, 2025 forthcoming[35]); **Invalid source specified.**; **Invalid source specified.**; (Kergroach and Héritier, 2025[17]).

Two recent breakthroughs in AI development have stimulated city adoption and could spur further diffusion: generative AI and agentic AI

- ***Generative AI*** (GenAI) creates content in response to natural (human) language queries, and produces text, programming codes, images, videos, sounds or artworks. Introduced in 2022, GenAI, compared to previous AI systems, is not designed for prediction or to provide

recommendations, make decisions, or act on the real world. It can, however, draw on large amounts of municipal data to develop analysis and generate new contents. In addition, it requires lower cost of deployment or technical pre-requisites than earlier AI systems, because it can leverage pre-trained models and low-code or no-code platforms, bringing the technology within the reach of many. It also provides greater flexibility and modularity to contexts and needs allowing to personalise output (Calvino, Haerle and Liu, 2025 forthcoming[35]).

Applications typically include citizen interfaces and virtual assistants (e.g. chatbots) that can operate 24/7 multilingual, personalised public services or support participatory governance and citizen engagement (e.g. feedback platforms). GenAI can also significantly increase cities' capacity to analyse data, including from various unrelated sources (e.g. reports, council notes, citizen complaints, administrative registers, archives etc.).

- ***Agentic AI*** is a type of AI systems designed to pursue specific goals autonomously within a specific context. It possesses capabilities to make decisions, take actions, and adapt strategies based on environmental feedback, often requiring minimum human oversight or intervention. Mainly deployed since the second half of 2024, agentic AI is increasingly used in software and computer engineering or interfaces, in robotics and autonomous vehicles, or in decision-support systems (Casper et al., 2025[36]).

  Applications can be found in multiple areas of relevance to urban operations, such as autonomous management and co-ordination of mobility and utilities services (e.g. fleet, energy, waste and water). In particular, agentic AI can support multi-agent collaboration, i.e. the ability of city systems and computers to co-ordinate, synchronise action (including in real-time) and break city administrative silos.

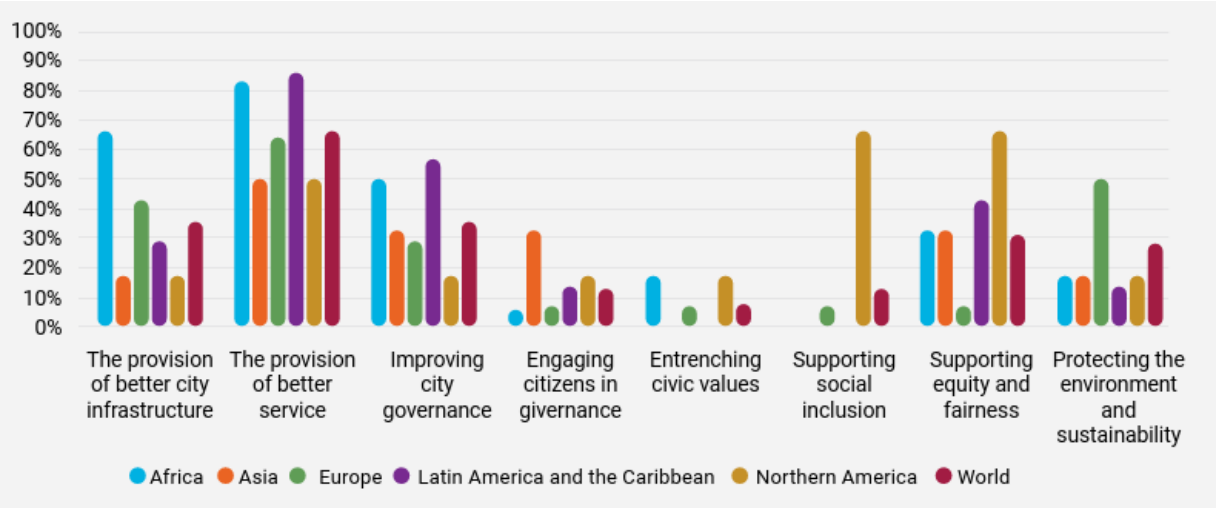
Some cities have established themselves as AI leaders, often drawing on their size, access to larger resources, and wider and more advanced local innovation systems. According to a survey by Deloitte, ThoughtLab, ServiceNow and Nvidia (2025[32]) 44% of large cities are estimated to use AI widely, as compared to just 12% of small cities (Deloitte, ThoughtLab, ServiceNow, and Nvidia, 2025[32]). This is the case of San Jose and San Francisco, Tel Aviv, Dubai, Paris, Berlin, Seoul, Hong-Kong and Tokyo. However, according to this same ranking, smaller cities, such as Quebec City, Bratislava, or Edinburgh, have also been able to integrate AI into their urban operations and become AI leaders, just as cities in countries with a lower level of economic development, such as Harare (Zimbabwe) or Curitiba (Brazil).

While the factors of success in urban AI adoption would deserve further investigation, the gaps observed between early adopters and others, as well as the different profiles of leaders, suggest diverse pathways in the transition.

Not all cities adopting AI pursue the same objectives and ambitions. According to a global survey by UN-Habitat (2024[37]) questioning municipalities on the core values underpinning AI adoption, responses showed marked differences in cities' AI agenda worldwide . While municipalities in Africa aim to improve city infrastructure and services, more focus was given on city governance in Latin America, on environment and sustainability in Europe, on citizen engagement in Asia, and on social inclusion, equity and fairness in North America. A key trend recently observed in cities' AI adoption is the focus on inclusivity, reflecting a broader recognition that smart cities must not only be efficient but also equitable, i.e. making services accessible to all citizens, regardless of age or ability (The Smart City Journal, 2024[33]).

Figure 1. Core values underpinning AI projects in cities

Share of respondents (%)



Note: Global survey of 122 municipalities across Africa, Asia, Europe, Latin America, and North America, to city managers, experts, researchers, and other stakeholders involved in AI planning, design, and governance. The report also combines a comprehensive desk review and 70 case studies to gather diverse perspectives on AI in urban settings. Assessment was validated by an expert group, including city government representatives of various countries. Academia was represented by experts from the Seoul Institute of Technology, Research ICT Africa and the Kibabii University (Kenya), PIT Policy Lab (Mexico), the University of Montreal (Canada), and the Institute for Ethics in Artificial Intelligence of the Technische Universität München (Germany), among other institutions.
Source: (UN-Habitat, 2024[38]).

Consequently, AI solutions are designed for promoting innovation and transformation in specific areas. These targeted approaches reflect difficulties in integrating AI across broader functions or in a systemic way across the whole spectrum of city operations, and priority setting in tackling challenges. Recent findings from business statistics also show that AI applications and patterns of diffusion vary significantly across business sectors and places (Kergroach and Héritier, 2025[17]). Firms are more likely to use AI to increase competitiveness, especially in core business areas, and the (substantial) investment required for change is driven by speculation on future competitiveness-enhancing effects. The use of AI in non-core business areas or general administration is less common.

Differences in city transitions to AI are also likely to arise from differences in local conditions and barriers. Recent literature review that investigates barriers to AI implementation in smart cities reports a number of obstacles, including data availability, lack of qualified professionals, (too high) cost and (too long) duration of AI initiatives, and high unemployment rates that could reduce economic and financial capacity for change, and raise fear of job losses and public resistance (Herath and Mittal, 2022[39]). These barriers do not have the same magnitude across cities.

2 Cities worldwide are using AI to address pressing urban challenges

Cities around the world are harnessing artificial intelligence (AI) to improve urban management and sustainability. AI uses differ, as cities adopt and combine applications depending on their specific needs. From smarter mobility and housing planning to more efficient government services and enhanced urban resilience and safety, AI is becoming an integral tool for shaping more sustainable, efficient and inclusive urban futures.

Building on desk research and interviews with urban stakeholders in selected frontrunner cities, Chapter 2 aims to illustrate the variety of AI use cases and challenges in urban planning and city management. Overarching considerations are complemented with selected examples to better document AI solutions adopted in smart cities, the reasons for their adoption, and the conditions of their implementation. The chapter also explores possible evidence on impact and return on investment (ROI).

AI in urban mobility and transport

AI-enabled mobility can help cities reduce congestion, emissions and safety risks while improving connectivity and accessibility for residents and visitors. Urban mobility is among the earliest and most dynamic fields for applying artificial intelligence (AI) in smart cities. This is partly due to the longstanding digital infrastructure that supports transport management, including Internet of Things (IoT) networks, urban sensors, GPS-enabled platforms and centralised control systems. These systems generate large volumes of behavioural and mobility data, a prerequisite for effective AI-driven analysis and decision-making.

Early applications of AI in mobility focused on analysing travel patterns to understand how movement relates to economic activity, well-being and access to services. By combining mobility data with other urban indicators, cities gained new insights into economic and spatial dynamics. For example, the MIT City Science Lab used AI to analyse behavioural data in Andorra, identifying travel patterns across multiple spatial and temporal scales to inform planning and service provision (Gringnard et al., 2018[40]; MIT Media Lab, 2020[41]).

AI also supports the real-time optimisation of transport systems. Integrated with IoT-based networks and municipal decision-making, AI enables dynamic traffic light control, predictive maintenance of road infrastructure and targeted safety interventions at high-risk intersections. These capabilities reduce congestion, improve safety and lower emissions. For instance, as part of the AI4Cities programme, the City of Meudon (France) deployed AI to optimise traffic light sequencing and improve traffic flow in real time.[3]

The next stage of AI integration in urban mobility relates to autonomous vehicles and delivery robots. Although still emerging, these applications aim to adapt continuously to traffic conditions, reduce network friction and support seamless, on-demand mobility. In Seoul (Korea), for example, municipal

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authorities and private companies such as Hyundai are testing autonomous mobility solutions, positioning the city as a living laboratory for these technologies (Seoul Metropolitan Government, 2025[42]).

AI can modernise critical urban mobility infrastructure, as illustrated by the case of the metro in Barcelona (Box 4). Through real-time data integration, predictive analytics and adaptive control, the system improves passenger comfort and safety, while reducing negative environmental impacts and operating costs. Its success reinforces the potential of AI to support sustainability, resilience and well-being in complex public transport networks.

Box 4. AI-optimised ventilation in the metro in Barcelona, Spain

Barcelona (Spain) operates a century-old metro network with more than 130 stations and over 400 million annual passenger journeys. As urban density increases and climate pressures intensify, maintaining passenger comfort, air quality and safety underground has become a strategic priority for the city. The Barcelona metro faces challenges of particulate matter pollution, thermal stress, and ventilation inefficiencies. Platforms in the Barcelona metro can reach up to 35 °C during midday in summer, particularly in older lines. Traditional ventilation systems relied on fixed operations, which often resulted in inefficient energy use, limited adaptability to real-time conditions and only modest improvements in thermal comfort. The outdated, non-dynamic fan systems of the Barcelona metro consume large amounts of energy, and the network has lacked predictive capacity to manage and maintain ventilation assets effectively. These conditions have threatened operational efficiency and passenger well-being.

To address these issues, Transports Metropolitans de Barcelona (TMB), a public enterprise owned and managed by the Barcelona Metropolitan Area (AMB), partnered with SENER Engineering, a private Spanish engineering and technology group, to create and deploy an AI-powered ventilation control platform called RESPIRA.

The initiative pursues multiple objectives: reducing heat and improving air circulation to enhance comfort, improving air quality for safety and public health, cutting energy use and operational costs, and advancing sustainability commitments by lowering carbon emissions and optimising asset use. These ambitions align with Barcelona's broader digital transformation and climate action strategies.

First introduced in 2020 on Line 1, the busiest route in the network, RESPIRA is scheduled for expansion in 2025 to Lines 1–5, which together carry 94% of total passengers. The project involves upgrading 187 station fans and 142 tunnel fans. By combining real-time monitoring of temperature, humidity, air quality and electricity use with predictive analytics such as weather forecasts and ridership trends, the platform can dynamically regulate fan operations across the metro system.

RESPIRA integrates and analyses more than 500 million data points annually. A self-learning algorithm continuously adjusts fan activity to balance thermal comfort, measured through a heat index reflecting passenger perception, with energy efficiency. Predictive capabilities also support long-term planning, helping prioritise maintenance and capital investments. The centralised platform allows operators to monitor and control ventilation remotely and adapt quickly to changing conditions.

The project's governance model combines technological expertise and operational knowledge. SENER leads system design and AI integration; Ferrocarril Metropolità de Barcelona (FMB), a publicly owned enterprise, manages infrastructure and daily implementation; and TMB provides operational context, ridership data and overall oversight. This collaboration has been essential to ensure technical integration, trust among operators and safety assurance for passengers.

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Financially, the initiative is supported through a collaboration agreement between SENER and FMB. Energy savings and reduced equipment wear are expected to offset investment costs over time, contributing to the long-term viability of the system.

However, implementation has faced challenges. Integrating AI with an ageing metro infrastructure has required overcoming technical complexity and legacy system constraints. Managing hundreds of millions of data points has demanded robust data governance and analytics capabilities. Building confidence among staff and passengers in AI-driven decision-making has also been critical to adoption.

At the same time, the initiative has brought about significant benefits. Pilot operations demonstrated up to a 30% reduction in energy consumption, a 25% decrease in ambient temperature and a 10% rise in passenger satisfaction between 2020 and 2024. Improved ventilation has been critical to support public health during the COVID-19 pandemic, while annual carbon emissions have been cut by more than 700 tonnes since the implementation of the pilot in 2020. By providing predictive insights, RESPIRA also helps operators plan maintenance and investment more strategically, reducing future costs and enhancing network resilience.

Source: (SENER, 2025[43]) (Ferreira Martins, 2016[44]); (Velasco, 2025[45]).

AI in housing

AI is gradually being integrated into housing policy and management to create more affordable, inclusive and sustainable living environments. AI can strengthen the capacity of housing authorities to plan, manage and deliver services, helping cities meet growing housing demand, improve energy performance and advance inclusion goals.

One established application is the use of AI for more sustainable and resilient construction and building management. AI can help optimise energy use and reduce greenhouse gas emissions in publicly owned housing throughout building operations, in particular heating, ventilation and air conditioning (HVAC) systems. AI-enabled smart grids can also allow buildings to operate in closed-loop systems or participate in peer-to-peer energy trading. These systems can maintain functionality even when disconnected from centralised energy networks.

Cities are also exploring AI to improve housing market intelligence and planning. For example, in Rotterdam (The Netherlands), digital twins and AI-based analytics help monitor housing developments, track pricing dynamics and inform responses to market fluctuations (European Commission, 2019[46]). Such tools provide authorities with more timely, granular insights to support housing affordability and stability. The case of Rotterdam illustrates how AI is used to monitor housing developments and pricing trends, not only to help the city make informed decisions on property values and energy demand and pricing, but also to increase its revenue (Box 5).

Another emerging area is the use of predictive analytics to identify households at risk of homelessness. By analysing data on income, employment, health or tenancy status, AI can help housing agencies design targeted interventions before crises occur. For instance, in Los Angeles County (United States), local authorities have applied predictive analytics to prevent homelessness by proactively identifying individuals at heightened risk of losing their home (Kempe, 2024[47]). The Homelessness Prevention Unit, in partnership with the California Policy Lab, has developed a machine learning model that integrates administrative data from health, social services, and justice systems to generate risk scores indicating the probability of homelessness within 12 to 18 months (Blackwell et al., 2024[48]). Households

with the highest scores are contacted and offered targeted assistance, including short-term financial support and case management. Early results from the pilot phase (May 2022 to February 2023) suggest that participants were about 71% less likely to enter street outreach or emergency shelter services compared to similarly high-risk individuals not enrolled.

AI is increasingly embedded in housing service delivery as well. The city of Helsinki (Finland) has introduced an AI-powered chatbot to assist residents in navigating rental housing services, offering 24/7 multilingual support while reducing the administrative burden on city staff (City of Helsinki, 2025[49]). More broadly, AI applications automate information provision, streamline application and eligibility assessments, and optimise resource allocation. These innovations enable faster service delivery, better response to residents' needs and improved access for vulnerable groups.

Box 5. Use of AI to monitor housing developments and track pricing dynamics in Rotterdam, the Netherlands

Accurate and timely monitoring of housing stock is essential for taxation, urban planning and managing the energy transition. In Rotterdam, property values depend not only on location but also on physical modifications such as roof extensions that add floor area. Many of these changes are not subject to mandatory permits or direct reporting, creating gaps in official housing databases. Such gaps have led to property undervaluation, inconsistent tax records and difficulties in planning infrastructure, including smart grids for solar energy.

To address these challenges, the Rotterdam city government has developed an artificial intelligence (AI)-based system, Spotr, that analyses high-resolution aerial and satellite imagery to detect building modifications. Using computer vision, the system identifies roof expansions, window additions and solar panel installations that could affect property values and energy demand. Detected changes are verified on site by municipal staff before updates are made to housing and tax registers.

The AI platform integrates multiple data sources, including cadastral records, underground infrastructure maps and the city's digital twin. Outputs feed directly into municipal functions such as taxation, energy planning and emergency response. Development was led by Rotterdam's in-house analytics team, which combines expertise in deep learning, geospatial data and urban planning. Collaboration with European peers, including Amsterdam (The Netherlands), Hamburg (Germany), Milan (Italy) and Tampere (Finland), has helped refine technical approaches and align with emerging standards for urban digital twins and "Cityverse" development.

Governance and transparency have been central to implementation. Rotterdam, together with Amsterdam and Eurocities, has created an algorithm registry to document AI systems, monitor risk levels and align with the EU AI Act's transparency requirements. Strong privacy protections ensure that personal or household-level data are never disclosed or processed beyond the project's legal remit, while bias assessments are systematically performed to detect and correct potential disparities in algorithmic outcomes across neighbourhoods. AI outputs are systematically reviewed and validated by human inspectors, helping to mitigate errors and maintain accountability and public trust.

The system has delivered several benefits. Property tax assessments are now more accurate and equitable, as unreported structural changes are detected and integrated into official records. AI-enabled monitoring of rooftop solar deployment improves planning for decentralised energy systems. Operational efficiency has increased, with tasks that previously required months of manual inspection

now completed in near real time. Data interoperability has also been strengthened, feeding Rotterdam's digital twin and supporting future integrated urban services.

Source: Based on an interview with Rotterdam city officials in August 2025.

AI in urban land use

AI is used in urban planning to enable more data-driven and adaptive decision-making. AI can help urban planners balance competing land use needs, respond to informal development, and anticipate environmental and social outcomes of policy choices.

One important application is AI-assisted zoning and land use optimisation, where algorithms generate multiple design scenarios in a short period based on a wide range of constraints, including regulatory limits, building heights, unit counts and floor area ratios. This capability allows planners to evaluate and compare development options more quickly and systematically.

AI is also applied to monitor and forecast urban expansion, particularly in informal settlements that are difficult to assess with traditional methods. For example, in eThekwini (South Africa), UN-Habitat and UNITAC have developed a machine-learning tool that accelerates the detection of informal settlements, helping local authorities move beyond slow, manual land monitoring and target service delivery more effectively (UNITAC, n.d.[50]).

Another emerging use case is the simulation of localised impacts of housing and land use policies. AI models can estimate potential changes in air pollution, access to green spaces or housing prices at the neighbourhood scale, providing valuable insights for more equitable and sustainable urban development (Beroche, 2019[51]). In Korea, the Urban AI project led by the Korea Research Institute for Human Settlements (KRIHS) and supported by the Ministry of Land, Infrastructure and Transport (MOLIT) applies large-scale data analytics and AI to support evidence-based urban planning, although the use of AI in urban planning is still in its early stages[4]. Similarly, AI-driven computer vision is increasingly used to analyse how residents interact with public spaces, generating more detailed knowledge about the use of parks, streets and other shared areas.[5]

AI can also help enhance public participation in planning processes. Tools such as UrbanistAI (Box 1), used in Helsinki and Dubai, apply generative AI to visualise citizen input, making complex land use scenarios easier to understand and debate (UrbanistAI, n.d.[22]). By improving accessibility and transparency, these technologies support more inclusive and participatory planning. For example, in Dubai, residents take part in designing urban areas such as parks through the Dubai Urban Design Platform. The initiative seeks to integrate community input into urban planning to ensure urban projects meet local needs. It uses generative AI to help city planners and citizens visualise future neighbourhoods and residential areas, users can generate and refine urban design options in collaboration with communities. This initiative is intended to optimise investment in urban design and planning projects by leveraging AI, including scenario modelling and adaptive design guided by community input.

If applied carefully, AI can help urban planners balance competing land use needs, respond to informal development, and anticipate environmental and social outcomes of policy choices. Robust governance frameworks and clear communication with the public remain essential to ensure fairness and build trust in these emerging applications. One key example of AI use to optimise multiple land uses while allowing planners to explore alternative development options can be found in the municipality of Eslöv (Sweden) (Box 6).

Box 6. AI-assisted zoning and land use optimisation in Eslöv, Sweden

Like several local governments across the world, the municipality of Eslöv, Sweden, often faces challenges in optimising land use and zoning decisions in early planning stages. Traditional processes of land use planning rely on static maps, manual design iterations and fragmented datasets, making it difficult to test multiple scenarios or integrate diverse constraints such as zoning laws, environmental regulations and demographic needs. These limitations slow decision-making and constrain innovation in sustainable urban development.

To address these issues, the municipality uses an AI-assisted planning and design platform called Hektar to support early-stage urban planning and zoning optimisation through generative design and data-driven analysis. The tool combines geospatial data, user-provided site plans and parametric design features with AI models that generate and evaluate multiple land use and architectural scenarios. This approach allows planners to explore alternative development options rapidly and compare trade-offs between density, environmental impact and spatial quality.

The platform integrates municipal and national open datasets covering zoning rules, infrastructure, cadastral maps and environmental protection areas with project-specific files uploaded in formats such as GeoJSON or DWG. AI models use predictive analytics to suggest optimal combinations of building typologies, while natural language processing (NLP) automatically produces descriptive texts for design outputs. Parametric algorithms also generate volumetric massing studies and performance indicators such as floor-area-ratio (FAR) or gross-floor-area (GFA). All outputs are produced in a fully digital environment using cloud computing, without reliance on IoT networks or physical sensors.

Governance and ethical oversight are included in the initiative. An interdisciplinary team of municipal planners, GIS specialists, architects and machine learning experts reviews and validates AI-generated outputs before decisions are made. The platform uses only authoritative datasets and maintains transparency by documenting design assumptions and performance metrics. Collaboration with the RISE Research Institutes of Swedish and other municipalities have supported the experimentation and evaluation of the technology's planning relevance.

The pilot was linked to a broader urban transformation programme called "Stadsutveckling Östra Eslöv – Utveckla Eslöv", which has a mandate to test innovative solutions for sustainability. Funding for the platform was provided by the national innovation agency Vinnova. Future deployment is expected to shift to a subscription-based model, enabling municipalities to pay according to usage and reducing reliance on grants.

Early results suggest that AI-assisted zoning has improved the ability of municipal planners to test alternative scenarios, integrate regulatory and environmental constraints and communicate complex design options more clearly to non-technical stakeholders. Automatically generated descriptive texts make proposals more accessible for citizens and decision-makers, while human oversight ensures accountability and maintains trust.

Source: Interview with Hecktar in August 2025.

AI for social inclusion in cities

Cities are using AI to promote social inclusion and better respond to the needs of diverse populations. AI can strengthen inclusive planning and service delivery and enable cities not only to map

inequalities but also to co-create solutions with communities, making digital innovation a driver of equity and social cohesion.

AI can help improve the accessibility of urban services. By generating simplified and adaptive content, AI tools can make public information easier to understand and use, particularly for residents with language, literacy or cognitive barriers. Such applications may enhance equity in access to key services, including housing, health care and mobility. For example, the Prague 6 municipal district (Czechia) has launched an AI chatbot (through the CommuniCity project) that lets residents ask questions in natural language and receive responses drawn from municipal information. It acts as an "intelligent guide" on the municipal website, reducing the need to navigate through many pages (CityMind, 2025[52]). Similarly, as part of the inGOV project, a Horizon 2020 / EU research project to develop integrated public services, the City of Bjelovar (Croatia) has implemented an AI-driven virtual assistant to help citizens interact with public services. The chatbot leverages NLP / language models for the Croatian language and is intended to smooth the interaction with municipal services, especially for users less familiar with bureaucratic language (Point Jupiter, n.d.[53]).

AI can also help identify vulnerable populations, and better predict, prevent and mitigate risks of exclusion. AI methods such as machine learning (ML) and deep learning (DL) can analyse large and complex datasets to detect inequalities and patterns of vulnerability. AI has been applied to identify groups most exposed to risk during crises such as natural disasters or economic shocks, helping authorities target support more effectively (Pentland, 2014[54]). For example, Montevideo (Uruguay) has employed AI and predictive analytics to identify neighbourhoods most vulnerable to flooding, poverty, and service deprivation, allowing the city to better prioritise social and infrastructural investments. This initiative, supported by the Inter-American Development Bank (IDB) combines satellite data, socio-economic indicators and mobility data to map urban vulnerability.[6]

Finally, emerging initiatives are exploring how AI can help design more inclusive public spaces. For example, the GIZ Data Lab has used AI to support inclusive city planning in Manila (Philippines). By visualising how existing public spaces could be modified to accommodate under-represented groups (e.g. women, older people, people with disabilities), AI helps surface design gaps. AI is used as a 'what if' tool in participatory workshops: participants see AI-generated alternatives and thus can better critique or imagine inclusive design possibilities (Hochwald, 2024[55]). In this respect, Montreal (Canada) provides an example of how AI is used for inclusive urban design, to ensure visual concepts of public spaces reflect diverse needs and values. Research suggests, however, that for AI and data-driven urban infrastructure to be truly inclusive, data practices must themselves be equitable. This means that who collects data, whose voice is represented, how decisions are made respect human rights, dignity, participation and fairness, and should underpin how urban technologies are designed and deployed. (World Economic Forum, 2024[56]).

Box 7. Strategic integration of Artificial Intelligence in urban services in Montreal, Canada

In September 2024, the City of Montreal (Canada) adopted its "Artificial Intelligence Integration Strategy", consolidating nearly a decade of experimentation into a single, coherent framework. The city enjoys a world-class AI ecosystem, home to institutions such as the public research centre in AI called "Mila – Quebec AI Institute" and IVADO, and was among the first signatories of the 'Montreal Declaration for a Responsible Development of AI' in 2018.[7] Unlike many other cities, Montreal operates a centralised IT structure spanning more than 50 municipal services including police, fire, water, mobility and urban planning, enabling co-ordinated AI governance at scale.

The Artificial Intelligence Integration Strategy is built around seven guiding principles: i) necessity: AI is applied only where it solves a clear problem for citizens; ii) ethics: alignment with recognised ethical

standards; iii) explainability: transparency and interpretability of results; iv) security and confidentiality: robust data protection; v) human oversight: AI supports but does not replace human decision-making; vi) continuous improvement: models evolve with new data and monitoring; and vii) accountability: responsibility remains with the city, not the algorithm.

A cross-departmental AI governance committee, composed of officials from the IT, legal affairs, human resources, internal audit and performance management departments, reviews all AI initiatives to ensure ethical soundness, necessity and technical feasibility.

Montreal's approach combines operational pragmatism with long-term public value. Their strategic goals include:

- responsible integration of AI across all municipal services;
- measurable impact through pilot testing in a dedicated AI Lab;
- transparency and citizen participation in AI deployment;
- strong partnerships with local research institutions and start-ups;
- agility to adapt to fast-moving technological change.

Montreal's AI strategy has been at the origin of concrete projects across key sectors, such as:

- **Mobility and safety**: The project "AI for Vision Zero" uses edge computing and digital twins to detect "near misses" at intersections and inform infrastructure redesign, allowing reconfiguration before accidents occur. Through Building Information Modelling (BIM), the city is planning on extending digital twin coverage to the wider city. The city has piloted a traffic-light optimisation project, which delivered modest results (1% efficiency gain), but produced valuable lessons for refining problem definition, reflecting Montreal's pragmatic "fail fast" approach.
- **Water management**: The city uses predictive models to optimise water treatment and anticipate flow variations based on weather, reducing energy use and untreated wastewater discharge.
- **Public safety**: The city uses AI risk classification to help fire inspectors prioritise among 400 000 buildings, directing resources to the most at-risk sites.
- **Snow removal**: The city employs computer vision monitors to inspect snow truck loads, reducing fraud across more than 400 000 annual deployments.
- **Finance and administration**: Through the use of automated bill processing, the city managed to reduce costs from CAD 0.60 to under CAD 0.01 per invoice, saving about CAD 500 000 annually and relieve administrative burdens on staff.

A particular focus of Montreal's AI Strategy has been the use of AI technologies to advance inclusive urban design. In 2024, the city, with the support of Mila – Quebec Artificial Intelligence Institute, initiated the 'AI Alignment for Inclusion (AIAI)' project that operates as a complementary, participatory initiative focused on inclusive urban design. AIAI draws on Montreal's strong AI ecosystem and ethical commitments to engage residents, including underrepresented groups, in shaping AI-generated proposals for public spaces. The AIAI project combines expert knowledge with citizen participation to shape accessible urban areas. The project uses AI to generate and refine visual concepts of public spaces based on input from local communities, including underrepresented groups. Through iterative workshops and feedback sessions, residents participate in evaluating images for inclusivity and adapt AI-generated designs, which feeds back into model training and refinement, ensuring those reflect diverse needs and values. AIAI operates as a participatory pilot, aligning AI outputs with inclusion and diversity goals in urban design. Insights from AIAI on participation, bias mitigation and social equity feed into the city's wider AI risk management and citizen-focused communication. AIAI is a multi-institutional collaboration involving a wide range of stakeholders such

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as the Université de Montréal, Mila, Enclume, Sid Lee Architecture, Dark Matter Labs, IVADO, and the Canadian Commission for UNESCO. It is supported by a Canadian national-level research funding programme called Mitacs. Workshops are organised at various stages to solicit community input on AI prompt formulation and evaluation of generated outputs. Combining this bottom-up participative perspective with the city's top-down governance framework improves legitimacy and fairness in AI-driven decisions.

To address talent gaps and foster internal capacity, Montreal invests in AI literacy and experimentation. Several actions support this goal, for example: i) an annual AI hackathon involving 100+ staff to co-develop use cases; ii) "fusion teams" pairing IT specialists with operational departments; and iii) continuous internal education campaigns ("roadshows") on when and how to deploy AI effectively.

The city government explicitly identifies nine categories of AI risk, including algorithmic bias, shadow AI, vendor lock-in[8], cybersecurity breaches, environmental impact, and risks to democratic processes. Mitigation measures include a long-standing data governance framework (in place since 2014), internal AI literacy programmes, transparent citizen communication, and controlled alternatives to open tools (e.g. replacing ChatGPT with Microsoft Copilot under municipal oversight).

AI projects are financed directly through the municipal budget, using operational expenditure for pilots and capital investment for scaling. Each project must demonstrate clear efficiency gains or cost savings; for example, the automated invoice system alone generates estimated annual savings of CAD 500 000.

At present, Montreal manages around 23 AI initiatives within its AI Lab, with eight already deployed in production. All initiatives are aligned with broader strategic frameworks, including Montreal 2030 and the city's Climate Plan, ensuring that AI deployment supports equity, resilience and sustainability goals rather than technological experimentation alone. Montreal's ambition is to make AI integration a natural, responsible part of municipal innovation, comparable to the adoption of digital collaboration platforms.

Source: Interview with officials from the City of Montreal on 23 September 2025; (Mila, n.d.[57]); (Ville de Montréal, 2024[58])

AI in urban environmental preservation

Cities are making greater use of AI to monitor and protect urban biodiversity, providing more precise and large-scale environmental data for decision-making, expanding environmental monitoring capacity, improving adaptive management and supporting fairer access to nature in cities. Overall, AI offers a powerful tool to integrate ecological considerations into urban planning and climate action.

AI technologies can also assist cities in coastal preservation. AI tools can analyse satellite, drone, and sensor data to monitor shoreline erosion, flooding, and vegetation loss in real time, enabling faster and more targeted responses. Predictive models help identify future risk hotspots under sea-level rise, while AI-assisted simulations support the design of adaptive, nature-based solutions such as mangrove or dune restoration. Digital twins and smart monitoring systems provide cities with dynamic, data-driven insights for managing beaches and coastal infrastructure. For example, the Netherlands conducts an AI-driven coastal monitoring project that uses satellite imagery and 12-channel multispectral data (including elevation and water-indices) to monitor dune restoration, sediment movement and coastal erosion risks in real time (NL News, 2025[59]) This initiative leverages multimodal large-language models (MLLMs) to support the classification and monitoring of different coastal zone attributes by combining satellite, topographic, hydrological and socio-environmental data streams.

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AI tools can identify and track species, assess habitat quality and detect ecological change. New sensing technologies combined with AI are creating opportunities for more autonomous and scalable urban wildlife monitoring. Acoustic and camera sensors deployed across cities generate large volumes of environmental data, while AI algorithms detect and classify species from sound and image recordings. Connected through existing urban infrastructure such as power lines and Wi-Fi, these systems can function as Internet of Things (IoT) networks, delivering near real-time insights into urban biodiversity. The Queen Elizabeth Olympic Park in London (UK) provides an example of how AI-powered acoustic sensors have been used to map bat populations, offering insights into biodiversity trends and informing park management (Queen Elizabeth Olympic Park, 2017[60]) (Box 8).

When integrated within wider urban sustainability strategies, AI can also optimise the placement and design of green infrastructure. For instance, in Maastricht (The Netherlands), soil moisture sensors linked to AI-based analytics enabled tree managers to respond to real-time alerts during heatwaves. This approach achieved a 99% tree survival rate and accelerated growth, demonstrating how digital tools can strengthen resilience to extreme weather (Testi and Galle, 2022[61]).

AI-driven remote sensing initiatives are scaling these benefits beyond individual cities. Projects such as Green City Watch combine satellite imagery and machine learning to create dynamic, open-source tree inventories, supporting urban forestry strategies worldwide (Connecting Nature, n.d.[62]). These platforms allow local governments to track canopy coverage, biodiversity health and tree maintenance needs more efficiently and cost-effectively.

AI can also guide equity-focused interventions by mapping neighbourhoods with limited access to green spaces. For example, Sydney (Australia) uses Google's Environmental Insights Explorer (EIE) "Tree Canopy," which applies machine learning to aerial imagery, to visualise canopy gaps at neighbourhood scale and plan where shade/trees are most needed for heat-vulnerable areas.[9] The tool explicitly notes that canopy estimates are "derived from high-resolution aerial imagery and machine learning." Buenos Aires (Argentina) is covered in Google's EIE; the city uses these AI canopy layers alongside population/heat data to prioritize planting in underserved districts.[10]

Box 8. AI for bat monitoring in London, United Kingdom

Urbanisation transforms natural habitats into built environments, fragmenting ecosystems and threatening species survival. Yet cities can also provide refuge for wildlife displaced from intensively farmed landscapes. Monitoring these ecosystems is critical to understanding biodiversity and maintaining the ecosystem services that support human health and well-being. However, traditional wildlife monitoring is resource-intensive. It requires specialist expertise, repeated field surveys and often faces barriers such as limited access to private land and safety risks for surveyors and equipment.

A bat monitoring initiative in London's Queen Elizabeth Olympic Park uses 15 ultrasonic sensors installed on lampposts across the park to record bat calls continuously. AI models processed the audio to identify and classify species autonomously, producing detailed biodiversity data with minimal manual intervention. The detectors are connected to Wi-Fi and a power supply to enable them to record data and give reliable results quickly. Data are shared openly through platforms such as batslondon.com, supporting both research and public awareness.

The project is part of Nature Smart Cities, a collaborative research initiative combining environmental science, computing and urban infrastructure stakeholders such as University College London (UCL), Intel, Arup, Bat Conservation Trust and London Wildlife Trust. It is hosted in Queen Elizabeth Olympic Park, with support from the London Legacy Development Corporation (LLDC) in its role as park

manager. The Olympic Park - LLDC press pages describe the project as a joint effort among the university, technology and conservation groups, and present it under the framework of sustainable smart urban innovation.

The system has produced long-term, high-resolution datasets on urban mammals, birds, insects and plants, helping scientists and city agencies track biodiversity trends over time. It has informed the equitable planning and management of green spaces by revealing where biodiversity is thriving or declining. The London pilot has also demonstrated the feasibility of city-scale IoT-based wildlife monitoring networks, providing a model for other urban areas seeking to combine AI and environmental sensing for ecological resilience.

Source: (Queen Elizabeth Olympic Park, 2017[60])

AI in urban economic development

AI can help cities diversify their economies, support local businesses, attract talent and manage economic growth sustainably. AI is already adopted across multiple sectors to boost competitiveness and economic performance, improve working conditions and promote more sustainable and responsible business practices (Kergroach and Héritier, 2025[17]). From agriculture to advanced industry to low-tech manufacturing to services or retail trade, AI can transform business environments and how businesses operate, and place smart cities on new growth trajectories.

AI can help cities improve business conditions and reinforce economic competitiveness and innovation among local businesses. For example, Seoul (Korea) has articulated an ambitious strategy to become a global AI innovation hub, aiming to train 10 000 AI professionals annually, expand GPU infrastructure, and develop a large-scale “Seoul AI Tech City” to drive industry convergence and technological entrepreneurship.

Smart cities can also use AI to boost innovation and productivity in strategic economic areas. To support tourism businesses, AI is used to create more personalised visitor experiences and improve service delivery, making destinations more attractive and increasing benefits for local communities (OECD, 2024[63]). For AI to deliver a positive impact and help transform the tourism sector, policy makers need a clear understanding of its potential to drive innovation (OECD, 2024[63]). For example:

- In Turin (Italy), AI-powered systems are used to guide tourists, tailor recommendations and enhance hospitality services with positive externalities on urban mobility (Box 9).
- In Edinburgh (United Kingdom), a global centre for festivals and the arts, AI aims to reduce waiting times, improve operational efficiency during major events and ease pressure on local infrastructure.
- In Bogotá (Colombia), AI applications, such as the chatbot ‘Candelaria’, aim to strengthen perceptions of safety, improve tourist information and increase visitor engagement, helping attract international audiences to its cultural and historical heritage (IDT Bogota, 2024[64]).
- In Cape Town (South Africa), AI is used to improve security in tourist hotspots and connect visitors with local businesses, ensuring that tourism revenues benefit surrounding communities. In 2025, the city launched Africa’s first AI in Tourism Hub, a public-private collaborative platform meant to incubate and co-create AI applications in tourism: marketing, visitor safety, sustainability, operational efficiency, and visitor experience (ATTA, 2025[65]).

AI can also enable more responsible business conduct, creating room for smart cities to scale up their green-tech businesses and address new requirements in more sustainable and circular global

value chains. In Kalundsborg (Denmark), a small industrial city and leading example of industrial symbiosis, AI tools help co-ordinate resource sharing among companies, forecast demand and improve waste and energy management, enabling more circular and efficient industrial production (Kergroach, forthcoming[66]). The municipality acts as a facilitator, hosting the Kalundborg Symbiosis Center and providing support to integrate AI and digital twins for managing water and energy flows.

Box 9. AI-assisted tourism and hospitality in Turin, Italy

Tourism is a key economic and cultural asset for Turin, but the city has faced challenges in managing visitor flows, providing real-time and personalised guidance, and ensuring accessibility for international and less digitally savvy tourists. Traditional information channels are fragmented and do not generate the behavioural data needed to inform tourism and mobility policy. These limitations have constrained the city's capacity to improve visitor experience and plan sustainably for growing tourism.

The city of Turin launched the Navigation Exploring Tourist Assistance (NETA) project, an artificial intelligence (AI)-powered assistant designed to personalise and simplify tourism services. NETA uses a retrieval-augmented generation (RAG) architecture that combines large language models (LLMs) with a vector database of local tourism content. Visitors can access the assistant through multimedia totems placed at key entry points, including Turin Caselle Airport, and through an online chat platform, ensuring continuity of support throughout their stay.

NETA draws on Turismo Torino databases and anonymised user interaction data such as itinerary choices and visit durations, aggregated to protect privacy. The AI integrates natural language processing and semantic search to provide multilingual and context-aware recommendations tailored to user preferences, location, time and events. The system operates on a 5G-enabled cloud infrastructure and is deployed at strategic visitor touchpoints, starting at the airport.

Governance and ethical oversight have been central to the project's implementation. The City of Turin and Turismo Torino manage the system, supported by an independent Board Etico, which monitors compliance with the EU's General Data Protection Regulation (GDPR), bias prevention and fairness standards. Technology partners Orbyta Tech and Esosphera-Cometa contributed to system optimisation, dialogue coherence, inclusivity and moderation.

The initiative has also delivered clear benefits. Multilingual AI support and simplified language make the service more accessible to international visitors and those with limited digital literacy. Personalised itineraries and mobility suggestions improve visitors' experience and help disperse tourist flows across the city. Recommendations are filtered to avoid commercial bias, reinforcing trust and neutrality. Aggregated behavioural data also provide valuable insights for urban tourism policy and mobility management.

Source: Interview with the City of Turin in August 2025.

The most mature early use of AI in cities is not 'prediction for prediction's sake', but enabling anticipatory management of scarce urban capacity. For instance, the city of Dubrovnik (Croatia) has deployed a suite of interconnected digital tools such as smart parking, a real-time occupancy counter at each city gate, a booking system for excursion buses, and more recently, a digital culture card ("Dubrovnik Pass") that will soon require timed entry slots for 11 major cultural attractions. The combined effect of these digital tools is that Dubrovnik has moved from reacting to congestion after it happens to governing flows upfront, based on measurable thresholds. For example, the city administration has empirically identified

that the quality of visitors' experience within the city's medieval walls drops once more than approximately 11 200 people are inside simultaneously. This is why the city now tracks that threshold in real time, using AI not only for visitors' convenience but also to protect heritage, reduce emissions, manage mobility demand, and sustain the city's tourism economy whilst improving residents' quality of life. This example shows that cities can use digital tools to smooth peaks, steer behaviour, and avoid systemic stress well before it materialises, with positive implications in terms of safety, emergency responses, and public acceptance.

AI for local governmental efficiency

AI is used to enhance municipal efficiency by automating routine tasks and optimising internal processes, ultimately improving citizen engagement. By reducing administrative burdens and streamlining workflows, local governments can provide faster, more reliable services and reallocate staff time to strategic and high-value tasks.

AI systems can be deployed across a spectrum of complexity, helping cities get off a good start and build AI capacity, from simpler tools (e.g. chatbots, automated documentation, service routing) to more advanced analytics (predictive modelling, resource optimisation) (Ben Dhaou et al., 2024[67]). In fact, many beneficial AI applications for cities do not require high sophistication, and, although basic, these applications may help them gain experience before deploying more complex and sophisticated systems.

AI yields efficiency gains for local governments by automating repetitive tasks (e.g. answering FAQs, triaging service requests, preparing meeting summaries or drafting standard communications). Chatbot systems are deployed to improve public information services and reduce the workload of call centres, providing faster and more accessible communication with residents, such as in Bogota (Colombia) and Buenos Aires (Argentina). In Matosinhos (Portugal), the municipality launched in 2024 'Maria', a multilingual AI-driven assistant available 24/7 via chat, voice and web channels. Maria responds to routine inquiries on municipal services, tourism and family programmes, allowing human staff to focus on complex or sensitive cases (Municipality of Matosinhos, 2024[68]). The system also maintains service continuity during crises by ensuring residents can access essential information without delay. The municipality of Suresnes (France) illustrates the case of an AI-assisted contact centre (Box 10) which uses a hybrid model by combining automation with human support for municipal service modernisation. By reducing barriers for residents with different needs and digital skills, this AI application also helps the city promote greater accessibility and inclusion.

Beyond citizen-facing services, AI is being integrated into back-office operations, including finance, human resources and regulatory management. These applications automate low-value, time-consuming tasks and free resources for higher-impact activities. AI applications include automated document classification and paperwork processing; automated scheduling and routing (e.g. for inspections, cleaning, waste collection); and simple predictive analytics for demand or maintenance needs. In Virginia (United States), the Office of Regulatory Management has reduced more than a quarter of existing regulations and is deploying agentic AI to accelerate the review and simplification process. The initiative is projected to generate annual savings of over USD 1.2 billion (Teale, 2025[69]).

AI also enables local governments to more effectively integrate disparate datasets to support decision making, resource allocation, and service planning (e.g. infrastructure, population, service demand). UN-Habitat highlights that many cities see AI as a lever to streamline cross-department co-ordination, reduce silos, and identify bottlenecks (Ben Dhaou et al., 2024[67]). For example, cities are establishing governance structures and frameworks such as algorithm registries, data governance committees, and AI oversight boards that bring together different city departments, ensure unified policies for data use and AI deployment, and create shared accountability across service areas. Another way to streamline cross-department co-ordination is through shared data platforms and interoperable

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infrastructures across departments (e.g., linking mobility, housing, environmental and service-delivery data sets), which enable real-time co-ordination, reduce silos and duplicate efforts, and enhance operational efficiency through common information flows. Amsterdam (The Netherlands), for instance, since 2020 has instituted a public algorithm register 'Algorithm Register Beta', which requires municipal departments to document automated systems, create oversight mechanisms and ensure transparency and accountability across departments (OECD.AI Policy Observatory, 2023[70]).

AI and other digital technologies equip cities with powerful tools to measure, anticipate and respond to urban challenges in real time. The use of such AI tools compresses significantly the time required for data analysis, reducing what once took months to sometimes just hours or even minutes. For example, a geo-AI model trained on Abu Dhabi was instantly adapted to Doha to assess liveability patterns despite low data availability. Similarly, synthetic satellite imagery is being used to simulate both short- and long-term future urban scenarios (e.g. identifying optimal locations for planting trees, prioritising shading, or mapping areas at risk of future flooding). This suggests that the true value of AI does not lie in collecting data per se, but in using it intelligently to shorten the policy cycle.

Finally, AI benefits can expand into areas that directly impact city services provided to residents. For instance, the Tokyo Metropolitan Government (Japan) is implementing various AI-driven initiatives such as introducing chatbots for handling public inquiries, improving infrastructure inspections through image recognition technologies, and incorporating data-driven analysis into policy development. These efforts are not limited to internal administrative operations and aim to raise the quality of municipal services to Tokyo residents.

Box 10. AI-assisted contact centre in Suresnes, France

Suresnes is a dynamic suburb west of Paris that counts more than 49 000 residents and 1 100 municipal employees. The municipality has sought to modernise its citizen services by simplifying public inquiries, improving accessibility and raising citizen satisfaction while using resources more efficiently.

In 2025, the city created a unified, multichannel contact centre that integrates AI-assisted conversational agents into daily operations. Chatbots, voicebots and callbots work alongside four human service representatives in a hybrid model that ensures 24/7 support. A centralised knowledge base underpins both AI and human responses, while queue management, SMS notifications and callback options reduce waiting times. When needed, requests can be seamlessly escalated to subject-matter experts through Microsoft Teams, ensuring continuity and accuracy. The platform uses conversational AI to manage routine inquiries, such as waste collection schedules, administrative procedures and local service information. Real-time access to the shared knowledge base improves response accuracy for both AI and staff. This hybrid approach allows automation of frequent questions while preserving human support for complex or sensitive issues.

The AI-assisted contact centre was developed with the support of the Métropole du Grand Paris, and in partnership with NXO (an IT and digital infrastructure integrator) and Genesys (a customer experience and contact-center AI platform). Its integration with internal communication tools such as Microsoft Teams supports collaboration and ensures smooth handovers between automated and human service.

The new system has delivered measurable improvements. Around 60% of inquiries are now resolved at first contact, and escalations have decreased by 40%, freeing human agents to dedicate more time to cases requiring judgement or empathy. Service accessibility has also improved, with citizens able to reach the municipality at any time and through multiple channels.

Source: (Beriguete, Santos and Cantalapiedra, 2024[71]); (Digit-Collab, 2025[72])

AI for urban safety

Artificial intelligence (AI) is becoming an important tool for strengthening urban resilience and public safety, across multiple safety functions: from modelling and forecasting environmental hazards, to improving situational awareness for authorities and enabling faster, data-driven decision-making. AI can therefore help cities become more resilient to a wide range of risks, including natural disasters or overflows during large-scale public events, by making urban safety systems more preventive, efficient and trusted.

AI is being used to improve public safety during major events. For instance, during the Paris 2024 Olympic Games, AI-enhanced video analytics monitored large gatherings, detecting crowd surges, unattended objects and unusual movement patterns (Dal Bello, Hirsch-Hoefler and Canetti, 2024[73]). This provided law enforcement with real-time insights and increased the efficiency of urban security operations.

Beyond one-off events, some cities are integrating AI into permanent public safety systems. For example, Dubai has launched its platform Dubai Live in October 2025, offering a city-wide, AI-powered command hub integrating real-time monitoring, predictive analytics, digital-twin modelling and operational co-ordination across mobility, infrastructure, waste, inspections and more. The system can detect anomalies, co-ordinate multiple agencies in real time, monitor traffic, public space usage, building inspections, etc. It is conceived as a baseline operational platform rather than just a short-term pilot (Government of Dubai, 2025[74]). Another example is the 'Downtown Command Center' opened by Memphis (US) in April 2025, integrating AI-powered video analytics (real-time detection of wrong-way drivers, erratic vehicle behaviour, collisions) and a broad city-wide camera/sensor network. It supports incident detection, and resource co-ordination across agencies (e.g. police, fire departments) (Silver, 2025[75]).

Another major area of AI application is climate risk anticipation and adaptation. By combining large-scale environmental data with predictive analytics, cities can better target interventions and inform vulnerable populations ahead of extreme events. For example, the municipality of Jammerbugt (Denmark) has worked with researchers to pilot an AI-based early warning system for flooding. The platform integrates satellite imagery, weather forecasts and hydrological models to predict floods up to 48 hours in advance, giving local authorities time to co-ordinate response and inform residents (Meister, 2024[76]). In Tokyo (Japan), one of the world's most densely populated metropolitan areas, Internet of Things (IoT) sensors feed real-time data into digital twins that simulate disaster scenarios and support preparedness planning for earthquakes and other natural hazards. The Tokyo Metropolitan Government applies AI to strengthen its flood management systems. By analysing observed and forecast data on water levels, tides, atmospheric pressure, wind speed, and rainfall, the AI model predicts water-level fluctuations and alerts operators to the optimal timing for floodgate operations. These predictive capabilities enhance early warning systems and provide sufficient lead time for decision-making, supporting accurate and timely floodgate control during extreme weather events and emergencies.

The example of Seoul (Korea) also illustrates how AI can be used for more efficient surveillance, public safety and disaster response (Box 11). This experience highlights the value of combining decentralised operational control with citywide co-ordination, strong privacy safeguards and technical partnerships. It shows that AI surveillance must be accompanied by strict privacy safeguards. Seoul's use of anonymised data, emergency-only sharing protocols and public communication has helped maintain legitimacy while improving safety outcomes. demonstrates how AI can make urban safety systems more preventive, efficient and trusted when implemented within robust governance and ethical frameworks. It also highlights

the importance of securing digital infrastructure when deploying large-scale AI system through continuous cyber monitoring.

Box 11. AI for urban safety in the Seoul Metropolitan Area, Korea

The Seoul Metropolitan Government (SMG) operates one of the world's largest closed-circuit television (CCTV) networks. However, traditional surveillance relied heavily on continuous human monitoring, leaving blind spots and limiting the city's ability to prevent or respond quickly to incidents. These constraints created pressure on staff, reduced efficiency and raised concerns about public safety in a dense urban environment.

The Seoul Metropolitan Government (SMG) has applied computer vision to the city's extensive CCTV network and launched an AI-enabled CCTV initiative to strengthen prevention, improve response times and build public trust in safety services. Artificial intelligence analyses real-time video streams from more than 110 000 cameras across the city. Computer vision models recognise behaviours such as falling, wandering, aggression, crowd density or smoke detection. The system therefore detects potential incidents such as crime, violence, accidents, fire or individuals in distress, and supports search and rescue for missing persons. It also uses anonymised data, emergency-only sharing protocols and public communication, and is integrated with digital safety services, such as Seoul's "Safe Return Home" app for women, for creating a connected public safety ecosystem. And it combines surveillance data with environmental signals, location-based data and inputs from municipal and national emergency services, to help manage emergencies.

Computer vision models – sourced from multiple vendors and customised where needed – recognise behaviours such as falling, wandering, aggression, crowd density or smoke detection. Analysis occurs in local data centres operated by each of Seoul's 25 districts and is linked to a shared emergency platform managed by the Seoul Metropolitan Government. All data are transmitted over the Smart Seoul Network, a closed fibre-optic infrastructure that isolates CCTV traffic from the public internet and reduces cybersecurity risks.

Capacity building has been part of the initiative. Municipal staff receive training in computer vision and data analysis, while partnerships with technology vendors and national agencies strengthen evaluation and quality control. Procurement is conducted under clear public standards for accuracy and reliability, helping maintain trust and independence from private suppliers. Computer vision models are sourced from multiple vendors and customised where needed.

Governance and financing have been key to the initiative's sustainability. Costs are shared between the Seoul Metropolitan Government and the city's 25 districts, with occasional central government grants. This shared model, combined with reduced labour needs compared to traditional CCTV, improves cost-effectiveness. Privacy and cybersecurity are addressed through data anonymisation, strict emergency-only sharing protocols and continuous cyber monitoring.

The system has delivered tangible safety and operational benefits. AI-assisted monitoring reduces manual workloads by filtering routine feeds and flagging high-risk events for human review. In one case, AI detection of smoke in Songpa District triggered an immediate fire response, limiting damage. In Seocho District, cameras identified suspicious behaviour that led to an on-the-spot arrest, while in another case, the detection of a collapsed pedestrian enabled a rapid emergency intervention that saved a life. Integration with safety apps has improved protection for vulnerable groups, including missing children and older adults, while providing real-time support for women's safety services.

Source: Interview with the Digital Policy Division of the Seoul Metropolitan Government on 12 August 2025.

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Implementing AI projects in cities: key lessons

Cities are now transitioning from 'smart cities' to 'cognitive cities', not because the underlying technology has changed, but because the governance paradigm must shift from a technology-first to a human-first approach. While AI is bringing an unprecedented acceleration compared to previous digitalisation waves, this speed increases the risk of misalignment between municipal systems and public values if cities simply scale technology without re-thinking participation, transparency and integration. In this context, cities face three types of critical barriers: i) the integration of AI into complex legacy urban systems, ii) the uneven quality and reliability of municipal data, and iii) insufficient methodologies for involving citizens early in strategic design. A strategy-first approach is therefore essential, with clear objectives, upfront governance design, and structured frameworks to include citizens as co-creators of AI-enabled systems. The "human layer" is not a soft add-on, it is the critical precondition for responsible AI deployment.

Implementing AI projects requires an incremental approach. Sequencing allows a city to build maturity gradually while maintaining public trust. For instance, the city of Sendai (Japan) has piloted multiple AI applications in municipal operations, including generative AI for internal administrative work, AI-driven urban data visualisation, and AI systems supporting disaster resilience. This case shows how a city can approach AI incrementally across diverse government functions without rushing toward a single city-wide platform. Responsible adoption of AI can start with strategically selected operational pilots that deliver immediate value (such as administrative efficiency, better situational awareness, resilience support), whilst retaining caution about larger scale deployment.

Engaging citizens should not be a communication exercise after AI deployment, but a governance instrument before deployment. The municipality of Tampere (Finland) exemplifies this through its 'AI4Citizens' project, which explicitly grounds AI governance in public literacy, inclusion and civic dialogue. Tampere is intentionally taking AI out of expert spaces and into everyday life by running workshops with 9th graders, holding sessions with older residents via community colleges, and hosting public dialogues in libraries (e.g. between a bishop and a mathematician) about the human stakes of AI. This case demonstrates that building trust, shared vocabulary, and public understanding upstream is a core component of safe and legitimate AI scaling. The experience of Amsterdam (The Netherlands) suggests that AI literacy is not only required for citizens, but for municipal officials themselves. Public servants must be able to interrogate the value proposition, the environmental implication and the fairness impacts of AI use. Cities must strengthen institutional capability to ensure that AI systems remain auditable, contestable and adjustable in line with democratic mandates and shifting social priorities.

Aligning AI with democratic values, accountability and explainability is essential for a fair and effective AI deployment in urban systems. AI in cities cannot be treated as a neutral optimisation layer, it must remain subordinate to democratically set priorities and legible to the public. The City of Amsterdam (The Netherlands), for example, has used AI to optimise traffic lights with a transparent logic. However, if a future administration decides to shift priorities, for example to prioritise pedestrians over cars, that change is a democratic decision and must remain reversible. Optimisation is never a neutral technical act – it reflects social choices. An autonomous optimisation system cannot make that normative adjustment unless a human, and specifically a democratically accountable human, is empowered to change the 'value settings'. As AI tools become more powerful and more appealing, human oversight and accountability are not optional design features but essential democratic guardrails.

Co-developing open AI solutions allows cities to avoid lock-in while reducing costs and risks. This is one of the most viable pathways for responsible AI adoption for most medium-sized municipalities that do not have the scale or resources to develop and maintain advanced AI systems alone. This approach helps cities avoid dependence on proprietary vendor systems that are expensive, sometimes non-transparent and hard to adapt. For example, the city of Gelsenkirchen (Germany) is collaborating with

other neighbouring municipalities on nine AI prototypes in areas such as mobility, maintenance and public space management, all designed from the start to be reusable by other municipalities. This co-operation not only allows resource pooling, but it also creates a common governance framework through interoperable data models; shared ethical standards; and joint evaluation of risks and performance. The city is also investing in communicating benefits and safeguards to citizens through formats such as podcasts, public roadshows and press work because trust and social licence are part of the deployment strategy.

Using bias audits and participatory design may help prevent harm before AI deployment. For example, the PIT Policy Lab Mexico proposes running a bias audit and a participatory co-design process with the communities affected. In particular, in contexts with strong structural inequalities, predictive AI can very easily reinforce existing disparities if left unchecked. For instance, when using AI to identify students at high risk of dropping out of school, PIT works first with families, teachers, school staff and local actors to identify where harm could occur; to test how the system interprets signals; and to adjust the model and indicators so that the tool supports inclusion rather than penalising vulnerability. Responsible AI is not only about checking for bias once a model is built. It requires designing systems with the communities they affect to detect and mitigate harm early, and to ensure that the logic of the model aligns with social policy goals (e.g. protecting vulnerable children) rather than contradicting them.

Scaling AI requires investment in democratic processes, new capabilities, and structured city-to-city collaboration. For cities, technology readiness is no longer the binding constraint. The critical limitation is governance readiness and public legitimacy. Cities require i) new forms of participatory engagement; ii) investment in skills and literacy in public administrations; and iii) mechanisms for routine knowledge pooling across municipalities. For example, Tampere's (Finland) through the 'AI4Citizens' initiative invests in literacy-building across heterogeneous citizen groups (e.g. pupils, older residents), and Mannheim (Germany) works with universities to convert research AI models into practicable municipal processes contributing to build its own AI capacity.

Systemic scaling of AI is most feasible when national regulation, multi-city deployment, and experimentation instruments are co-ordinated under a unified architecture. Korea's experience illustrates the role of national frameworks to support safe scale-up from pilot projects into mainstream practice. Seoul is deploying AI-integrated CCTV and flood warning systems; Busan is using AI (including CCTV and drones) to monitor overcrowding on beaches and in nightlife zones; and Daejeon is equipping approximately 200 major intersections with AI-enabled sensors to optimise traffic flow and detect incidents. These are all operational, real urban deployments already affecting daily life. The national AI Basic Act, the National AI Strategic Committee, and the regulatory sandbox approach are providing the guardrails necessary to accelerate such adoption whilst maintaining ethical, legal and public legitimacy.

All these efforts are supported by conducive national governance frameworks. Germany's AI-enabled Smart City Model Projects support both small towns (e.g. Linz's AI-sensor "mobile trees" for microclimate management) and major cities (e.g. Munich/Hamburg/Leipzig digital twin cooperation). Korea has enacted the AI Basic Act, created a National AI Strategic Committee, and is institutionalising regulatory sandboxes. All these initiatives show that democratic capacity, ethical governance, and public trust must be built in advance of large-scale automation, not retrofitted after deployment. AI's success in cities must be measured not only in performance terms, but particularly in terms of how well it reinforces public legitimacy and supports inclusive urban development. National governments can accelerate city-level AI deployment by standardising data, co-funding demonstrators and providing shared platforms. For example:

- Korea's central government funded a five-year national R&D programme on AI for urban planning, coordinated through the responsible line ministries (primarily the Ministry of Land, Infrastructure and Transport, MOLIT) and national research institutes such as Korea Research Institute on Human Settlements (KRIHS) to build AI for urban planning with three pilot cities: Cheonan, Busan,

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Damyang. The objective is to publish all outputs free of charge for other local governments and private actors to adopt, reducing barriers to smaller municipalities for AI adoption.

- In France, the national government is enabling safe and rapid diffusion of AI by focusing on enabling conditions, not only pilots. The government has identified five levers: i) clear public governance of data, ii) targeted funding, iii) platforms to support replication of solutions, iv) public–private–research partnerships, and v) frugal AI (i.e. AI that reduces environmental footprint, and that is maintainable and cost-effective for smaller municipalities). The municipality of Noissy-le-Grand energy optimisation project for public buildings has used frugal AI to adjust energy use dynamically. This resulted in a ten-fold reduction in carbon footprint of computational needs, coupled with EUR 2.2 million per year in energy savings. This model is being designed for replication; the aim is to produce a set of standardised components, methods, and code libraries that other municipalities can re-use. France's national strategy positions the State not as the owner of municipal AI solutions, but as an enabler of market replication under public standards of environmental performance, privacy and ethics. France's experience show that national authorities can help cities avoid lock-in and excessive cost by promoting frugal AI approaches and by investing in common interoperable infrastructures, which allow local actors to adopt and adapt AI tools without needing large proprietary solutions.

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3 AI assets and enablers for smart cities

Promoting urban artificial intelligence (AI) requires cities to create the right conditions for its development and efficient, trustworthy and ethical use. This includes strategies for sourcing and managing assets, policies for enabling change and adoption across city services, and robust approaches to risk management.

This chapter discusses how cities access different types of AI assets, through different sourcing modes or indigenous development. The discussion aims to explore differentiated approaches of AI across cities, taking into account their local conditions, goals and capacities, and to identify key issues to consider for urban policy makers. It digs particularly into three urban policy areas, i.e. urban planning, safety, and transport. It builds on OECD activities to inform "place-based strategies for AI" (Kergroach, forthcoming[66]). Analysis is complemented with desk research that leverages literature review, interviews (Chapter 2) and generative AI for information sourcing and classification.

Sourcing and managing urban AI assets

AI technological change remains complex to implement, because of the diverse technologies and applications it entails, the diversity of assets it requires to perform, and because the frontier is in constant and fast evolution. AI is data-driven, and performs with both "soft" (intangible) assets, i.e. data, algorithms and skills, and "hard" (tangible) assets, i.e. AI compute infrastructure. Figure 2 presents a schematic view of the components of an AI system, the AI assets and their geolocalisation.

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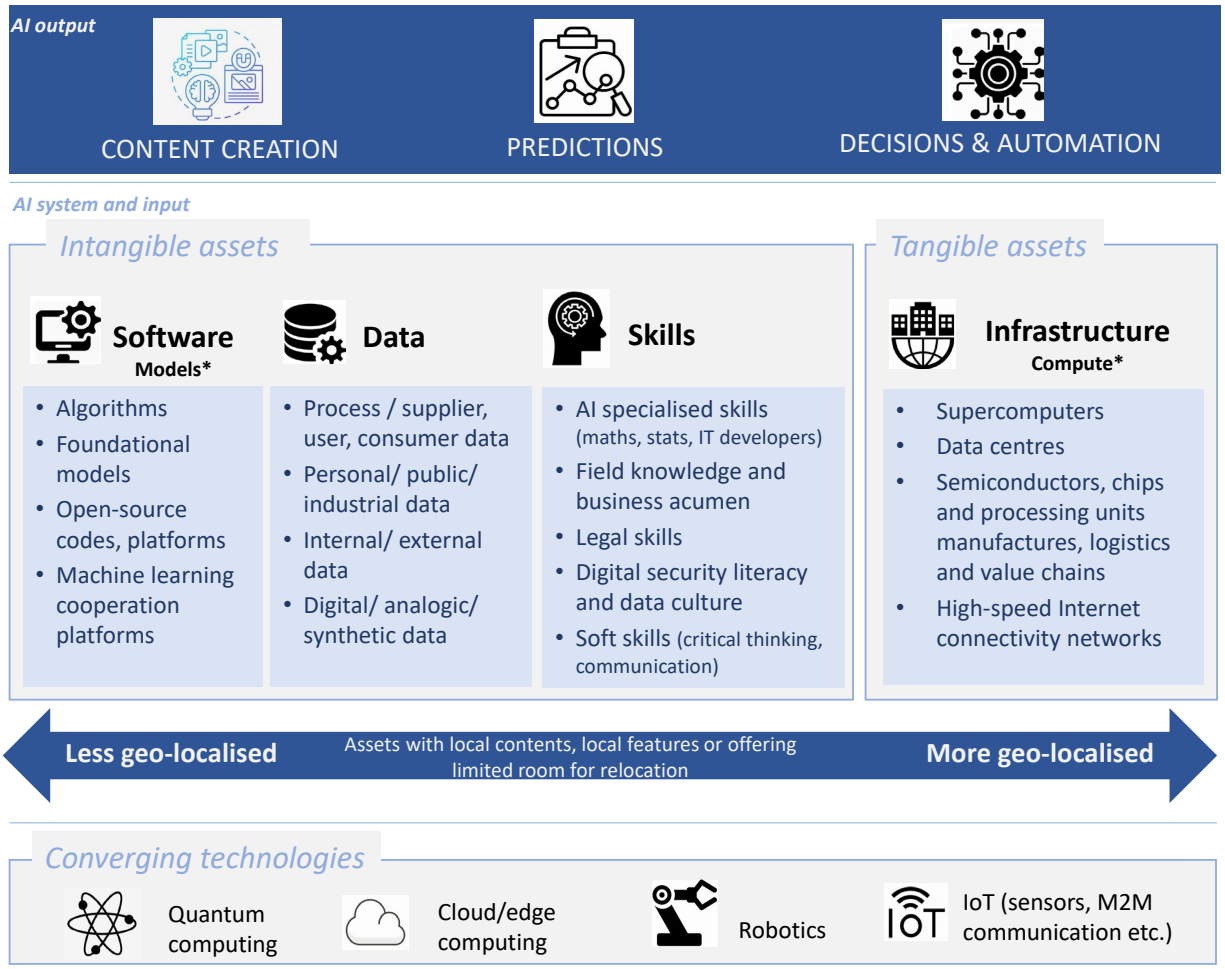
Figure 2. Input and output of an AI system



Source: (Kergroach and Héritier, 2025[17]).

Data is essential to AI systems

AI is trained by processing large amounts of data to identify patterns and infer responses. In general, the larger the volume of high quality and relevant data, the better, although in some cases lean models can perform just as well as those trained on large amounts of data.

'Data' refers to recorded information and can be in any format, including analogue formats like paper, or emerging quantum forms like qubits (Box 1). They are stored in structured or unstructured formats, including text, images, sound and video. Digitalisation has enabled the creation and boom of digital data, i.e. information stored by a computer in binary format, and that could be processed and analysed by digital technologies. Almost every aspect of the digital environment, including a website or a banner advertisement, is data.

There is therefore a great variety of data and different models of how cities can access and use them. Data are often categorised by ownership (e.g. personal, public or proprietary data) or by sourcing context (e.g. user, consumer, supplier or taxpayer data; process, industrial or government data; or product, technical, multimedia or communication data) (see Box 1 for definitions) (OECD, 2022[77]) (OECD, 2022[78]). In practice, cities adopt mixed strategies and combine different data sources for implementing AI

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solutions that are fit for purpose. Table 1 presents some examples of the types of data smart cities use across specific urban areas to illustrate this diversity.

Table 1. Data for urban AI, selected city and data source examples

	Cities	Barcelona (Spain)	Eslöv (Sweden)	Rotterdam (Netherlands)	Seoul (Korea)	Tokyo (Japan)
	Urban policy areas	Utilities services	Land use planning	Housing - taxation	Safety - security	Mobility - transports
Open government data	Administrative, municipal or cadastral data, city registers, census and surveys, infrastructure, green spaces and building records	Yes	Yes	Yes	Yes	Yes
Dynamic behavioural data	Purchase- or subscription-based data, online or physical activities (phones, GPS)				Yes	Yes
Smart platform data	Online activities on B2C or G2C platforms, Saas platforms.		Yes		Yes	Yes
Crowd-sourced data	Citizen input and reports, user uploaded data, community feedback	Yes	Yes			Yes
IoT generated data	Sensors, trackers, smart robots, camera and computer vision	Yes			Yes	Yes
Geospatial data	Aerial and satellite data, drones, smart meters (heat, air)	Yes	Yes	Yes	Yes	Yes

Note: B2C – Business-to-Consumer and G2C -Government-to-Consumer; Saas – Software-as-a-Service. Categories are not exclusive. Crowdsourced data could be collected through smart platforms. IoT-generated data could combine information from terrestrial and aerial devices.
Source: Based on case examples and interviews drawn from section 2 and (Kergroach, forthcoming[66]). Additional information come from (Parametric, 2025[79]), (Guliker, Folmer and van Sinderen, 2022[80]), (van Cranenburgh and Garrido-Valenzue, 2024[81]), (Smart Cities World, 2023[82]), (Linchpin, 2025[83]), (Berigüete, Santos and Rodriguez Cantalapiedra, 2024[84]), (Envac, 2023[85]); (Bibri and Krogstie, 2020[86]), (Future Electronics, 2023[87])

Open government data is a prime source of urban AI data. Most OECD countries today have adopted "open by default" government data policies. This approach reflects the notion of "public data as a public good", where a focus is given to re-use, alignment with user needs and contribution to value co-creation (Rivera Perez, Emilsson and Ubaldi, 2020[88]). Municipal data cover a broad spectrum of city information, from administrative, tax or cadastral data, city registers, census and surveys, or infrastructure, green spaces and building records.

- In the case of Eslöv (Sweden), zoning maps and demographic statistics are combined with geospatial data on building heights and forms, and green areas (e.g. orchards) to improve land-use planning.
- In Rotterdam (The Netherlands), housing registers, land use and tax rates are combined with street-level imagery that assesses residential local conditions and utilities for property valuation.
- In Montreal (Canada) or Suresnes (France), open datasets on municipal services and public consultation records promote citizen engagement and efficiency and transparency in public services.
- The UK 2025 AI Opportunities Action Plan aims to unlock planning data from local authorities through aggregation and standardisation. AI is used to extract geospatial information from historic PDF planning documents, and convert them into structured, machine-readable formats to re-publish them as open data. The UK has also created regulatory sandboxes to test the application of AI in regulatory environments (e.g. planning law) to assess whether existing legislations can accommodate AI-enabled processes. Through the PropTech Innovation Fund, central government,

academia and local authorities collaborate to trial AI use in real settings, for example shortening planning consultation times or easing new housing delivery.

Another promising source of urban AI data is digital platforms. Online platforms offer services through the Internet and serve as intermediaries to facilitate interactions between public administration, citizens and businesses. As they can collect information (e.g. via forms, user reviews) or track online activities and behaviours, digital platforms can generate large volumes of data on which to train AI models. For instance, AI can exploit purchase- or subscription-based data to increase knowledge on users and customers. As a matter of fact, municipalities worldwide increasingly use smart city platforms and AI-driven platforms, the share of the latter increasing from 16% to 60% between 2022 and 2024 (The Smart City Journal, 2024[33]). Tokyo operates an AI-assisted Data Highway platform bringing together government datasets on urban development, mobility, energy, health, education and industry to improve residents' quality of life. In Korea, cities like Daegu and Siheung have implemented Smart City Data Hubs, crucial for managing urban data and enabling real-time responses.

In some urban operations, real-time data are critical and rely on IoT systems or direct participation from citizens. For instance, Barcelona (Spain) and Meudon (France) use real-time operational data (e.g. ventilation, energy, traffic flow, sensor and maintenance logs) to optimise transport systems. Barcelona monitors many public services via IoT (such as lighting or parking). The city has deployed smart bins equipped with ultrasonic sensors to detect the degree of filing of containers and enable municipal services to optimise collection schedules and routes. Analytics on IoT-generated data enable forecasting on the smart waste collection system. Seoul and Tokyo stand out for their use of real-time behavioural data in urban safety and mobility. The Seoul intelligent disaster prevention and safety system is based on the population density data collected by security cameras and sensors (see Chapter 2). In addition, the Seoul Metropolitan Government operates a dual 119 emergency system where AI handles sudden surge in emergency calls, prioritises and dispatches alerts to human operators, and analyses simultaneous incidents for early detection, while human operators oversee AI responses in real time and deal with urgent cases. Crowdsourcing (real-time or opinion) data from residents or visitors, in turn, require fit-for-purpose digital platforms or mobile applications.

Geospatial data are commonly used to model cities, inform geographical information systems and fuel 3D simulation. Geospatial data monitor locations, shapes and spatial relationships between terrestrial objects and Earth's features (e.g. distance, connections). They include satellite and street imagery, aerial photos (e.g. drones), heatmaps or air quality grids (e.g. smart meters), etc. For example, Rotterdam and Helsinki employ geospatial, cadastral and satellite imagery data, alongside housing market information, to monitor housing developments, predict pricing trends and improve city service responsiveness. Although geospatial data is used across all selected examples presented in Table 1, it is not essential to all AI applications in smart cities. For instance, in the case of Suresnes' AI-assisted multichannel contact centre (France) presented in Chapter 2, AI agents operate chatbots and 24/7 support to streamline public inquiries and improve accessibility and citizen satisfaction, without geospatial information.

Against this backdrop, a sound urban AI data governance should be implemented to ensure data protection, privacy, transparency, ethics and digital rights. Low quality data can affect the training of AI models and biased algorithms, resulting in poor outcomes and harms in predictions and decisions. Data can also be poisoned, sabotaged or hacked (e.g. biased or low quality data contaminating urban data, fake reviews, false congestion signals, hacking data by hacking sensors etc.). Urban AI data governance should therefore be considered as a system of rules, policies, and processes that provides a framework for data collection and use – across various types of organisations, including non-governmental (OECD, 2023[89]). It should cover key aspects such as data access and sharing, data quality and curation, data control and ownership, data protection and privacy, data interoperability and standards, and data flows, as well as investments in data-related infrastructures, skills and competences. The OECD Recommendation on Enhancing Access to and Sharing of Data presents a set of principles and policy guidance on how

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governments can develop data governance frameworks that maximise the cross-sectoral benefits of all types of data while protecting the rights of individuals and organisations (OECD, 2021[90]) (OECD, 2022[14]).

Urban AI models

AI systems perform with algorithms. Algorithms are step-by-step instructions that guide AI, with different degrees of complexity and supervision, on how to process data and information. Once trained, the AI model can perform based on new data, and can keep improving with more training, better data and human feedback for reinforcement learning (E.U. and U.S Trade and Technology Council, 2023[91]) (OECD, 2024[92]).

In practice, cities use and combine generative, automation or prediction AI systems. The Eslöv municipality has developed a generative AI model in co-operation with a private company to design scenarios for land use planning. Natural language processing (NLP) algorithms support the production of descriptive summaries. Rotterdam performs 3D reconstruction from architectural plans and computer vision that detect structural changes (such as roofs, windows or solar panels), and applies machine learning to create hedonic pricing models and generate predictive housing valuations. The Seoul Metropolitan Government combines speech recognition and NLP for its emergency centre and performs a crowd density algorithm that uses computer vision models to detect and predict behaviours for disaster prevention.

Yet, technical risks are integral features of AI systems and raise challenges for cities' uptake and the management of socio-economic implications. Key algorithmic management risks for cities include discrimination, privacy violation, safety and security or intellectual property infringement.

- AI works as an echo chamber, mimicking and amplifying inequalities and ***discriminations*** embedded in data and eventually heightened during AI model training or (mis)interpretation. For instance, facial recognition has become a "high-risk" case, with actions worldwide to limit usage in public spheres (OECD, 2021[93]). Concerns with facial recognition include infringements to privacy and fundamental rights due to constant monitoring without consent, inaccuracy and bias (e.g. dark-skinned populations) leading to discriminatory decisions by municipal authorities, or insufficient data protection and security in case of attacks (OECD, 2022[13]).
- AI also increases the risks of ***privacy*** violation due to misuse, abusive inference or data leaks. Those can occur when municipal employers base their hiring decisions on applicants' online activity, or personal preferences outside of work contexts. In the case of urban mobility, AI analytics combining social medias check-ins and CCTV footage can re-identify individual citizens in their daily routines, and enable profiling and targeted surveillance. Weak anonymisation or poor access controls could expose citizen data and engage municipal government responsibility. Other harmful and invasive practices are linked to municipal workers surveillance (such as tracking screentime and bathroom breaks) (OECD, 2024[94]). Algorithmic management, while increasingly more widespread, can negatively impact workers' job satisfaction, workloads and stress levels and health (Milanez, Lemmens and Ruggiu, 2025[95]). Adverse effects on municipal workers could be an erosion of autonomy, intense work cadences to meet optimising performance targets, or a perception of arbitrariness and distrust in management if AI models lack transparency and accountability.
- In addition, untrustworthy AI models can endanger ***safety and security***, either because of biased data, incomplete training or lack of proper safeguards during deployment. A failure in autopilot systems in transportation or in the detection of human presence can have dramatic consequences. AI models used in autonomous transport systems that misclassify objects (e.g. vehicles versus pedestrians), especially at night or in unusual weather conditions, could lead to severe crashes. In security and surveillance, failures can occur due to poor targeting or unpredictable behaviours of combat or police enforcement drones, misidentification of people due to flaws in AI-powered facial

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recognition and wrong arrests, or biased predictions and misallocations of policy or emergency resources, reinforcing community distrust and tensions.

- Finally, AI tools can raise issues around ***intellectual property***, for the content it creates, and for the (un)protected content it can misuse. Generative AI, that is increasingly used in urban planning, architectural design, or land use scenario, is trained on massive amounts of data scraped from the Internet, that can include unlicensed content or copyrighted data, without the permission of rights-owners. Urban data ecosystems often combine open and proprietary data, including commercial satellite imagery or mapping databases that may be licensed under different terms and jurisdictions. Numerous court cases are under way to discuss the legitimacy of the approach, setting precedents for the AI industry on the way models will be trained in the future (Zirpoli, 2023[96]).

In response, numerous countries have adopted AI risk management frameworks to identify and classify potential AI risks, provide guidance for monitoring and mitigation, and/or set obligations and restrictions (e.g. audits, bans). Cities implementing AI need to operate with and within these risk management frameworks.

- The EU AI Act (2024) introduces a risk taxonomy that is relevant for municipal governments in Europe (OECD, 2024[97]). Among ***unacceptable risks*** are those arising from the use of AI for law enforcement and justice, such as predictive policing, remote biometric identification (including facial recognition) in public spaces, or social scoring – all of which are banned. Among ***high risks*** of AI uses are those that could bring significant potential harm to health, safety, fundamental rights, environment, democracy, and the rule of law. Most urban AI applications may fall under this category. Examples include systems used to influence elections and voter behaviour, automated processing of personal data to assess various aspects of a person's life, assessing eligibility to benefits and services, and safety components used in the management and operation of critical infrastructure. EU obligations include establishing a risk management system, conducting data governance, having in place technical documentation to demonstrate compliance, mandatory fundamental rights impact assessment, among others. ***Limited risks*** imply obligations of transparency, e.g. disclosing that chatbots are AI-based.
- In Canada, the Directive on Automated Decision-Making (last updated in 2023) defines an algorithmic impact assessment (AIA) scoring, requires an AI assessment against fundamental rights, and set binding rules for federal agencies before deployment.
- China's Algorithmic Recommendation Regulation (2022) requires transparency, fairness, user opt-out. It prohibits AI applications that promote illegal content, manipulate opinions, or false accounts. Algorithm providers must carry out periodic reviews of algorithms, models, data and results, and establish mechanisms for audit and oversight.
- Korea has adopted a comprehensive AI legislation taking effect in 2026. The Framework Act on Artificial Intelligence Development and Establishment of a Foundation for Trustworthiness targets "high-impact" AI, generative AI and high-performance AI systems. It introduces specific obligations for "high-impact" AI systems in 11 critical sectors that are considered posing risks to human life, physical safety and fundamental rights, such as healthcare, energy, and public services. It mandates transparency obligations, e.g. labelling requirements for certain applications of generative AI. It imposes risk identification, assessment and mitigation for high performance AI systems, i.e. above a certain threshold of computational power. Obligations include explanation methods for AI outputs and criteria, user protection plans, human oversight of high-impact AI, documentation of safety and reliability measures etc. (Future of Privacy Forum, 2025[98]) (IAPP, 2025[99]).
- Some countries have developed guidelines or practical toolkits of a non-binding nature as soft guardrails as well. Australia provides a practice guide to government officials for the ethical use

and management of algorithms. France and the UK have issued guides on public algorithm transparency. Singapore provides practical guidance to government agencies for deploying AI.

At local level, cities have also implemented initiatives to manage AI system risks.

- Barcelona (Spain) has adopted a municipal strategy on "algorithms and data to ethically drive artificial intelligence" (GOUAI, 2025[100]). In procurement, the city requires algorithmic impact assessment for digital solutions deployed in the city.
- Amsterdam (The Netherlands) and Helsinki (Finland) maintain public AI Registers where algorithms used by the city are inventoried and documented, including considerations about risk level, human oversight and fairness. Those serve as municipal-level risk management and transparency frameworks.
- Turin (Italy)'s AI-powered assistant for tourism and hospitality services is supported by an independent ethics board (Board Etico) that monitors compliance with EU's General Data Protection Regulation, bias prevention and fairness standards. This formal AI governance structure ensures ethical review, neutrality and privacy.
- The Cities Coalition for Digital Rights, representing 50 cities worldwide, has set standards along these lines, which are implemented through projects like the Global Observatory of Urban AI or the Digital Rights Governance Project (OECD, 2024[97]).

However, the opacity of AI models makes it difficult to correct algorithmic biases and mitigate risks. Countermeasures are difficult to implement because AI algorithms are complex and often protected by copyrights or trade secrets. Cities need to take appropriate measures to ensure the AI systems they operate fulfill requirements of robustness, fairness, accountability, transparency, and safety. This entails developing or using the right metrics and tools to systematically scrutinise AI systems and models used in their services and operations to make sure they deliver inclusive and fair results (OECD, 2024[97]). This also includes having safeguards in place to prevent or rectify biases (e.g., gender, racial, digital literacy etc.) and other problematic outputs. Solutions for enhancing AI model accountability would include the establishment of algorithmic accountability standards, or open registries of public algorithms, but also exploring new institutional and multi-level governance arrangements. Non-executive branches of government (e.g. judiciary and parliament) and accountability institutions (e.g. information access agencies, data protection agencies, ombudspersons, audit offices) aim to secure the oversight of AI development and use within the public sector. In addition, the centre of government may have a role to play in steering a coherent use of AI across all branches of the public sector and ensuring horizontal and multi-level coordination.

Hard and soft skills

AI relies on human expertise for its development and reinforcement. Advanced statistical, mathematical or programming **skills** are required for developing AI models, as well as competencies in data engineering (for data collection, processing and storage) or cybersecurity. Expertise in geospatial analysis and geographical information systems is another technical skill that could be essential for urban AI deployment, e.g. for leveraging mobility data or satellite imagery or developing digital twins.

Non-AI, expert and soft skills, such as domain knowledge, critical thinking and communication, are as important to train the machine, interpret results and ensure a trustworthy and ethical use of AI. Domain-specific urban skills span from transport engineering and multimodal transport optimisation to energy and environmental science, urban planning, land use and spatial development, crisis management, policing or public safety etc. Legal expertise and ability to audit and validate AI models for public decision-making are also critical for AI governance and algorithmic accountability.

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Interdisciplinarity and ability to work across city departments and knowledge silos are needed to enable specialised engineers and data scientists to adapt models to local contexts. Collaboration on AI innovation may involve national, subnational and municipal governments, private actors, academia and citizens. In highly exposed jobs with high task complementarity between AI and humans, such as those that still require human supervision, or where AI cannot reproduce human tasks (e.g. in interpersonal interactions or complex decision-making), AI may become a co-worker. However, human workers who will need to engage with AI may introduce biases in interpretation, make mistakes during AI training or deployment, or not ensure proper oversight -- all of which represent risks for which cities will need to retrain staff for better prevention and mitigation.

Finally, AI diffusion requires public acceptance, a collective data culture and digital security literacy (OECD, 2022[77]) (OECD, 2024[92]), meaning broad and effective communication and awareness raising capacity. Citizens need to understand how AI systems operate, what data they use, and how safeguards protect privacy and fairness, and what responsibilities are theirs. Building this shared understanding will help in turn foster trust, encourage responsible data sharing, and ensure that innovation aligns with public values and social inclusion. Building this data culture and digital literacy is the first objective of national policies implemented across the OECD countries to improve data governance among firms and turn data into business (64% of total policy initiatives in place in (2022[77]), based on a mapping of 487 policies).

Skills needed for urban AI are mainly fulfilled with local talent pools. In Eslöv, AI-powered land planning was enabled through interdisciplinary collaboration among planners, architects and machine learning experts, supported by the Research Institute of Sweden (RISE). In Rotterdam, using AI for housing valuation and taxation was made possible by mobilising an advanced analytics teams with expertise in deep learning and geospatial analysis. The municipality has partnered with an external technological firm to access 3D computing vision expertise (Spotr, 2025[101]). The implementation of AI for urban safety and security in Seoul has required expertise in computer vision and data science, dedicated training of municipal staff, collaboration with an AI service provider and input from national agencies.

Governments worldwide recognise the need to develop AI skills and address related skills gaps. Efforts are in part embedded in national AI strategies that aim to strengthen the pool of AI talent across the whole society, and sometimes with special mention to the public sector. For example:

- Canada's AI Strategy for the Federal Public Service (2025-27) has built a training and upskilling plan for public servants as a priority (Government of Canada, 2025[102]). The Strategy aims to respond to a talent deficit within the government, as 30% of digital roles remain vacant, leading to a costly dependence on external contractors. The strategy also includes offerings from the Canada School of Public Service for e-learning, or the "Learning Week on Artificial Intelligence" an awareness campaign to help civil servants gain foundational knowledge and capability.
- The UK's National AI Strategy also includes pilots and workshops to improve public sector capacity to buy AI products and services and to ensure AI ethical and technical dimensions are understood in procurement. The UK government offers Civil Service Learning and other resources, such as free e-learning courses, for introduction to AI and ethics. These offers are part of the UK's "Artificial Intelligence Resources for the Public Sector."
- The experience of Singapore, the City-State, shows that successful AI adoption in cities depends on broad investment in human capital rather than narrow technical recruitment. AI Singapore has run over 300 applied AI projects aimed not only to deliver solutions, but also to train engineers. Singapore's government has provided AI literacy training to 250 000 people, to overcome low workforce literacy. It also introduced an apprenticeship programme offering nine months of full-time training to graduates from different fields, such as computer science, law, accountancy and engineering. , to build talent and literacy at scale and across professions.

At city level, several municipalities have aimed to build local capacity to support AI adoption and adapt to its requirements, either by creating interdisciplinary "fusion" team (Eslöv, Montreal), by

developing in-house analytics competencies (Rotterdam), or training municipal staff (Montreal). **Some initiatives are undertaken within multi-city programmes**. A key aspect of municipal staff upskilling is to ensure that future AI projects can be overseen by humans.

- Montreal uses an annual AI hackathon involving staff to co-develop use cases, "fusion teams" pairing IT specialists with operational departments; and continuous internal education campaigns ("roadshows") on when and how to deploy AI effectively. One of the guiding principles of the Montreal AI Integration Strategy is to maintain adequate human control over critical decisions taken by AI systems and avoid total automation.
- In 2025, the Seoul Metropolitan Government announced key strategies to leap forward to become a "global AI Innovation Leading City" (Seoul Metropolitan Government, 2025[103]). Seoul places priority on responding to the growing demand for AI talent by training 10 000 AI professionals annually, and will strengthen the city-wise support system for AI talent development with a new scholarship (for 60 students with KRW 600 million as a start). In 2024, the city also became the first local government in Korea to announce AI Administration plans, which supported the adoption of AI-powered services to 38 projects in four sectors.
- The International Council for Local Environmental Initiative (ICLEI), a network of local and regional governments committed to sustainable development, together with Google and the Centre for Public Impact, launched in early 2025 the AI Opportunity Fund, an interactive training programme tailored for city officials across Europe (ICLEI Europe, 2025[104]). The AI Opportunity Fund training offers a free online course designed to build foundational AI knowledge, on machine learning, neural networks or large language models, and the societal implications of AI. Participants integrate a European network of peers for knowledge exchange and peer learning on AI.
- The city of Helsinki's "AI ABC" course and the City of Suresnes' hybrid AI-assisted contact centre illustrate how public administrations can combine human expertise with AI capabilities to enhance responsiveness while maintaining human oversight. Investing in training and interdisciplinary teams ensures that municipal staff understand both the opportunities and risks of AI, enabling them to use it ethically and effectively.
- The Tokyo Metropolitan Government views internal capacity-building as a prerequisite for responsible AI deployment. It considers that the main constraint on safe and effective urban AI use is not access to technology, but the capability of the administration itself. Tokyo is prioritising the development of AI skills and literacy within the civil service, through structured AI training programmes that equip officials to understand AI models output assessment, and supervision . The city's approach is to build own capability to ensure AI can be deployed in consistent ways with public priorities, social equity, and Japanese legal and cultural norms. For Tokyo, capacity-building is a core condition for urban AI adoption.

Urban AI infrastructure

Urban AI requires a backbone of digital and AI infrastructure, as well as physical, energy and institutional networks and facilities to perform. AI computing resources include one or more stacks (layers) of hardware and software used to support AI workloads and applications. AI compute requirements can vary significantly, depending on the application, AI system lifecycle stage, or the size of the system (OECD, 2023[105]).

High-speed networks and supporting software and platforms constitute critical infrastructural assets for urban AI. High-speed connectivity, including broadband and 5G networks and towers, is necessary to support real-time data transmission, which, in turn, is essential for smart mobility or safety and surveillance. Sensors and IoT devices, including cameras, air quality and mobility trackers, generate unique urban data streams. These large datasets can be stored on data platforms and repositories, sometimes cloud-based. Data lakes, data warehouses and data lake-houses enable the integration and

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processing of urban data, which typically come in various formats and from multiple sources (Heritier and El Hani, 2024[15]).

AI compute infrastructure is the computational power required to train and run AI models. The most complex AI models are trained with high-performance computing (HPC), i.e. dedicated servers and processors. Cities can access AI compute power through national or regional infrastructure or commercial cloud-based providers (e.g. Amazon Web Services, Google Cloud, Microsoft Azure). Some host HPC centres, which are often operated by local universities, federal/regional research labs or within public-private partnerships. For example:

- Barcelona hosts the MareNostrum supercomputer that is managed by the Spanish Ministry of Science, Innovation and Universities, the Catalan government and the Polytechnic University of Catalonia, and forms part of the Spanish Computing Network.
- The Tokyo Institute of Science operates the Tsubame supercomputer systems, with the latest generation TSUBAME4.0 aiming to support modelling and simulation workloads for complex scientific research in medicine, materials science, climate research, and turbulence in urban environments and address the computational demand for all (GSIC, 2025[106]) (HPE, 2023[107]). The construction of the compute infrastructure was procured by the Japanese government to Hewlett Packard Enterprise.
- Korea is building a new supercomputer (KISTI-6) that will serve data-intensive research projects and form the backbone of AI and simulation R&D in Korea (InsideHPC, 2025[108]). The new supercomputer is developed by the Korea Institute of Science and Technology Information and Hewlett Packard Enterprise.

Urban AI computing power could also be provided in edge computing nodes, which are implemented at stations, intersections or traffic nodes and can process data in real time. Compared to traditional or cloud computing solutions, edge computational networks connect demand and users of compute power to 'on-premises infrastructure', allowing to reduce latency, better secure data and enhance system resilience (Vangibhurathachhi, 2025[109]). Edge computing plays a critical role in enabling instant processing of data from vehicle-to-everything (V2X) communications, traffic cameras, and road sensors, allowing dynamic adjustments to traffic lights and rerouting strategies. By minimising latency, it can better address congestion and improve emergency vehicle navigation and pedestrian safety. In public safety and surveillance, edge computing supports analysis of video feeds and sensor data in real-time, enabling faster and easier crime detection, anomaly recognition, and event response. Edge computing is also used in urban utilities services for improving waste and water management. Data from bins, pipelines and treatment systems help detect fill levels, leaks, contamination, or pressure fluctuations and trigger immediate corrective actions. It is estimated that edge analytics have improved solid waste collection efficiency by over 30% through real-time bin monitoring by avoiding near-empty bin pickups (based on pilot studies conducted in 10 different locations across Lahore, Pakistan) (Addas, Khan and Naseer, 2024[110]). For instance:

- Barcelona has deployed edge servers close to where data is generated (at street-level) to bring compute closer to sensors and devices (Lenovo, 2023[111]). Edge-enabled sensors process several terabytes of data daily to analyse road conditions and traffic density and support traffic optimisation, leading to a massive reduction in congestion (Asad and Martin, 2024[112]).
- The Smart Seoul Network is a closed fibre-optic network with district level data centres and city-wide emergency platforms (Smart City Korea, 2020[113]).
- Tokyo has adopted edge-enabled controllers in the city's surveillance and sanitation systems to enhance urban service delivery.

However, various risks are associated with AI compute and digital infrastructure and can compromise city operations. Deficient infrastructure, ranging from faulty or obsolete hardware to power

outages and broadband network disruptions, can harm AI systems, as much as data biases, data poisoning or algorithmic errors. Latency, bottlenecks or outages can slow or stop time-critical services. The risk of hacking cannot be excluded either, causing breaks, accidents, or massive disruptions in urban services (Wired, 2018[114]). Legacy sensors that are deployed across cities, e.g. for traffic, lighting, or air-quality monitoring, may embed weak or obsolete authentication methods and heighten cyber exposure, especially since interconnectedness dramatically increases operational vulnerability in IoT-systems. Even in centralised infrastructure, which rely on cloud hubs or major data centres, a widespread computing model of smart cities, disruptions affecting a link can have considerable and cascading impact on the entire network. Compromised pipelines create backdoors and central facilities offer attractive targets to break through. AI compute infrastructure can also be endangered by geographic risks (e.g. natural disasters) and raises a number of issues related to the energy, space and cooling needs of their data centres, which can create severe strains on a city's land, power grids and water supply capacity.

In this respect, the OECD has established several recommendations to guide governments in planning for and governing their AI compute and digital infrastructure. A 2023 blueprint aims to help map and assess the national AI compute capacity, and forecast and plan needs in terms of capacity (availability and use), effectiveness (people, policy, innovation, access), and resilience (security, sovereignty, sustainability) (OECD, 2023[115]). In addition, an OECD.AI Expert Group on AI Compute and Climate helps countries to raise awareness and understand the issues around AI compute, including looking at closing "AI compute divides" within and between countries (OECD, 2025[116]).

Enabling conditions for urban AI innovation

Despite the potential that AI represents for cities to meet the many imperatives they face, adoption remains challenging. Creating the right conditions for urban AI use would require tackling and reducing the barriers that prevent broader diffusion.

Barriers to AI adoption typically include common innovation challenges, such as high implementation costs, a lack of awareness and skills in-house to integrate the new technology into city operations, and technology locks-ins and paths dependency that prevent users to switch to new solutions (Kergroach and Héritier, 2025[17]) (OECD, 2021[117]). Similarly, the AI transition requires capital upgrading and complementary organisational and skills investments to integrate AI systems and converging technologies into business practices and workflows. These changes entail costs, depend on workers' acceptance and engagement, and imply reskilling and new management approaches. This calls for effective city strategies and leadership to ensure AI adoption is efficient and effective.

In addition, the uptake of AI raises critical challenges related to risk management and the need to ensure that it does not negatively impact fairness, human rights or the environment. Managing AI-related risks is particularly complex because once the integrity of AI data, models or infrastructure has been compromised, a vicious circle of degradation can occur. Low quality data may affect the training of AI models and biased algorithms; algorithmic biases can compromise the integrity of AI systems and input data; human errors during AI training or deployment can further deteriorate AI output, data and models; and deficient infrastructure may expose AI systems to cyber-attacks, data breaches or sabotage. These failures can have a cascading effect on other AI and non-AI infrastructural assets, exposing the city to legal and reputational risks and jeopardising public trust.

Common barriers, together with AI-specific challenges, add complexity and uncertainty in the transition, conditions that are rarely favourable to risk-taking. A recent UN-Habitat survey of 122 municipalities found that the main perceived challenges in using AI are high implementation costs, concerns over personal data protection, and the legal and regulatory risks of unethical and untrustworthy AI. More than 50% municipalities surveyed identified these issues as definite challenges, ranking them ahead of technological or skills-related gaps (UN-Habitat, 2024[38]) (Figure 3).

Figure 3. Costs, legal uncertainty and risk management raise challenges for city adoption

Percentage of respondents to a UN Habitat global survey of 122 municipalities (%)

Note: Global survey of 122 municipalities across Africa, Asia, Europe, Latin America, and North America, to city managers, experts, researchers, and other stakeholders involved in AI planning, design, and governance. The report also combines comprehensive desk review and 70 case studies to gather diverse perspectives on AI in urban settings. Assessment was validated by an expert group, including city government representatives of various countries. Academia was represented by experts from the Seoul Institute of Technology, Research ICT Africa and the Kibabii University (Kenya), PIT Policy Lab (Mexico), the University of Montreal (Canada), and the Institute for Ethics in Artificial Intelligence of the Technische Universität München (Germany), among others institutions.
Source: (UN-Habitat, 2024[38]).

Financing urban AI innovation

Financing AI innovation requires large and sustained investments in AI assets, complementary technologies, and experimentation and maintenance. Cities must mobilise adequate funding to acquire and manage urban AI assets such as models, data, skills and infrastructure. In addition, upgrading existing IT equipment and systems may be required to support the deployment of auxiliary technologies and to integrate AI into physical or digital urban environments. This includes advanced automation and developments in sensors to expand AI capabilities and embedding intelligent software into digital platforms, applications, vehicles, buildings or public spaces to enable real-time analysis and decision-making. In some cases, retrofitting legacy systems and ensuring interoperability across outdated infrastructure could be even more expensive than deploying new, AI-ready systems from the outset.

The cost of implementing urban AI will vary depending on the scale and complexity of AI applications, the size of cities and the preparedness of staff and infrastructure. It is estimated that the cost for deploying basic AI solutions, i.e. pre-built pre-trained AI models for focused and well-defined tasks, with short development cycles and limited data requirements, such as chatbots, basic recommendation systems, sentiment analysis, data analytics or simple image recognition, could range from USD 20 000 to USD 80 000 (Softerwii, 2025[118]) (Coherent Solutions, 2025[119]) (Sumatosoft, 2025[120]). More complex solutions requiring integration with existing systems, data preprocessing and tailoring and training AI models (e.g. for decision-making, predictive analytics, risk management and real-time processing) could cost between USD 80 000 and USD 500 000. Finally, large-scale AI projects involving massive datasets, complex model architectures and strict security and compliance protocols, such as for deep learning, autonomous driving platforms, could cost up to several millions USD. Consequently, a medium-sized city might expect base infrastructure investments of USD 200-300 million for comprehensive coverage, while larger metropolitan areas could see costs exceeding USD 1 billion when including specialised systems for transport, public safety, and utilities (Monetizely, 2025[121]) quoting Deloitte's Smart City Infrastructure Development Index). These entry (sunk) costs can be substantial, irrecuperable, but lowered through cooperation, open data or open innovation (OECD, 2019[122]). The cost of AI integration into urban systems is also to compare with the city budget and financial capacity.

In addition, AI adoption entails hidden and recurring costs that must be considered from a longer-term perspective. Expenditure often arises after deployment and include maintenance and post-deployment support, such as model monitoring, fine-tuning or retraining as data evolves, debugging, technology upgrades, and capacity expansion (especially if number of users increase). In a fast-evolving technological environment, needs for constant learning call for regular training and upskilling of AI specialists or municipal employees. Future costs may also increase as cities ensure legal and ethical compliance with standards and laws (e.g. audits, documentation) or aim to strengthen risk mitigation policies (e.g. data protection, cybersecurity), especially if the regulatory environment evolves. Lastly, budget forecasts should include projections of energy and water consumptions for running compute infrastructure and cooling systems (Medium, 2025[123]) (Softerwii, 2025[118]) (Sumatosoft, 2025[120]).

The costs associated with AI transition and maintenance place additional pressure on the limited resources of municipalities (see Chapter 1). These expenses can strain already constrained budgets, create competition and crowding-out effects with essential urban services, and potentially intensify internal tensions over municipal priorities and vested interests. Financing AI innovation is made even more difficult by the fact that ownership and benefit structures can cut across traditional boundaries of city administrations or public and private sectors, raising complex questions about cost allocation and benefit sharing. For instance, an AI-powered smart mobility system may optimise and secure both public transport and private rideshare services. Improved traffic management could reduce both police and emergency department costs, but also traffic fine income. Urban AI can generate spillovers from smart city adopters to surrounding municipalities, e.g. by reducing commute times and fuel consumption.

Urban AI innovation often requires co-financing arrangements through blended models involving national and subnational governments and the private sector. In particular, Public-Private Partnerships (PPPs) appear to be a key operational and financing model for AI in cities as they allow to access the technological expertise, infrastructure, and data-processing capacity needed from the private sector, while maintaining public oversight and alignment with social objectives. For instance:

- In Eslöv (Sweden), the deployment of AI for land-use planning is supported by a public-private partnerships (PPPS). This case shows how transitioning from grant-based funding (through Vinnova, the national innovation agency) to a subscription - pay-per-use - model can help scale up from the pilot phase and reduce dependency on external funding.
- Montreal's AI Alignment for Inclusion (AIAI) project is a city-funded initiative under its AI Integration Strategy, supported by Mitacs, a Canadian national-level research funding programme.

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- In Seoul (Korea), AI use for safety and security is co-funded by the city and the 25 districts, with occasional central government support. This co-funding model illustrates how financial and administrative co-operation can enable the implementation of AI projects on a large scale.
- Suresnes (France) has partnered with NXO, business specialist in data flows management and integration, and Genesys, a software-as-a-service platform, to build its AI-assisted citizen contact centre, with inter-municipal support and co-funding from the Métropole du Grand Paris.

State and local governments can also form consortia to pool resources and share AI cloud or data infrastructure, or access international funding. For example:

- Regional collaboration within Rotterdam's partnership with Amsterdam, Hamburg, Milan, and Tampere, has helped reduce costs through shared development of digital twins, algorithm registries, and cloud platforms.
- In the case of Barcelona (Spain), a major contribution is made by the European Union InvestAI initiative that allocates EUR 200 billion to finance AI infrastructure in Europe, including EUR 20 billion for data centres and AI gigafactories (EC, 2025[124]). Seven consortia have been selected to establish and operate the first AI Factories across Europe, including the Barcelona Supercomputing Centre's AI Factory that results from the upgrade of the MareNostrum 5 system.

National support can be afforded with conditionality to help, especially small municipalities, scale AI, and avoid diluting resources into one-off local prototypes.

- The Slovak Republic comprises around 3 000 municipalities, most of which are small, under-resourced and lack specialised technical staff. A main challenge for the national government is not only to foster innovation, but to ensure its diffusion across a fragmented municipal landscape. In response, it is developing a national smart city data platform, as a shared infrastructure, enabling local governments to use AI and data tools without needs to build their own systems. In addition, EUR 70 million is made available for municipal pilot projects, on the condition that they demonstrate scalable business models. The aim is to avoid isolated experiments, and prioritise AI-enabled solutions that can be rolled out across the country.

On a longer-term perspective, the AI transition can also be financed by cost efficiency gains, risk reduction, and new sources of revenues and models of value capture. Rationalising operational costs, cutting on energy or input consumption, reducing maintenance expenses or safeguarding critical infrastructure, or dropping damage penalties, can generate significant budgetary savings. Charging for AI-enhanced services (e.g. public transit, smart parking, licensing, surveillance etc.) through user fees, taxes, permits or licenses etc., commercialising data generated through AI services and activities, trading access to government AI facilities among others., can generate new and significant municipal income (Deloitte, 2019[125]) (OECD/Lincoln Institute of Land Policy, PKU-Lincoln Institute Center, 2022[126]), (NLC, 2024[127]), (StateTech, 2025[128]). For example, Barcelona (Spain) adopted an outcome-based and cost-saving financing model by linking AI investment to measurable outcomes such as energy savings, reduced maintenance costs, or improved asset longevity to justify upfront expenditure and attract co-financing from private partners. Energy and operational savings are then reinvested into scaling AI projects.

Leveraging local innovation systems

Local innovation systems play a critical role in AI transition, reflecting that innovation does not take place in isolation and AI uptake is tied to local conditions and capacity. These systems include actors involved in knowledge creation and diffusion, such as universities, research labs, start-ups, SMEs and multinationals, consultancy services and knowledge providers or the civil society at large, as well as the networks these actors have built and the institutions and norms that govern them.

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Innovation systems contribute to pushing the AI frontier and strengthening AI knowledge (co)creation and transfer, especially tailored to local needs. Early analysis of business adoption patterns has shown that leading regions in the AI transition are also top innovation performers (Kergroach and Héritier, 2025[17]). Leading regions stand as pockets of excellence, even in their own country, and combine highly educated and digital savvy population, efficient research systems, intensive production of intellectual assets (e.g. patents, trademarks) and a large population of innovative firms, including SMEs, engaging in cooperation, including with academia (EC, 2023[129]). Among capital regions, the Brussels-Capital Region (Belgium) reports more than 32% of business adopters in 2024, almost twice as many as in 2023. The region is highly skilled, with over 90% of local jobs in services, especially in financial services and professional, science and technology activities. It is also home to the headquarters of European institutions, and serves as a hub for the country's integration into international service networks. In Vienna (Austria), 26% of businesses use AI in 2024, up from 16% in 2023. The capital region is heavily service-oriented, playing a major role in financial services, and in the digital transformation. Vienna hosts numerous research institutions and universities, world-class research facilities and innovative firms, the region having developed an edge on renewable energy, smart city and environmental technologies. Oslo and Viken, the capital region of Norway, is the most innovative in the country and an innovation leader in Europe. In 2024, it counted almost 26% of AI business adopters, compared to 12% the year before. The region is a key maritime and logistics hub, and a global centre for financial, and communication and media services. It has developed comparative advantages in fintech, and green and health tech, with regional "innovation districts" supporting public-private collaboration and the integration of research and the start-up ecosystem. Among non-capital regions, Central Jutland and Region Zealand (Denmark) lead at 35% and 28% of AI adoption, followed by Tirol, Vorarlberg and Upper Austria (Austria) and Southern Denmark (at around 21%). These regions stand out as global hubs for green and health tech, robotics and advanced manufacturing.

AI innovation arrangements vary across cities

Universities, through their missions of education, research and technology transfer, and public research institutes, which often conduct more targeted and specialised research and transfer activities, can help cities build advanced AI capabilities. They can support cities in collecting, curating and analysing data, as well as tailoring AI models to address specific urban challenges. Whether locally based or overseas, academic and research partnerships can strengthen urban AI capacities and foster the development of applications and services that generate broader benefits for residents. For example:

- Barcelona (Spain) involves research institutions in its AI transformation, via challenges and competitive project-based calls for which universities can partner (EurekAlert!, 2023[130]).
- London's bat monitoring system results from a collaborative and multidisciplinary research initiative whereby university, technology and conservation groups, including the University College London (UCL), have joined forces and combined environmental science, computing and urban infrastructure expertise for smart urban innovation.
- In Montreal, the AI Alignment for Inclusion (AIAI) project that forms part of the city's AI Integration Strategy with strong focus on partnerships with local research institutions, is led by Mila - Quebec Artificial Intelligence Institute.
- The Seoul Metropolitan Government has signed a memorandum of agreement with the Massachusetts Institute of Technology (MIT) to open a new AI research lab in the capital city (Korea JoongAng Daily, 2025[131]). The MIT Senseable City Lab, which focuses on urban studies using sensors and data, has previously launched joint labs in Amsterdam, Singapore, Stockholm, Rio de Janeiro and Dubai. The Seoul lab is expected to run 3–5 urban AI projects, applying research directly to local municipal problems, with the final selection to be jointly made with Seoul government departments and affiliated agencies.

- Rotterdam has established a longstanding institutional partnership with the Erasmus University Rotterdam, including for housing AI (EUR, 2025[132]) (EUR, 2025[133]). As part of it, Thematic Knowledge Labs provide a forum where city officials and researchers co-design projects, involving academics into city planning and transformation.

Universities can act as trusted third parties to evaluate AI systems, or more broadly enhance credibility and transparency of AI applications. For instance:

- In the EU-funded AI4Cities project, or UrbanAI projects in Paris, universities were designated as evaluation partners to test for fairness, bias, and interpretability of AI pilots that were proposed by private vendors before city-wide adoption (AI4Cities, 2020[134]).
- Barcelona's Municipal AI Strategy (2021) emphasises transparency and auditability of AI models and databases, which should be accessible, understandable and auditable by the general public. Partnering with academia is part of the city's digital rights commitments (Cities Coalition for Digital Rights, 2025[135]).
- The Helsinki AI register was co-developed by the City and Helsinki's Centre for Data Science. The university created the methodology to document algorithms and ensure transparency. The AI Register provides general descriptions of the city's AI systems to residents, who, in turn, can give feedback and participate in building human-centered AI locally (Helsinki city, 2025[136]).
- In Seoul, national research institutes such as the Korea Research Institute for Human Settlements (KRIHS), are engaged in evaluating smart city projects.

Start-ups and SMEs traditionally play a key role in experimentation, for addressing niche demand or commercialising tailored solutions. In innovation systems, they often bear the risk of innovation, help shorten innovation cycles and speed diffusion through prototyping and more agile work organisations, or supply small scale, small volume demand that may not be profitable for larger firms, ultimately bringing the benefits of AI innovation to a larger number of places and actors (OECD, 2019[122]) (OECD, 2023[137]). Start-ups and SMEs are integrated into urban AI developments through research cooperation initiatives, public procurement or access to testbeds, incubators and networking facilities. For example:

- Barcelona runs a challenge programme for implementing innovative urban mobility solutions, with two AI pilots aimed at reducing noise pollution (Fira Barcelona, 2025[138]). The challenge is open to companies, SMEs, startups, universities, research institutions and technology centres, and non-for-profit organisations. The SmartCatalonia Challenge also operates as a regional innovation programme inviting SMEs to co-develop AI solutions for addressing municipal problems across Catalonia, including Barcelona (Gencat, 2025[139]). The programme then links municipalities and research actors to scale up pilots regionally.
- The municipality of Eslöv (Sweden) has used Hektar, an AI-assisted planning and design platform, to support early-stage urban planning and zoning optimisation, which has been developed by a consultancy start-up in architecture (Parametric).
- Korea has launched a Convergence Alliance to foster the domestic smart city industrial ecosystem, and develop technological co-operation between large and small companies, research institutes and associations (Smart City Korea, 2025[140]). The Seoul Business Agency, together with comprehensive and systematic support to the city's SMEs, promotes start-up incubation and growth (SBA, 2025[141]).
- Turin (Italy) has established a collaboration between municipal authorities, tourism agencies and local technology providers to develop its AI-powered Navigation Exploring Tourist Assistance and simplify tourism services. The City of Turin and Turismo Torino manage the system, while technology partners (Orbyta Tech and Esosphera-Cometa) contribute to system optimisation, dialogue coherence, inclusivity and moderation.

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Multinationals and foreign affiliates largely contribute to advancing the global knowledge frontier and building the digital infrastructure (OECD, 2023[137]). In 2024, 50 companies alone contributed to 40% of global R&D, four sectors making up more than three quarters of total investment (ICT hardware, ICT software, health and automotive) (Nindl et al., 2024[142]). The top ten R&D investors were responsible for over 50% of the increase that took place between 2022 and 2023. The fastest accelerations came from ICT hardware (23% of global investments) and ICT software (21%), with a focus on generative AI for programming for the latter. The "superstar" firms of the ICT sector, such as Alphabet, Meta, Apple and Microsoft, stand among the big tech companies, with Samsung Electronics, and appear among the firms with the largest numbers of mergers and acquisitions (M&As) deals from 2008 and 2020. De facto, multinationals create standards for AI in a broad range of relevant areas to urban management, including transport, energy, digitalisation or data.

Multinationals operate as AI knowledge and solutions providers, developing auxiliary technologies, supplying cloud, data and compute infrastructure, or offering pre-packaged ready-to-use AI systems (e.g. Amazon Web Services, Microsoft Azure, Google Cloud). Through their investments and the establishment of foreign affiliates, labs or accelerators in smart cities, they create linkages to local innovation systems. Through their global value chains, they channel technology, knowledge, expertise and funding towards the host places (OECD, 2023[143]). Some enter into strategic partnerships with municipalities to develop AI solutions. For instance:

- In 2025, Barcelona's City Council reaffirmed its commitment to work with Microsoft to improve municipal services and internal management through AI technology. Agreements were signed with Cisco to train 250 students in cybersecurity, or with Huawei to develop innovation and implementation in smart cities, smart buildings or digital platforms. A recent challenge aims to foster public-private collaboration on urban mobility and optimise good distribution (e.g. catering) to reduce emissions (Meet Barcelona, 2025[144]).
- Japan's Ministry of Land, Infrastructure, Transport and Tourism (MLIT) has been instrumental in rolling out smart traffic management initiatives, including AI-powered traffic signal control, real-time monitoring, and predictive congestion algorithms. Leading automotive and technology companies like Toyota, Hitachi, and NEC have invested in connected vehicle technologies and digital infrastructure that feed into Japan's growing mobility data ecosystem.
- Since 2024, the Seoul Metropolitan Government collaborates with Microsoft to boost AI innovation and adoption in the city, and support overseas expansion of Korean AI start-ups. The strategic partnership aims to mobilise the technical and human resources of Microsoft, including the cloud computing and software development platforms, management support, legal consultation, space or rent subsidies, to provide startups, Seoul citizens and developers with customised AI training, to foster advanced AI talent, and to foster decacorns (i.e. new venture companies with a corporate value of over KRW 10 trillion, i.e. USD 10 billion). The Seoul AI Hub, Korea's first AI support organisation, pursues joint research projects with industry, academia and research institutes and in partnership with global big tech companies.

Co-operation can be business-driven and initiated by private actors, municipal authorities serving as facilitators or playing a consultative role. For example:

- The Miami-headquartered multinational Foundever set up an AI innovation Lab in Barcelona's 22@district to facilitate strategic collaborations with other companies and across the 45 countries where the company operates (ICEX Spain, 2025[145]).
- Korea's Ministry of Land, Infrastructure and Transport (MOLIT) has developed the Smart City Integrated Platform to foster real-time event monitoring and global interoperability. The platform can collect, analyse, and utilise urban data while processing time- and location-based real-time information to improve the efficiency of urban services. It visualises GIS-based situational data, enabling rapid and accurate responses during disasters or emergencies. The platform has been

distributed to 108 local governments, including Seoul and overseas, setting an international standard with both public and private sectors working together to support local governments. (Korea Post, 2025[146]) (Smart City Korea, 2025[147]).

- In addition, the Seoul Metropolitan Government is creating the AI Seoul Tech City as an industrial, cultural and residential space to attract and bring together AI talent and companies, including from abroad, and lay the foundations of an innovation ecosystem for future AI industries (2028).
- In 2024, Waymo, the self-driving unit of Alphabet, Nihon Kotsu, a local taxi fleet operator in Tokyo, and GO, a Nihon Kotsu's affiliate and a popular taxi app in Japan, announced partnership for testing the deployment of autonomous vehicles in Tokyo (The Verge, 2024[148]) (Reuters, 2025[149]) (IoT World Today, 2025[150]). Manually driven vehicles, provided by Waymo and managed by Nihon Kotso, are deployed to map key areas of the city and gain insights into local infrastructure and driving patterns. The co-operation includes the establishment of a depot for self-driving taxis, training sessions for Nihon Kotsu and GO staff, and building relationships with relevant stakeholders and authorities, including local organisations, government agencies and public bodies.

Collaboration and knowledge exchange can also take place between peer cities and within multi-city programmes. Cities co-operate, even across borders or within international fora, to develop common projects, share good practices and innovate. Collaboration could help them enhance capacity and capability for implementing AI. In some cases, co-operation includes co-financing. For instance:

- Rotterdam collaborates with European peers such as Amsterdam, Hamburg, Milan, and Tampere to harmonise AI practices through initiatives like the Eurocities Algorithm Register[11], which supports compliance with EU standards.
- Seoul's co-funding model (i.e. 50% Seoul Metropolitan Government, 50% district governments, with national support) illustrates how financial and administrative co-operation can enable large-scale AI implementation with better results than when operating in isolation.

A key challenge for smart cities in their AI transition is to scale up solutions and move from pilot projects to large-scale deployment. For that purpose, urban labs serve as testbeds, opening experimentation facilities to multiple innovation actors and promoting cooperation and knowledge sharing. For example:

- Rotterdam runs Urban Living Labs, where university researchers study the social and governance aspects of AI and smart systems, with citizen input.
- Seoul has established the Magok district as a living lab for smart city solutions, inviting universities, research institutes, and companies to collaborate with the municipality.

Finally, citizen engagement is critical in urban AI development and diffusion, participative approaches being increasingly seen as a way for building urban AI legitimacy and acceptance. The models of civil society engagement can however differ across cities. From information campaigns and capacity building to broad consultations, to co-creation and citizen science, to democratic debates, city residents are called to take a proactive role in urban AI projects. For instance:

- The AI-assisted chatbot of Helsinki to assist residents in navigating rental housing services has benefited from early participation of residents in co-design through tools like UrbanistAI, that allow them to visualise AI-generated urban scenarios and provide input during planning.
- By design, Montreal's pilot programme for AI Alignment for Inclusion is paired with participatory workshops, to engage residents, including underrepresented groups, in shaping AI-generated proposals for public spaces.
- Rotterdam hosts multiple living labs where citizens participate in co-creation workshops by testing AI-driven innovations for housing, energy or logistics systems. The city's Knowledge Labs include

projects on Liveable Neighbourhoods where residents contribute experience and needs to orientate AI-enhanced projects (EUR, 2025[151]).

- The Seoul AI Smart City Center, supported by the Seoul AI Foundation, is a public experience space where citizens can gain first-hand experience of AI technology, and learn about how it is applied to Seoul City administration, including in transportation, safety, welfare, and environment (Smart City Korea, 2025[152]). The Centre offers five spaces proposing immersive experiences, based on actual cases, educational programmes or networking opportunities, with a view to enabling citizens to participate directly in ideation and solving urban problems using AI.

Creating urban AI governance arrangements

Cities are increasingly recognising institutional readiness as essential for scaling experimentation responsibly, and the need for coherent approaches to AI across city functions and departments.

Some cities adopt AI strategies that can offer a framework for coordinating purpose-driven AI solutions and tackle specific urban challenges. Some cities integrate AI into their digital or smart city strategies. For example:

- Barcelona's RESPIRA platform was introduced to optimise metro ventilation after traditional fixed systems failed to ensure adequate air quality and temperature control amid rising energy costs. It forms part of Barcelona's AI Strategy (*Estrategia Municipal de algoritmos y datos*) to promote a human-centred and rights-based approach to AI across the city, ensuring that technology serves the public interest, strengthens transparency and accountability, and supports the city's digital transformation (Ajuntament de Barcelona, 2021[153]).
- Montreal's AI Alignment for Inclusion (AIAI) project was introduced to engage residents in more inclusive urban design. It forms part of Montreal's AI integration strategy to promote the use of AI responsibly, ethically, and inclusively to improve the quality of life of residents while strengthening municipal efficiency and innovation (Ville de Montréal, 2024[58]). Montreal's AI strategy is also aligned with the Montreal Declaration for the Responsible Development of AI, Montreal 2030, and the Climate Plan.
- Rotterdam has adopted an AI system to detect unreported housing modifications because manual inspections were time-consuming and incomplete, leading to lost tax revenue and poor urban planning data. The initiative forms part of a broader municipal vision of a Digital City, including emergency responses or a digital twin for the Port of Rotterdam (AEC Business, 2025[154]).
- Seoul's AI-enabled CCTV system was developed to detect security incidents earlier, strengthen prevention and improve response times, and build public trust in safety services. The Seoul Metropolitan Government has adopted an AI-based plan that introduces a dedicated control office, territorial budgets, and commitments to embed AI across municipal functions.
- The Tokyo Metropolitan Government applies AI to strengthen its flood management systems and enhance early warning systems and disaster responses. It forms part of Tokyo's AI Strategy that outlines the fundamental principles and strategic direction for engaging with AI. The Strategy acknowledges AI as a core technology (tool) for realising Tokyo's development long-term vision.

Critically, these initiatives tend to be aligned with broader, national and international, digital frameworks and governance ecosystems. Tokyo aligns vertically with Japan's national digital and AI strategies, while Barcelona aligns horizontally with European (EU AI Act) and national frameworks focused on ethical, human-centred AI and digital rights. Montreal's strategy is explicitly aligned with national (Pan-Canadian Artificial Intelligence Strategy 2021-2025), provincial (*Québec's Plan d'action en intelligence artificielle 2021–2025*), and international (OECD AI Principles 2019) AI governance frameworks, embedding local innovation within a broader ecosystem that prioritises ethical, transparent, and citizen-

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centred AI. This multilevel alignment ensures coherence, legitimacy, and shared standards for AI deployment in cities.

Cities are creating dedicated AI or digital innovation units supported by cross-departmental committees to ensure coherence, accountability, and ethical oversight in the integration of AI into the city systems.

- Barcelona created an Advisory Council on Artificial Intelligence, Ethics and Digital Rights, chaired by the Deputy Mayor and the Commissioner for Digital Innovation, to advise on AI and digital rights issues across municipal services.[12]
- In the city of Montreal, the government created a cross-departmental AI governance committee to ensure that projects follow shared ethical standards, data governance rules, and procurement processes. This committee includes representatives from IT, legal, data, public service, and communications departments, promoting a whole-of-city approach to responsible AI. This governance model allows local governments to manage AI projects consistently, share data and expertise across sectors, and align local innovation with broader regulatory and digital strategies.
- In Tokyo, the Digital Strategy Division of the Tokyo Metropolitan Government is in charge of managing the implementation of the AI Strategy.
- Turin (Italy) has established an Ethics Board for emerging technologies, composed of independent external experts, to review specific use cases and anticipates the EU AI Act requirements by designing checklists for suppliers and internal guidelines for municipal staff.

Cities are also growing their own institutional capacity, building on existing governance instances, strengthening democratic processes, or fostering structured city-to-city collaboration. For cities, beyond technological readiness, key challenges lie in governance capacity and public legitimacy. Cities require i) new forms of participatory engagement; ii) investment in skills and literacy in public administrations; and iii) mechanisms for routine knowledge pooling across municipalities.

- Nantes (France) has anchored AI deployment in long-established data governance structures, including a Chief Data Officer in place for a decade and a Data + AI Charter adopted in 2019. The city also conducted 'Nantes Debating AI', a structured public consultation that identified citizens' priorities such as environmental impact, human agency, and education.
- Ghent (Belgium) has leveraged its AI competence centre, ensured the active involvement of a Data Protection Officer, and introduced privacy-by-design and 'inclusion-by-design' principles in AI initiatives from the outset.

In addition, cities require public institutional capacity, not only vendor procurement. Cities are currently on a trajectory where AI capability is overwhelmingly procured externally. The risk may be replicating the dynamic seen in earlier digitalisation waves, where fragmented vendor solutions created opaque landscapes and eroded public trust. The risk is that minor functions can become socially corrosive when intelligence is externally controlled without public surveyance. Cities need to invest in the institutional architecture of 'civic intelligence' through standardised data governance, transparent algorithmic oversight, common technical and ethical frameworks, and the ability to conduct bias testing and risk assessment in-house. This would provide the basis for vendor integration on public terms, rather than public dependence on private terms. AI should become a new form of public infrastructure, with the same level of institutional investment as water, sanitation, transport or energy systems.

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4 Ways forward: AI and the future of smart cities

AI is transforming the way cities are planned and managed, how urban systems operate, and how residents and visitors experience urban life. However, AI adoption is not an end in itself but a tool to inform urban planning, facilitate citizens engagement in decision-making, manage resources more effectively and efficiently, and strengthen transparency and accountability. While there is tremendous potential for AI to help smart cities tackle the global and local challenges they deal with and are responsible for, related risks are of a similar magnitude.

This chapter explores possible futures for smart cities and proposes key issues for discussion for urban policy makers to ensure a trustworthy, ethical and sustainable use of AI in future AI-shaped smart cities.

The future AI-shaped, smarter city

An AI-shaped city will look different across places because AI design and applications reflect geographical contexts, local priorities, available resources, and governance cultures. In advanced digital economies such as Finland, Japan and Korea, AI is often embedded in existing smart-city infrastructures to optimise public services, enable smart mobility, and enhance climate resilience. These cities use dense sensor networks, digital twins, and predictive models to support data-driven decision-making while maintaining strong institutional oversight and citizen participation mechanisms. In emerging economies, the AI-shaped city may evolve more incrementally, focusing on addressing pressing urban challenges such as informal settlements, public safety, and public service delivery gaps. AI applied to satellite imagery in Latin American cities helps identify underserved areas and inform inclusive planning. The 'Mapping with AI for Informal Areas' (MAIIA) project uses AI-based photogrammetry methods to map informal settlements from aerial imagery, helping municipal governments in Latin America identify underserved communities and plan service and infrastructure interventions (World Economic Forum, 2025[155]).

Multiple urban futures may emerge, shaped by governance choices, societal priorities, and the technological capacities available as AI is embedded in city systems.

One possible urban future is the 'predictive city' where AI continuously analyses data from sensors, digital twins, and administrative records to anticipate needs and optimise services, from energy and transport to waste collection and emergency response (Zain, 2025[156]). AI may enable cities to move from reactive service delivery to predictive models that anticipate risk, demand and system stress. Flood forecasting in Jammerbugt (Denmark), dynamic traffic optimisation in Meudon (France), and predictive building maintenance in Barcelona (Spain)'s metro ventilation system all illustrate a shift toward early intervention and greater resilience. Moreover, many AI initiatives break down silos by linking disparate data streams such as transport flows, energy demand, land use, safety signals, into unified decision-support tools. AI can then support integrated planning, as in Rotterdam's (Netherlands) AI-driven housing

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monitoring strengthening taxation, energy and emergency services, or Seoul Metropolitan Area's safety network linking CCTV, apps and disaster response.

Such cities could achieve unprecedented efficiency and resilience, but risk becoming overly technocratic (i.e. governed or managed primarily by technical experts and automated systems) if human oversight and ethical safeguards are weak. In these cities, the use of AI-driven digital twins offers significant potential to enhance the effectiveness and precision of urban planning by enabling real-time simulation, monitoring, and forecasting of city systems. However, their implementation is often constrained by technical challenges, such as fragmented data, interoperability issues, and varying levels of system maturity. Barcelona and Montreal face issues related to data reliability, London's challenge is the limited sensor reliability, and Seoul faces administrative fragmentation sometimes leading to fragmented data.

Another urban future may be the 'participatory intelligent city', where AI is designed to augment collective intelligence rather than replace it. In this case, data and algorithms are open, transparent, and co-created with residents, enabling citizens to contribute to planning, sustainability, and service design. The key issue here is to ensure that the primary focus of smart city project is not technology infrastructure but to understand how these projects will address human needs (UNDP, n.d.[157]). Helsinki's AI Register and Nantes' citizen assemblies on AI demonstrate how participatory governance can ensure that automation strengthens democracy (URBAN AI, 2025[158]).

However, there is also the risk of the emergence of a fragmented or inequitable city. This may be the case if AI adoption reinforces existing divides between digitally connected and excluded communities or between rich and poor cities. Research shows that higher levels of public sector innovation and data use practices correlate to higher levels of city and life satisfaction among residents (OECD, 2021[159]). Therefore, without inclusive data strategies, algorithmic accountability, and investment in skills, AI could deepen inequalities in access to services and representation.

The rapid deployment of AI in urban safety can lead to serious governance and ethical failures when oversight is weak. The use of advanced surveillance systems, originally justified as tools for public protection, may lead to excessive monitoring, privacy violations, and loss of citizen trust in the absence of proper safeguards. When cities rely heavily on opaque, automated systems without transparency, accountability, or public consent, they risk creating environments that are not only intrusive but also vulnerable to abuse, cyberattacks, and misinformation. Without strong democratic safeguards and citizen engagement, "smart" technologies can make cities less safe socially and institutionally, even as they promise greater efficiency.

The challenge for city leaders is therefore to steer urban AI towards people-centred and ethical futures, where technology enhances social inclusion, environmental sustainability, democratic values and economic development. It may be argued that the future AI-shaped, smarter city should not be defined by automation alone, but also by how effectively it combines intelligence with social empathy, efficiency with fairness, and innovation with accountability.

A possible next step in using AI to advance smart cities is to move from individual applications to platform-level integration, where multiple AI use cases can run off shared data, logic and governance. The real acceleration of AI adoption occurs when cities shift from procuring isolated solutions towards building or participating in shared platform infrastructures where one investment in data governance, interoperability and ethics underpins many applications. For example, Dubrovnik (Croatia) is starting to move in this direction. Although many of its tools began as stand-alone applications for independent services (e.g. parking management, excursion bus booking, visitor counting, culture card), the next phase focuses on integrating these services into a unified mobility regime (e.g. the forthcoming park-and-ride system tied to tourist access restrictions). The value of each tool increases when combined with others, because the city can monitor, co-ordinate and manage flows across the entire system, rather than solving each pressure point separately.

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Key issues for discussion for urban policy makers

Artificial Intelligence is moving from pilot initiatives to core urban systems, transforming how cities plan, manage and deliver services. Its growing application across mobility, housing, land use, environmental management, economic development, safety and public administration signals a shift toward more data-driven and adaptive urban governance. It offers a powerful lever for making cities more resilient, inclusive and sustainable, but it is not a 'plug-and-play' solution.

The following issues are of particular policy relevance for the future of AI-shaped smart cities:

1. ***AI adoption is a strategic decision and requires coherent city-wide strategies and policy alignment around a shared vision of purposes and means.***

Cities need to clearly understand the problem they want to address and to explore different alternatives before opting for and deploying AI solutions. Cities implement AI projects for specific operational necessity, for improving a core city function or for addressing specific urban development challenge. Considering the complexity of AI-driven innovation and the cost of transformation, targeted approaches may prevent wasting resources, creating redundant systems, or introducing unnecessary complexity into the city's public administration. Targeting may also allow for experimentation and capacity building before scaling up to more sophisticated, cross-cutting or systemic applications.

In addition to shaping a vision on purposes and approaches, AI strategies, or the integration of AI considerations into smart city strategies, help strengthen public policy alignment across the board, and with national and international frameworks such as the EU AI Act or the ASEAN Guide on AI Governance and Ethics.

2. ***Any urban AI strategy starts with a data strategy***

Without quality data, there can be no AI. Even the simplest applications require a proper data governance, from collection, aggregation, analysis to sharing and protection. Cities use a large variety of administrative, open government, behavioural, IoT, platform-based, geospatial or crowdsourced data to train AI systems and inform decision-making. Access, sharing and use conditions vary, including across city departments, raising IPR, protection and interoperability issues, not to mention risks of data leakages and contamination.

Cities are taking action to valorise their data, promote data integration, e.g. through platforms and standards, and leverage new sources of (big) data. Municipal authorities have established data governance protocols, privacy-by-design mechanisms, and cybersecurity safeguards to ensure reliability and trust, efforts that imply (sometimes significant) investments in data infrastructure, cybersecurity, and workforce training.

3. ***New institutional capacity and competencies are needed for operating AI and ensuring human stewardship***

Cities introducing AI in their systems aim to strengthen their institutional capacity and skills of their staff. Early adopters have created skilled city teams capable of developing, procuring, evaluating and monitoring AI solutions responsibly. Similarly, they have trained municipal staff to ensure human stewardship and reduce risks associated with "shadow AI", i.e. a non-official use of AI in the workplace that can introduce vulnerabilities, expose sensitive data or undermine compliance and reputation.

4. ***Urban AI is open user-driven innovation that calls for experimentation and co-operation***

Cities do not innovate in isolation. Collaboration, with peer cities, with the private sector, with the academia and public research, with the civil society, or even across city silos, is critical to accelerate learning, technology developments and transfer to urban systems. In fact, cities increasingly share AI knowledge through international fora, to speed the diffusion of good practices. Co-operation can also help reduce innovation costs and risks, e.g. by sharing access to strategic infrastructure, or limiting technology (and

vendor) locks-in when co-creation and open-source tools enable the production of indigenous solutions. Building on a large range of partnerships and networks, cities have become testbeds for urban AI, driving research and its adaptation to urban challenges, and turning local universities, start-up ecosystems, and multinationals as key stakeholders of urban transformation.

5. ***Citizens contribute to the urban AI transition, from data sourcing to participative governance, or simply as users of city services***

Citizens, as final users of AI-powered city services, are part of the innovation process. Their engagement spans from data crowdsourcing to the co-design of AI solutions or the scrutiny of algorithms, and the retro-feedback they provide on AI-enhanced public services. AI helps simplify citizens' interactions with city governments, expand municipal services to underserved or excluded groups, and open opportunities for broader participation in public affairs, supporting more democratic and equitable urban planning processes. Deliberative citizen participation can, in turn, enhance trust and legitimacy in urban AI solutions, making the AI transition more inclusive and socially grounded.

6. ***Municipal authorities have a major but challenging role to play in governing the AI transition***

AI solutions are adapted to each city's legal, social and infrastructural contexts. Differences in regulation, governance capacity, digital literacy or connectivity determine the modalities of city's transformation. Legal requirements, such as data protection, procurement rules, and public-sector accountability obligations, are critical in AI adoption and monitoring. Social factors, such as cultural attitudes toward technology and patterns of inequality, shape how residents interact with AI systems and whether those foster trust and inclusion. Infrastructural constraints, in terms of data availability, connectivity and legacy systems, influence the feasibility and performance of AI applications. Without this contextual adaptation, even technically sound solutions risk amplifying biases, violating privacy regulations, or failing to integrate into existing urban systems.

Cities with the more mature AI initiatives have put emphasis on setting a robust governance framework for AI, including clear standards, rules and oversight responsibilities. Ethics review boards, algorithmic impact assessments, and participatory design processes aim to strengthen accountability and limit risks of fragmentation, bias, or public backlash. Municipal authorities also play a role in defining safeguards, e.g. though contractual agreements with private technology providers to secure data use and service continuity, or through ethical and cybersecurity requirements embedded in contracts. Finally, they are instrumental in building the incentives and funding mechanisms to support the AI transition.

7. ***Financing urban AI, under already tight budgetary conditions, remains a critical issue***

Sustainable financing models are key to the long-term viability of urban AI solutions. Embedding AI into urban systems can involve substantial costs, not only for technology acquisition and upgrading, but also to support organisational changes and staff retraining. Costs are then likely to increase as AI solutions become more sophisticated and cities have to leapfrog to more advanced digital environments.

Cities combine diverse, flexible and blended funding models, leveraging local public investment, together with intercommunal or metropolitan support, (research) grants, international subsidies or private co-funding to kick-off AI integration. Subscription-based models and AI-enabled cost efficiency aim to ensure continuity.

8. ***Metrics, monitoring tools and evidence on AI impact on city services are needed to inform the urban policy process***

Developing robust metrics, monitoring tools and evidence on AI impact on city services, and the returns on investment, is essential to guide urban AI policy. To date, transparency on costs and benefits is often limited, making it harder for cities to benchmark or replicate models. More systematic and harmonised evaluation frameworks would enable them to assess whether AI applications deliver measurable public value, improve efficiency, or advance inclusion and sustainability objectives. Reliable and comparable

indicators on city readiness for AI, urban performance, costs of transformation, and outcomes would inform decision-making, and contribute to reinforce the transparency and accountability of urban policy. Monitoring frameworks should ideally capture both quantitative and qualitative dimensions — such as user trust, equity and environmental gains — and evolve to support continuous policy learning. Embedding such impact assessment tools in cities' AI governance framework would also help municipalities allocate resources effectively and ensure that AI innovation and investments align with long-term urban development goals.

9. Cities should anticipate the impacts of AI before deployment.

Cities need to test the 'future system effects' of AI need to be tested before deployment, using structured foresight and scenario tools. The key question is not only ask 'what can AI do today?' but 'what kind of city does AI create?'. The reason is that AI is not more than a new tool, it is changing the speed, decision logic and decision power dynamics of urban decision-making. Many urban technologies have been deployed in the past in ways that solved short-term issues while creating new long-term vulnerabilities. For example, AI-driven optimisation of energy use can deliver immediate efficiency gains, but if the city invests in large numbers of sensors and hardware too fast, this investment may generate so much carbon in the infrastructure that it can outweigh these operational efficiency gains. Similarly, Iin the mobility domain, autonomous solutions might improve traffic 'efficiency' in traffic terms but simultaneously erode the perceived safety of public spaces for women, which would undermine wider social equity goals. AI is not a neutral optimisation layer because it embodies a path dependency. Foresight should be part of the governance instruments in AI-deployment in cities, ensuring that the AI solutions delivered today support the city tomorrow that residents want tomorrow, rather than preventing difficult-to-reverse systemic lock-in.

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Endnotes

[1] For further information see: https://www.ebrdgreencities.com/policy-tool/operations-centre-rio-de-janeiro-brazil/

[2] Technical debt refers to the future costs associated with relying on shortcuts or suboptimal decisions made during software development. See: https://www.ibm.com/think/topics/technical-debt

[3] For further information see: https://ai4cities.eu/news?c=search&uid=2x0PkMi0

[4] Kim, David and Kim, Donghan, Application of AI to Spatial Delineation in the Comprehensive Plan: The case of Busan, Republic of Korea, Unpublished material provided to the OECD by the authors.

[5] Interview with Arianna Salazar Miranda, Assistant Professor of Urban Planning and Data Science at the Yale School of the Environment on 6 March 2025 conducted by Hubert Beroche. “AI allows us to analyse urban environments at an unprecedented scale”.

[6] For further information see: https://www.montevideo.com.uy/Noticias/El-Ministerio-del-Interior-comenzo-a-usar-IA-para-detectar-personas-en-situacion-de-calle-uc928163 and https://saltograndeextra.com/uruguay-aplica-inteligencia-artificial-para-detectar-personas-en-situacion-de-calle-y-asistirlas-por-el-frio-extremo/

[7] For further information see: The Montréal Declaration for a Responsible Development of Artificial Intelligence, https://montrealdeclaration-responsibleai.com/the-declaration/

[8] ‘Vendor lock-in’ occurs when switching from one supplier to another becomes prohibitively costly or complex, leaving the customer dependent on the original provider. This dependence may arise from financial constraints, limited technical capacity, or the need to maintain operational continuity, ultimately restricting flexibility and innovation and potentially resulting in reliance on suboptimal products or services. See: https://www.cloudflare.com/learning/cloud/what-is-vendor-lock-in/

[9] For further information see: Google Environmental Insights Explorer at: https://insights.sustainability.google/places/ChIJl9aAttixEmsR8d2wSrqVi5k

[10] For further information see: Google environmental Insights Explorer at: https://insights.sustainability.google/places/ChIJvQz5TjvKvJURh47oiC6Bs6A

[11] See: https://www.algorithmregister.org/

[12] See: https://www.barcelona.cat/infobarcelona/en/tema/digital-rights/the-ai-advisory-council-starts-life_1276232.html

Annex A. Benchmarking urban AI-related initiatives in selected cities

CASE STUDY	CONTEXT			URBAN AI FEATURES								
	Policy Area	Objectives	Challenges	Data	AI Models	Infrastructure	Skills	Governance	Financial model	Stakeholders	Risks	Benefits
TURIN AI-assisted tourism	Urban economic development	Provide personalised touristic services	Bias, privacy, inclusivity, feedback, ambiguity, trust	Tourism Turin databases + anonymized user behavioural data	Retrieval-Augmented Generation (RAG) Natural Language Processing (NLP)	Multimedia totems 5G Network, Cloud-based API	NLP, semantic search, AI fine-tuning, prompt design, human oversight, local tech expertise	Managed by the city of Turin, Turismo Torino and technical partners. Board Etico provide ethical oversight	Public budget with resources from the municipality, national and EU funds	City of Turin, Turismo Torino Cometa Covisian Turin Caselle Airport Orbyta Tech, Esosphera-Cometa.	Technical failures, cyber risks, exclusion, privacy, bias	Improved access to personalized itineraries, Better distribution of tourist flows
MONTREAL AI integration strategy	Urban AI across multiple policy domains	Responsible integration of AI into all municipal services.	Explainability, data quality, resistance, talent, inclusivity, bias, vendor lock-in, sustainability	Centralised municipal data on different policy domains	Predictive models, computer vision, AI assistants, digital twins, Generative AI	Centralised IT department serving 50+ services AI Lab Cloud platforms	AI prototyping & experimentation; Cross-disciplinary collaboration Advanced machine learning knowledge Practical AI problem-solving & deployment	Cross-department AI governance committee	Funded through municipal budgets Limited scope for PPPs	City of Montréal IT and AI Lab. Local AI ecosystem: Mila, IVADO, universities, startups.	Shadow AI and unregulated tool usage. Algorithmic bias; Vendor lock-in; environmental costs	Enhanced safety; cost savings in administration; Fraud reduction; Optimised water management
ESLOV AI- Assisted zoning	Land use planning and zoning	Support planners by generating	Limited realism, no AI strategy, early	Authoritative geospatial data, open	Generative design algorithms,	Scalable cloud computing	Architects, urban designers, ML	Public-private partnerships, Private	Vinnova-funded pilot, subscription	Municipality of Eslöv; Start-ups	Incomplete inputs, pilot limits, startup	Provides a complementary planning tool,

		multiple design options for decision-making.	pilot, adoption risk	portals, user inputs, quality control	predictive analytics, NLP, in-house R&D, partnerships, external APIs.	with geometry servers for parametric design.	experts, research collaboration, municipal input (GIS)	developers involvement, ethical safeguards, human oversight	model, flexible municipal pricing	(Parametric Solutions), Research Institute of Sweden, Private developers	dependency, early AI risks	Supports exploration of sustainability-oriented urban development. Build AI capacity for planning
SEOUL METROPOLITAN AREA (SMA) AI for urban safety	Urban safety and security, with applications in crime prevention, emergency response	Crime prevention and deterrence; Faster emergency response; Protection of vulnerable groups; operational efficiency	Privacy concerns; Cybersecurity threats; Balancing privacy and effectiveness; Administrative fragmentation; Funding	Real-time CCTV video, location data, official public sources	Computer vision models; Crowd density analysis models;	Secure city network, local data centres, emergency coordination platform	computer vision, machine learning, data science, algorithm evaluation.	Procurement model, supplier diversity, limited inter-district data sharing	Co-funding: 50% SMG, 50% district governments. Occasional subsidies: National government grants (when selected).	SMG; 25 district governments; private vendors; national government, citizens; Cyber Safety Center	Privacy violations; Cybersecurity breaches; Over-reliance on AI could miss edge cases or produce false alarms; Fragmentation risks	Faster emergency response; crime prevention and enforcement; Protection of vulnerable groups; operational efficiency and costs savings.
ROTTERDAM AI in housing development	Housing development	Develop an immersive platform connecting physical and social dimensions of the city. Simulate future urban scenarios.	Conservative planning culture, innovation tension, technical gaps, bias/privacy risks, trust rebuilding	3D geospatial datasets (3DRotterdam), architectural archives, satellite and drone imagery. Mandatory underground infrastructure data (by local law). Datasets from multiple municipal departments.	Satellite image analysis, 3D modeling, safety mapping, LLM interoperability	Digital twin, open data platform, drone-assisted emergency response	In-house data and AI teams, including a dedicated AI specialist. Knowledge on ethics, privacy, and security.	AI advisory board for ethical and privacy oversight. Cityverse governance model: municipality as kickstarter, ownership shared with citizens, businesses, and associations.	Municipal budgets and EU programmes (DG CONNECT, Living-in.EU). Cityverse will have co-financing by local partners (citizens, businesses, cultural and social organisations).	Municipality, academia, private tech, European networks, citizen co-creation	Fragmentation between pilots and mainstream adoption (2D vs. 3D culture); Privacy and governance of external LLMs; social exclusion; dependance on external platforms.	Immersive planning, emergency support, European collaboration, scenario simulation
BARCELONA AI-based metro upgrading	Public urban transport	Set predictive ventilation control, foster energy	Challenges ensuring: seamless integration,	Real-time environmental sensors, weather	Environmental forecasting, ventilation optimization,	IoT sensors, cloud-edge analytics, SCADA/BMS	HVAC engineering, data science, IT integration,	AI oversight, transparency and auditing of model	A commercial-agreement between SENER and	Transports Metropolitans de Barcelona	Air quality risk, sensor dependency, vendor lock-	Energy savings, passenger comfort,

		efficiency, improve air quality, support targeted maintenance	data reliability, goal balancing, predictive accuracy, cybersecurity, and scalability	forecasts, ridership, energy data	predictive maintenance	integration	metro operations expertise; transport regulations.	behaviour, data governance, contractual clarity, performance monitoring	the metro operator TMB. Energy savings help offset costs: reported reductions in electricity consumption (network-wide) of ~3 %, equating to ~EUR 1.7 million in saved electricity bills.	(TMB); SENER; Engineering and HVAC contractors; municipal agencies; citizens and metro staff	in, security threats, scaling challenges, regulatory liability, upfront costs	operational insights, lower carbon footprint, improved health & safety
LONDON AI for bat monitoring	Urban environmental preservation	Environmental and biodiversity protection; build green infrastructure; enhance public health and wellbeing	Limited sensor reliability, model generalization, actionable planning, weak governance & trust	Ultrasonic wildlife sensors, ecological context data	On-device bat detection, species classification, edge-cloud analytics	Ultrasonic IoT network, Wi-Fi connected, cloud dashboard	Urban ecology, bioacoustics, ML/edge AI, data engineering collaboration	Part of Nature Smart Cities, a collaborative research initiative combining environmental science, computing and urban infrastructure stakeholders.	No information	University College London (UCL), Intel, Arup, Bat Conservation Trust and London Wildlife Trust; and Queen Elizabeth Olympic Park	No information	Granular biodiversity data, rapid habitat feedback, public engagement
SURESNES AI-assisted contact centre	Local governmental efficiency	Simplify public inquiries, improve accessibility and raise citizen satisfaction while using resources more efficiently	Ensuring privacy, data protection, preventing algorithmic bias.	A centralised knowledge base	Natural language processing; Automatic speech recognition; Conversational AI	Hybrid could-based contact centre infrastructure	Combination of technological (AI and data science, NLP), operational (Service design and contact centre management) and governance 9ethical and	Managed jointly by the City of Suresnes IT Department and the Métropole du Grand Paris digital innovation unit	No information but it is possible that part of the funding coms from the municipality of Suresnes and additional resources from the	Metropolis of Paris, Municipality of Suresnes, NXO, Genesys	System reliability and accuracy, Data protection, accountability gaps, algorithm bias	In general 60% of inquiries are resolved at first contact, and escalations have decreased by 40%, freeing human agents to dedicate more time to

							procurement) skills		Metropole of Paris.			cases requiring judgement or empathy.

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