Shaping smart cities of all sizes

Proceedings of the 4th OECD Roundtable on Smart Cities and Inclusive Growth (17 September 2024)

OECD

Smart City DIALOG
International Smart Cities Network

Table of contents

FIGURES

Executive summary

This paper summarises the proceedings of the 4th OECD Roundtable on Smart Cities and inclusive Growth, which took place on 17 September 2024 at the OECD Headquarters in Paris.

Key messages

Digitalisation is reshaping the way cities of all sizes are providing public services and transitioning towards a more inclusive and sustainable development model. Several factors are driving digitalisation in cities, such as the objective to:

- become more resilient and enhance preparedness to face both man-made crises and natural disasters;
- improve capacity and capability to tackle urban sustainability challenges, for example those related to housing, mobility, climate change, safety, and inequality;
- provide public services such as education and healthcare more effectively in the context of demographic change (e.g. population shrinking and ageing);
- attract talent and involve citizens in public affairs and decision-making.

While many cities are adopting smart city agendas or strategies, not all cities have the same capacity and capability to leverage digital technologies for sustainable and inclusive urban development. Some barriers to the digital transition include the following:

- Cities have different sizes, digital capacity levels and socio-economic context. Large cities have traditionally been frontrunners of the digital transition, while small and medium-sized cities are facing more barriers to build a bridge between people and technology, and this complicates the design of national strategies to encourage the digital transition.
- A lack of adequate funding, infrastructure, and data standardisation can prevent smart city projects from scaling up.
- Small and medium-sized cities do not always have the capacity to elaborate sound project proposals to obtain national funds.
- A lack or an excess of regulation may prevent planning smart city investments in the medium and long-term.
- A shortage of a qualified workforce and low digital literacy in the population may create an additional barrier to the digital transformation particularly in small and medium-sized cities.
- Cities of all sizes suffer from poor data management practices due to regulatory, capacity and security challenges.
- Smart city tools can contribute to the net-zero transition, but the use of digital technologies also produces GHG emissions.

Artificial Intelligence (AI) technologies are taking a more prominent role in urban life, although cities are at an early stage of using Generative AI (GenAI). A growing number of cities are elaborating AI strategic plans to harness the advantages provided by these technologies as their use, in particular Gen AI, is expected to have a more profound impact than in rural areas. By combining AI with urban planning, cities can engage in complex problem-solving, for example as generative design tools can help improve city plans continuously to build safer and more efficient urban environments while reducing the carbon footprint. Adopting AI in cities may also have a broader impact on how local public servants work; for example, it is estimated that AI could boost civil service productivity by 45%, which could increase even more with GenAI. However, cities need pragmatism in solving ethical dilemmas related to AI; for example, handling private data may incur security and privacy risks, and self-learning AI algorithms may generate or reproduce bias and lead to unfair decisions. The uneven adoption of AI may also create a new digital divide, as not all cities have the capacity to understand and leverage the potential of this technology. To limit the risks associated with AI technology, both countries and cities need a human-driven rather than a data-driven approach to AI; regulatory systems to ensure safe, transparent, traceable, and non-discriminatory AI systems to safeguard people's rights to privacy; and an adequate governance framework to enhance interoperability, accelerate research, and explore regulatory sandboxes to test ideas safely.

What lessons drawn so far?

Vision and planning

- Cities should have a clear strategic vision of what they want to achieve in urban development through the use of digital technologies.
- When planning digitalisation, cities should not be treated as a homogenous group as they have different socio-economic contexts, population sizes, capacities and priorities.
- Early consideration of the ethical, social and legal implications of adopting AI technologies, in particular GenAI, into the city operations is essential to mitigate potential negative side effects.
- Setting policies, rules and guidelines on the responsible use of AI technologies, particularly GenAI, is essential to maximise the benefits of these technologies.

Managing digital technology and data

- Developing data governance arrangements would ensure an effective data management to underpin smart city initiatives.
- Effective policy-making is based on reliable data, transparent algorithms and human assessment of the outputs .
- Piloting the use of AI technologies before scaling them up may help gain experience and raise awareness among citizens and city government officials.

Governance

- Small and medium-sized cities could develop partnerships with other cities and the private sector to reinforce their capacity for the digital transition and the utilisation of digital technologies.
- To be successful, digitalisation and smart city initiatives need to build trust and a participatory system of governance.
- Achieving the digital transformation and facilitating the adoption of GenAI require co-ordination and networking to break down siloes within city administrations.

Human and financial capacity and innovation

- Small and medium-sized cities need national governments' financial and technical support to implement smart city initiatives.

- Scaling up smart city projects of cities of all sizes requires diversifying the sources of funding and financing.
- Cities should nurture a culture of innovation, continuous improvement, and the search for best practices.

1 Urban digital transformation in cities of all sizes - why does it matter?

How is digitalisation transforming urban life?

In recent years, advances in development of digital technologies and their cross-cutting applications have driven transformations that are having an impact in cities functioning, economy, and society. The increased adoption of digital technologies, in the framework of smart city initiatives, tied to intensive use of data has the potential to affect the well-being of people and the competitiveness of the economy.

Digitalisation is seen as a tool to transition to a new, more inclusive and sustainable development model for cities of all sizes. This process can be observed in the emergence of 'smart cities' across a large number of countries of different levels of development. Smart cities may be defined as initiatives or approaches that effectively leverage digitalisation to boost citizen well-being and deliver more efficient, sustainable, and inclusive urban services and environment as part of a collaborative, multi-stakeholder process (OECD, 2018[1]). Digital technology developments also have the potential to help cities implement the New Urban Agenda, meet the Sustainable Development Goals (SDGs), and achieve the Paris Agreement targets by providing access to accurate real-time data to support decision-making, monitor progress, and highlighting gaps in every field of the SDGs.

While digital transformation is understood by some countries as the transition of cities into smart cities (BBSR; BMUB, 2017[2]), the OECD defines it as the impact of digital technologies and data on existing and new activities[1]. Digital transformation is creating new opportunities for sustainable development, and yet raising challenges and risks that must be addressed to reap the benefits. In particular, digital technologies, applications and tools such as the internet of things (IoT), big data analytics, edge and cloud computing, immersive technologies, 5G networks, and artificial intelligence (AI), have the potential to contribute to creating more sustainable and inclusive places (Box 1.1). Digital transformation builds on two related concepts, digitisation – the process of converting analogue data into digital format; and digitalisation – the conversion of analogue processes and making them digital to streamline operations and increase their efficiency.[2]

Digitisation, digitalisation and digital transformation are ubiquitous to smart cities for several reasons, for example: i) cities are converting data to digital format to improve their analysis, storage and security; ii) different processes are becoming digital such as fees and taxes payments, real-time data gathering for decision-making using sensors, communication with government and participation in public consultations; and iii) the use of digital technologies for urban planning. Leveraging digital technologies in urban development may bring various benefits to city administration, citizens and businesses: more informed policy-making, better public services; improved healthcare access, new products and services, while reducing the costs of public services and improving their sustainability and efficiency.

While Information and Communication Technologies (ICTs) have been impacting cities for a long time, what has propelled the development of new technologies and applications as well their adoption by cities is four interrelated trends:

- the spread of wireless broadband access;
- the diffusion of smartphones and mobile devices;
- the declining costs of managing data (i.e. collecting, processing and storying); and
- the diffusion of social media and platform business models (van Winden and Carvalho, 2017[3]).

Box 1.1. Different types of digital technologies

- **Internet of Things (IoT)** – connects objects and sensors that gather and exchange data;
- **Big data analytics** – allows processing and interpreting large volumes of data;
- **Artificial Intelligence (AI)** – allows machines to perform human-like functions;
- **Blockchain** – facilitates transactions and interactions through decentralised and immutable information exchange;
- **Cloud computing** – offers services of computing resources over the Internet;
- **Immersive technologies** – create distinct experiences by merging the physical world with digital or simulated reality;
- **5G networks** - enable a new kind of network that is designed to connect virtually everyone and everything together including machines, objects, and devices at higher multi-Gbps peak data speeds;
- **Online platforms** – enable innovative forms of production, consumption, collaboration and sharing, through interactions among and between individuals and organisations.

Source: Barteková and Borkey (2022[4]) *Digitalisation for the transition to a resource efficient and circular economy*, OECD Environmental Working Papers No 192.; Visual Equity Partners at https://www.vistaequitypartners.com/insights/an-introduction-to-immersive-technologies/#:~:text=Definition%20and%20Types%20of%20Immersive,many%20of%20the%20same%20qualities; and Qualcomm at: https://www.qualcomm.com/5g/what-is-5g

How are countries and cities approaching digitalisation?

National government leadership

Many national governments are promoting the digital transition through national digital strategies. These strategies provide support and guidance to local governments to foster the digital transformation. Such national digital strategies are often built in co-operation across levels of government and aim to facilitate investments in themes which are particularly complex and where there are interdependencies across different authorities, sectors, and levels of government. For example:

- In **Denmark,** the national government adopted the Danish National Strategy for Digitalisation in 2022 to guide the investment of more than DKK 2 billion over five years. Denmark's strong digital foundation allowed a quick response to the COVID-19 crisis as the country has good quality, reliable and shared data practices and digital solutions that enabled an efficient and effective roll out of vaccines for the population and quick adaptation of business to e-commerce. Building on

this experience, Denmark's authorities plan to use more digital tools, data, and new technologies in the future to increase growth, find new solutions in the green transition and develop and strengthen the welfare system.

- In **Brazil,** the federal government uses three main instruments to promote the digital transition: i) the Brazilian Strategy for Digital Transformation, which highlights the potential of digital technologies for sustainable and inclusive development, innovation, competitiveness, productivity, and job creation, especially in cities; ii) the National Plan for the Internet of Things, which establishes technological guidelines for digital services and data protection standards; and iii) the Brazilian Charter for Smart Cities, created through collaboration with 130 public and private institutions to reflect the country's perspective on the development of smart, sustainable, and integrated cities.
- In **Japan**, the national government coined the term "Society 5.0" as a vision for a future society where the digital transformation is at the level of society and not at the level of technology. Society 5.0 seeks a human-centred society that balances economic advancement with the resolution of social problems by a system that highly integrates cyberspace and physical space (Japan Cabinet Office, n.d.[5]).
- In **Germany**, the federal government set up the national dialogue platform on smart cities, a comprehensive multi-stakeholder process to develop fundamental principles, guiding the way towards common-good oriented smart cities. Its results were codified in the German Smart City Charter published in 2017. On this basis, the federal government launched the "Model Projects Smart City" programme in 2019. To scale up smart city solutions beyond model projects, the federal government adopted the "Step-by-step Plan Smart Cities and Regions". It establishes a framework that promotes intermunicipal co-operation and provides access to digital solutions through a competence centre and a marketplace for all German municipalities.

To facilitate and guide the digital transition, countries tend **to adopt a multi-level governance approach** as they incorporate digitalisation into the National Urban Policy supported by discussion with stakeholders from national and subnational levels (e.g. Brazil). The aim is to have a more inclusive, resilient, and sustainable urban policy for all cities.

The diversity of cities' physical features and socio-economic contexts requires taking heterogeneous approaches to the digital transition

Cities adopt smart city agendas or strategies to leverage digital technology and maximise their advantages. Smart city strategies have gained traction over the past few decades based on their promise of improving the economic and environmental performance of cities and delivering higher quality urban life. Cities such as Amsterdam, Barcelona, Copenhagen, Curitiba, Malmö, New York City, Singapore, Tokyo, Toronto and Vienna, among others, have developed a smart city strategy to guide the digital transition. This strategy has provided a long-term vision, facilitated the involvement of the private sector in providing solutions and sharing value, and encouraged the active collaboration of citizens, academia and other sectors in driving the digital transformation.

Large cities have traditionally been on the frontline of the digital transition. The scope and speed of digital transformation differs across cities, in particular between large metropolises and small and medium-sized cities, notably due to differences in technical and financial capability and needs. For example, while cities like **London** (UK) can ground their digitalisation strategy in robust data management practices, solid digital infrastructure and capability, a wide variety of private sector and academia stakeholders, and the digital literacy of most of its population (Greater London Authority, 2018[6]), other smaller cities like **Geestland** (Germany) require support from national governments to test their smart city strategies. **Israel** has categorised cities into three levels based on their digital capacity. Cities with high digital ability just

need some funding and can mentor less advanced cities. Cities with some capacity require support and assistance, while cities with low digital capacity need the national government to provide the services for them. Investment in training, knowledge sharing and developing regional hubs to provide basic services not currently available at the local level is helping to bridge the digital gap.

Digitalisation of local governments is not happening in a uniform manner. The smaller the city, the less likely it is to have adopted digital technologies. For example, in the **United States**, there are approximately 20 000 local governments serving populations of less than 50 000 inhabitants. There are around 2 000 local governments with more than 50 000 inhabitants and over 60% of them have adopted any specialised software. Only 48% of local governments serving populations between 10 000 and 50 000 inhabitants have adopted specialised software to make their services function, and even fewer (36%) local governments with less than 10 000 inhabitants have done so.[3] **Israel** aims to provide 80% of municipal public services digitally, while keeping 15% via phone support and a minimum amount of face-to-face services. It has been estimated that digital services cost only USD 1 whereas physical services cost USD 100; and younger generations tend to prefer to use services through their smartphones rather than face to face.

Although the term digitalisation is often used as a synonym of smart cities, **urban solutions do not always require the use of digital technologies.** As shown in the experience of cities such as Barcelona or Medellin, smart cities seek to improve quality of life for citizens, and this can be achieved without digital technologies, for example by pedestrianising some streets, implementing urban regeneration projects, etc. Nevertheless, it must be acknowledged that urban challenges are rarely isolated and are deeply linked to a broader range of other phenomena. Digitalisation alone may do little to address urban challenges such as inequalities in cities, and in some cases, may even exacerbate them, which is why digitalisation must be part of a broader urban development policy package.

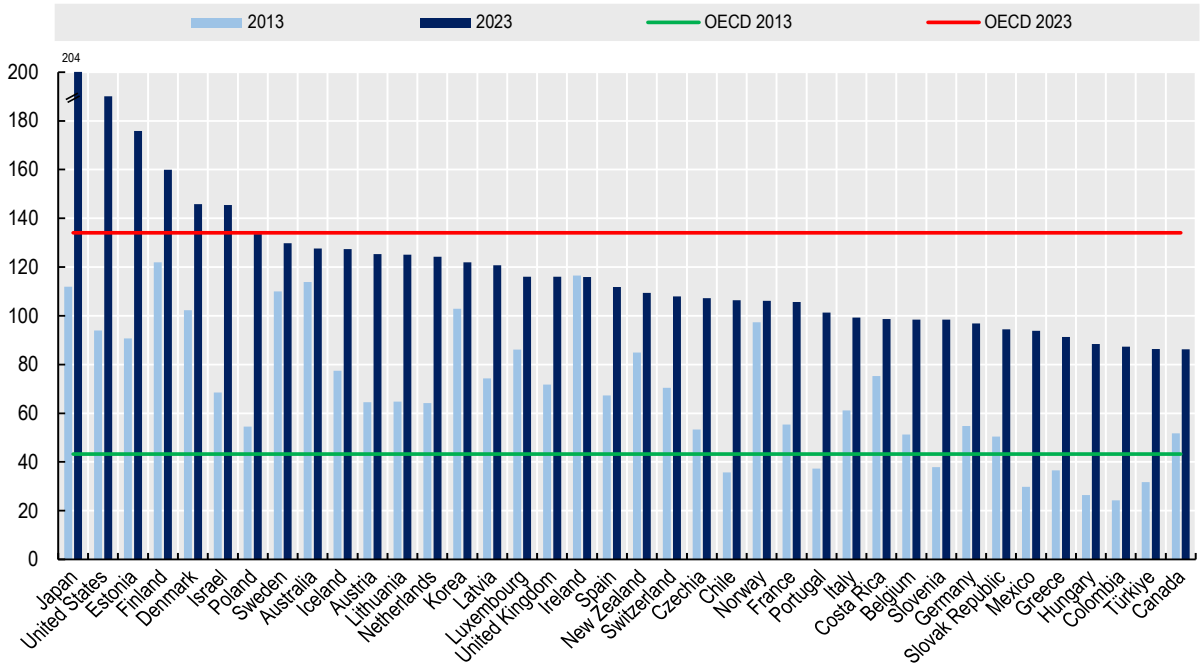
Access to fast broadband internet is a critical component of digitalisation

A key element in supporting digitalisation is access to broadband Internet. In particular, mobile broadband access has become almost universal across OECD countries. While in 2013, only 43 for every 100 inhabitants had a mobile broadband connection, in 2023 that figure reached 134 on average, which means that some individuals have more than one subscription (Figure 1.1). Fixed broadband subscriptions have had the same level of increase, but still rose from 27 per 100 inhabitants in 2013 to 38 in 2023 (Figure 1.2).Over the past five years, small cities witnessed the most significant increases in broadband download speeds -a measure of Internet quality- although disparities persist between small and large cities and between rural areas and cities. During this period, broadband download speeds increased the fastest in smaller functional urban areas (FUAs) especially during the first year of the COVID-19 pandemic. Although growth has slowed in midsize and large FUAs, small FUAs continued to improve steadily. By 2024, broadband download speeds in small FUAs were more than twice (2.4) as fast as they were in 2021, faster than the increase seen in larger FUAs (2.1 times) (OECD, 2024[7]).

Beyond households, it is also essential to consider the access of small- and medium-sized enterprises (SMEs) to digital technologies. Across OECD countries, SMEs account for 50% to 60% of value added on average.[4] According to OECD research, most SMEs, including micro firms, have access to basic broadband connections, but are not engaging with the most advanced technologies. As technologies become more sophisticated, SMEs tend to lose ground compared to larger firms (OECD, 2023[8]). SMEs are also a heterogeneous group and not all SMEs have the capacity to adopt digital technologies. The smaller the firm, the less likely it is to digitalise its practices (OECD, 2021[9]).

Figure 1.1. Access to mobile broadband is becoming almost universal across OECD

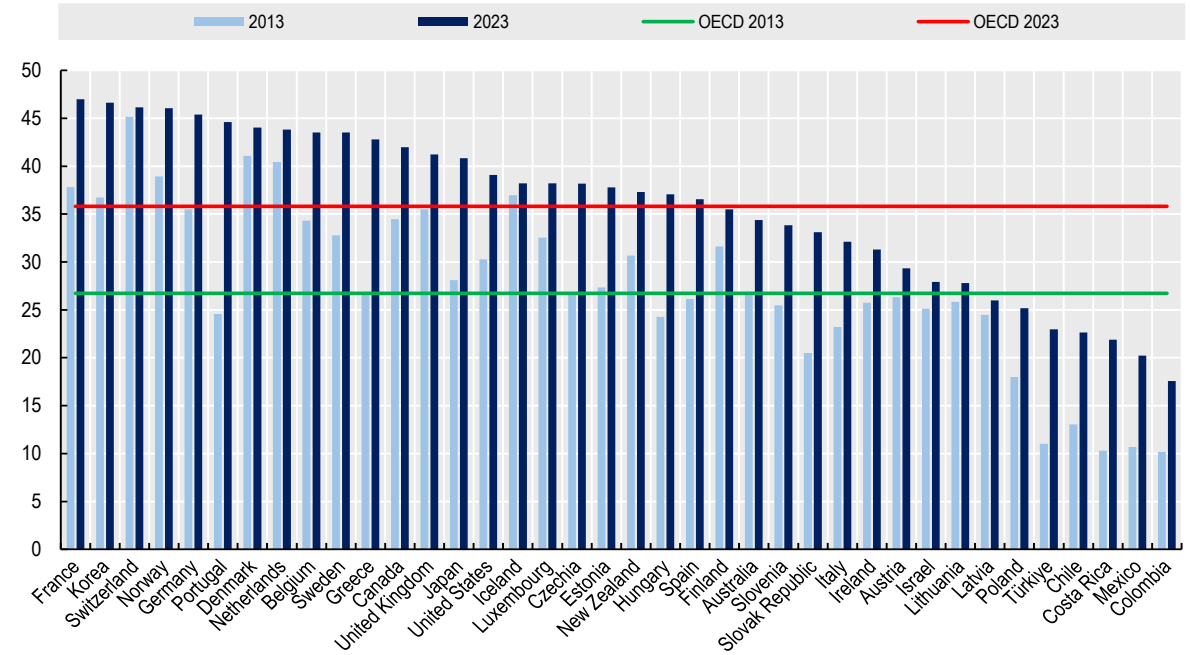
Number of mobile broadband subscriptions per 100 inhabitants



Source: OECD Broadband and Telecom databases. OECD Database.

Figure 1.2. Fixed broadband Internet subscriptions

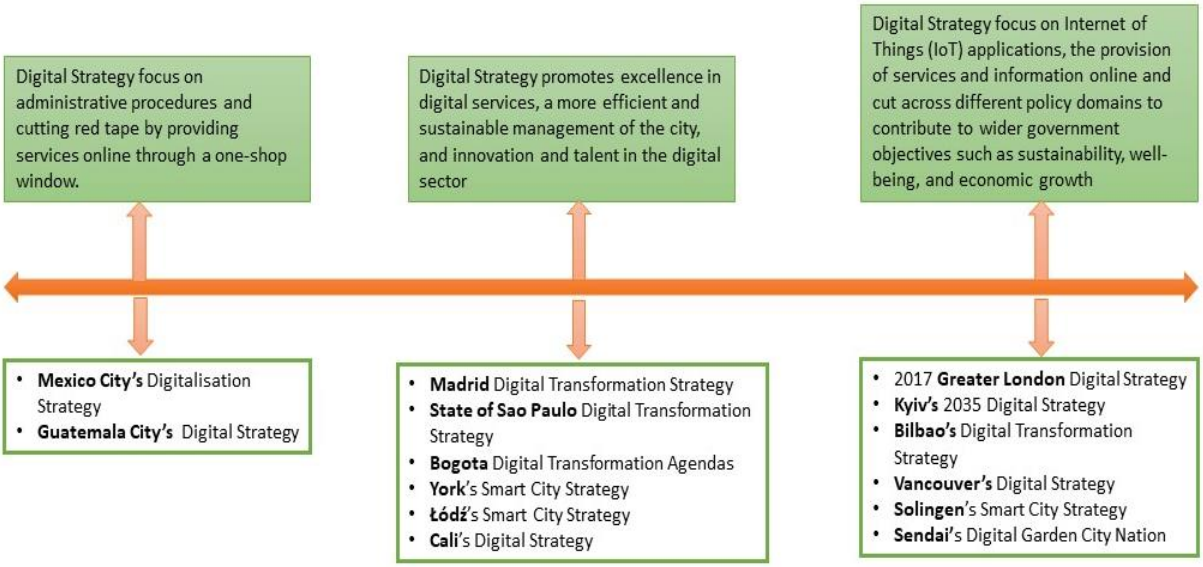
Number of fixed broadband subscription per 100 inhabitants



Source: OECD Broadband and Telecom databases. OECD Database.

There seems to be an evolution of digitalisation across cities regardless of their size (Figure 1.3). While some cities are more focused on providing services on the web, some others are more into Internet of Things (IoT) applications that are embedded into urban infrastructure. This signals, somehow a level of maturity in their digitalisation efforts. It may be that cities despite having important levels of Internet connectivity like Madrid the focus is largely on providing administrative procedures online.

Figure 1.3. Exemplifying different approaches to digitalisation through cities' digital strategies.



Elements of a successful digitalisation process

Digital technologies are almost always promissory meaning they are more about what they will do or could do, and not necessarily on what they are doing now. This has two effects; first, it excuses failure as there is the promise that the next generation will be better – more efficient, less biased, less resource intensive- justifying shortcomings by pointing to speculative future benefits; and second, it forecloses alternatives as people (and cities) believe in promises about technology making a substantial contribution to better lives, and thus do not explore other possibilities.

Participants at the Roundtable suggested that a successful digital transition is multifaceted and includes:

- **Participatory process:** The digital transition requires a democratic, participatory, inclusive, and transparent process. The digital transition is not only about the outcomes achieved but also about the process to achieve them. This process is driven by the involvement, commitment, and trust of a diverse range of stakeholders to co-create a vision that reflects the needs and aspirations of a community.
- **Measurable outcomes:** Cities need to explore different methodologies for measuring and evaluating success. Aligning objectives with activities allows cities to set measurable goals and track progress while adjusting strategies as needed.
- **Commitment to the common good:** Digital initiatives must benefit the community and contribute to a sustainable future.

2 Digitalisation in cities of all sizes: drivers and challenges

Leveraging digital technologies to meet urban challenges

The use of digital technologies in urban development should enable the creation of a network and stream of continuous information to plan for equity, environmental sustainability, quality life, and efficiency in cities. One of the first steps cities take is to have a clear strategic vision of what they want to achieve to guide efforts such as data collection and the adoption of digital technologies, for example:

- **Alba Iulia** (Romania) is a small city of approximately 70 000 inhabitants. It aims to be the first smart city in the country using digital technologies to foster accessibility (i.e. smart mobility projects), environmental objectives (i.e. intelligent street lighting to reduce energy consumption), and competitive (i.e. development of an education platform to nurture innovation).
- **Vari-Voula-Vouliagmeni** (Greece) has a population of 53 000 inhabitants with the vision to be the first smart, green and sustainable city in the country through the implementation of citizen-centric solutions using digital technologies to improve public service delivery and resilience capability.
- **Krefeld** (Germany), a city of 230 000 inhabitants, has adopted a Smart City Strategy called 'SmartKrefeld'. The city has developed its smart city strategy with the vision of building a liveable and connected city for all. The strategy was developed under a participatory process that involved citizens, businesses, academia, and the city administration. Key features of the strategy include a targeted use of technology for the benefit of all people; a focus on achieving sustainability by balancing environmental, social, and economic aspects; and consideration of gender issues.[5]

Cities use digital technologies to prepare for and build resilience against natural or man-made crises

Digital technologies are supporting cities to become more resilient and enhance their preparedness to face man-made crisis and natural disasters. Digitalisation was a crucial lever in cities' response to the COVID-19 pandemic, as they used digital tools to monitor contagion risks and enforce confinement and social distancing measures, while enabling the continuity of certain public services and economic activity (OECD, 2020[10]). Cities quickly moved from services requiring physical presence to online services. In other cases, digital technologies have been central in keeping people safe during natural phenomena (e.g. earthquakes, hurricanes, floods), as in **Mexico City** (Mexico), and man-made crises (e.g. war), as in **Kyiv** (Ukraine). Platforms for service delivery in cities have shown flexibility to provide transport-related information to emergency services. The experience in the use of these tools and changes in

people's habits have since then pushed the digital transition forward to enhance economic recovery and preparedness for potential new crises. Although disasters often drive or accelerate change, it is essential to enhance preparedness by continue improving digital technology applications even when there is no immediate crisis.

Therefore, cities are harnessing digital technologies to upgrade their capacity to protect themselves, be better prepared to face crises and enhance recovery efforts. For example:

- Drawing on the experience of the 2011 Great East Japan earthquake and tsunami, the city of **Sendai** (Japan) has developed a 'disaster-resilient and environmentally friendly city' strategy. As part of this strategy, the city has adopted the Bosai-Tech initiative that uses cutting-edge technology to enhance the city's prevention capabilities, for example by using an automatic evacuation information drone to alert citizens in case of a tsunami. A critical aspect of this initiative is that it engages both the public and the private sector, together with academia and citizens, who all join forces in the field of risk reduction and technology development.
- Since the start of Russia's large-scale war of aggression against Ukraine, the city of **Kyiv** has transformed the municipal application into a digital lifesaver tool to help citizens survive the conflict. The #kyivdigital app has shifted from providing information about transport and utility services towards providing information about military operations (e.g. via air raid alerts, maps of bomb shelters and heating centres, curfew reminders). The app prioritises public safety and citizens' access to reliable information by offering a one-stop-shop official channel.[6] Kyiv's Situational Centre[7] also uses digital twins, not only to plan public transport and buildings, but also to develop potential scenarios such as the destruction or damage of a dam around the city, map the potential flooding taking into account the city's elevation, and prepare a recovery plan.
- The municipality of **Vari-Voula-Vouliagmeni** (Greece) uses digital technologies to respond to earthquakes and fires in a more effective and efficient manner. It has also created a digital map of mountain roads to assist fire brigades in case of need.

Cities are aiming for a resilient digital transformation that can help them navigate the complexities of an ever-changing environment. Anticipating political, social, and economic disruption and how technology will evolve is nearly impossible due to their dynamic nature. That is why a flexible and adaptable approach to digitalisation is essential. The experience of **Freiburg** (Germany) suggests the need for continuous learning, capacity building, and creating a robust process of worst-case scenarios.

Cities also need to develop a culture of anticipation and adaptation rather than only mitigation of possible shocks. For example, in **Wales** (UK), the government adopted the Well-Being of Future Generations Act in 2015.[8] This is a key instrument for long-term planning to enhance preparedness. It requires public bodies to think about the long-term impact of their decisions, to work better with people, communities and each other, and to prevent persistent challenges such as poverty, health inequalities and climate change. All public bodies are now bound by law to plan for the long-term, ensuring adaptability and anticipation. In the case of the digital transition, anticipation and adaptation would work in two ways. First, cities need to consider the long-term impact of the digital transition, including on future generations. Second, cities should consider how digital technologies could help enhance their resilience. For example, data on issues such as demographic trends, extreme weather conditions and predictions, sea-level rise, and urban heat modelling combined with Artificial Intelligence can provide a picture of what the world might look like in the future. While this cannot predict what will happen exactly, it can help governments anticipate and be better prepared to face future crises.

Digital technologies are being used to pursue sustainable urban development in cities of all sizes

Digital technologies and data offer a vast potential to improve cities' capacity and capability to address urban sustainability challenges. One example has been the use of digital technologies to optimise transport, smooth traffic flows and promote active mobility, not only to reduce commuting times but also emissions. For example:

- **Copenhagen** (Denmark) has been leveraging digital technologies to develop an intelligent traffic management system coupled with mobility applications. The use of sensors and cameras deployed along roads helps the city adjust traffic light cycles in real time to reduce traffic jams, which are a major source of emissions. At the same time, mobile applications help citizens better plan their trips by combining different transport modes and encouraging them to opt for the less polluting option. It is estimated that this approach has contributed to reducing CO_2 emissions by 61% since 2005 in Copenhagen.[9]
- **Los Angeles** (US) also faces challenges related to congestion and environmental pollution. To tackle these challenges, the city has adopted a Smart City Plan to promote research and development into sustainability and data science, adopting technologies such as the Internet of Things (IoT) to improve residents' quality of life.

Digital plans or strategies are being developed by cities of all sizes. They serve as an opportunity to localise existing national guidelines or policies on digitalisation, by tailoring them to the specific needs of every city. Such digital strategies also provide an overarching and integrated digital agenda, rather than dealing with a series of one-off projects in an isolated manner. In some cases, digital plans are mainstreamed into broader urban plans, but in most cases, this remains a standalone practice. For example:

- **Kyiv's** (Ukraine) Digital Strategy aims to strike the right balance between addressing immediate urban needs and championing long-term environmental and social objectives through the use of digital technologies.
- **Bilbao's** (Spain) 2030 Digital Transformation Strategy defines the projects capable of accelerating the digitalisation of the city to respond to new economic and social challenges, promote new opportunities for the urban economy, improve the quality of life of its inhabitants, and guarantee social cohesion and the reduction of inequalities.[10]
- **Vancouver's** (Canada) Digital Strategy aims to facilitate how citizens engage with and access the city through online, mobile, and social media channels; improve and expand digital infrastructure; and support and strengthen the city's digital economy.[11]

Cities leverage digital tools to address demographic challenges such as population shrinking and ageing. Depopulation in some cities and towns is a key challenge faced in countries such as Korea, Japan, Spain, and Poland. The use of digital technologies has been instrumental in assisting cities to ensure the provision of services in a context of lower but more specific demand. For example, in **Japan**, in suburban areas, buses normally follow a fixed route according to a timetable, but they generally run empty as there is almost no demand. Thus, authorities are exploring how to use Artificial Intelligence (AI) technology to conduct dynamic routing of bus services reflecting real time demand of the local population, mostly the elderly. In other cases, AI-powered telemedicine platforms are enabling people living in remote areas to receive medical consultations without having to travel long distances (Bournisien de Valmont, 2024[11]). Digital technologies are assisting local authorities in articulating a new way of providing services (i.e. healthcare) and making those services accessible (i.e. public transport) in a context of changing demand. For example:

- **Sendai (Japan)** has implemented a 'virtual medical consultation service car' project, where a nurse rides in a medical service car equipped with medical and communication devices and visits patients. The medical service car and the doctor are connected online to provide medical treatment. This has allowed the city to provide high quality medical services, mostly for the elderly, while addressing the shortage of doctors in towns and villages.
- **The New York State Office for the Aging (NTSOFA)** and Intuition Robotics are credited for a 95% reduction in loneliness and for improving the well-being of older adults using the platform ElliQ, the first ever proactive AI companion.[12]

For cities of all sizes, the digital transformation can be a powerful means to achieve the UN Sustainable Development Goals (SDGs). It is estimated that more than two-thirds of the UN's targets for sustainable development can benefit directly from digital technologies[13]. The SDG Digital Acceleration Agenda highlights the wide-ranging importance of digital technologies and data in achieving sustainable development. For cities, digital technologies can be particularly relevant to help achieve goals such as SDG 11 (Sustainable Cities and Communities), SDG 9 (Industry, Innovation and Infrastructure), and SDG 13 (Climate Action). Similarly, the OECD Principles on Urban Policy promote not only maximising the potential of cities of all sizes by supporting systems of cities and leveraging territorial assets, but also by leveraging digitalisation to build resilient and sustainable cities.

Digitalisation can play a key role to support intermediary cities in their quest for sustainability, economic growth and social inclusion. Considering their rapid expansion, it is more relevant than ever for intermediary cities to develop their capacity and capability to deploy new technological innovations in service delivery. Digitalisation could help them tap into several benefits. For example, better mobile big data -data that derives from mobile application services, network services, and mobile devices -and digital tools could help better grasp commuting patterns; develop more effective digital systems for land governance and tenure; improve sanitation and waste management systems via open-source mapping platforms to identify waste hotspots; expand tax revenue by using digital tools (i.e. drone imagery) to calculate property tax more effectively; and enhance citizen participation in decision making, particularly women and marginalised groups. Moreover, digitalisation may contribute to reducing the carbon footprint of cities, for example by enabling real-time data collection and analysis facilitating better understanding and management of urban logistics, and curbing congestion through sensors or video cameras in urban infrastructure to better monitor and manage mobility flows.

Other factors that are driving forward the digital transition in cities, in particular in medium- and small-sized cities, are:

- **To attract talent and improve public services**. For example, urban-rural partnerships can help deploy e-services, including e-government services. For instance, the **Jelenia Góra** Agglomeration (Poland) has implemented a project to strengthen municipal capacity to deliver public e-services by improving access to information and communication technologies, including in the three urban-rural municipalities in the agglomeration (OECD, 2022[14]). **Malmö** (Sweden) is using digital technologies to improve access to public health as it is unequal in different parts of the city.[14]
- **To meet climate and environmental challenges**. For example, the city of **Amsterdam** (Netherlands) is using digital twin technology to simulate climate change scenarios, identifying areas prone to urban heat island effects and seizing opportunities to incorporate more nature into different areas in the city and foster climate resilience. Simulations help model the potential cooling effects of adding green roofs, trees, and other vegetation to a city, helping city leaders make informed decisions about where to add more nature and how to mitigate heat and excess water most effectively.[15] In another initiative to deploy digitalisation for sustainability, the city of **Geestland** (Germany) has equipped street lamps with an intelligent control system, and

purchased e-bikes and electric vehicles for the city administration (KFW; Stadt Geestland, 2022[15]).

- **To involve citizens in public affairs and decision-making.** Digital tools have the potential to enhance citizen participation within an appropriate institutional design. Such digital tools come in a variety of forms, including online forums and meetings, interactive web or mobile applications, and electronic polls. Digital tools can foster interaction between citizens and enable citizen self-organisations. They can also reduce the cost for city governments to crowdsource and consult citizens, reduce barriers to participation, promote equality and inclusion, and create direct connections between citizens and policymakers. In general, there is a broad appetite among citizens for more digitally enabled public services. However, without a more granular understanding of people's relationships with technology, city governments risk disconnecting as many citizens as they connect. Cities such as **Cascais** (Portugal), **Rotterdam** (Netherlands), and **Sofia** (Bulgaria) are exploring different ways in which digital solutions can help them build digital participatory processes for urban development. Gaining a deeper understanding of various options and limitations of digital tools is essential for achieving specific purposes and streamlining policy-making stages with citizens. A particular issue for cities is to decide on the right timing to invite citizens to participate. If cities are going to utilise digital-based services, it is typically more effective to invite citizens to the discussion at the piloting stage of the new service rather than at earlier stages of service design. Other cities such as **Paris** (France), **Espoo** (Finland), **Porto Alegre** (Brazil), **Chicago** (US), and **Warsaw** (Poland) focus on participatory budgeting to decide on budgetary allocations using, in some cases, digital surveys.[16] The municipality of **Krefeld** (Germany) has adopted a series of initiatives oriented towards citizens participation using both online and off-line means, hackathons, spontaneous suggestions from citizens, and data donations (data flows from citizens to government).

Challenges in promoting the digital transformation in cities

Not all cities have the same capacity and capability to leverage digital technologies for urban development and inclusive growth. Challenges to make the most of digital technologies are context-dependent, but in general, they tend to originate from the amount of financial resources available for acquiring digital technologies, the digital skills of the public labour force, the organisational arrangements for implementing smart city projects, and clarity on what cities want to achieve. The different levels of capability in local governments may also lead to more inequality in the financial support obtained for the digital transition. For example, in Brazil, to access funds from the national government, municipalities need to apply, but cities with more capacity, in general large cities, tend to present better projects than smaller cities. Therefore, the government has implemented a capacity-building programme for small and medium-sized cities to present better framed projects to increase their chances to access national funds.

Cities have different sizes, levels of digital capacity and socio-economic contexts. This adds complexity in terms of designing national strategies to encourage the digital transition. The lack of awareness of some local leaders about the potential of digital technologies could also limit cities' digital transition. In countries as dissimilar as France, Brazil and Israel, municipalities (over 34 000 in France, 6 000 in Brazil, and 259 in Israel) vary widely in terms of capacity, capability, socio-economic development, demographic background, and urbanisation. In Israel, for example, 50% of cities have less than 15 000 residents and their municipal administrations have between 20 and 100 employees. In many cases, local authorities regard digitalisation as 'nice to have' rather than as an essential tool to meet people's needs. The COVID-19 pandemic has certainly helped push digitalisation forward as municipalities had to provide public services in a digital form. However, this has also revealed the extent of the digital gap between national and local governments and between small and medium-sized cities and large metropolises.

Scaling up smart city projects remains a challenge. The 3rd OECD Roundtable on Smart Cities and Inclusive Growth held in July 2023 discussed the barriers to scale up and broaden smart city solutions towards net-zero, such as the lack of adequate funding, infrastructure, and standardisation (OECD, 2023[16]). An additional challenge is that several smart city pilot projects do not always scale up (e.g. smart shuttle in **Columbus**, US; smart bins in **Copenhagen**, Denmark; and smart pole in **San Jose**, US) (Bundgaard and Borrás, 2021[17]). If these projects are to solve the challenges of urban sustainability outside of a few specific spaces and streets, they must scale up and operate throughout the entire city. The difficulty in scaling up could be due to limited co-ordination among stakeholders, who might perceive the value of smart city projects differently. Another factor may be the limited technical and operational capacity and capability of the local government. Moreover, smart city pilots may not respond to the needs of an entire city as problems may vary from one neighbourhood to another. Social acceptance of the use of digital technologies may also hinder scaling up smart city pilots as they may raise concerns about data privacy and data ownership, for example. The uncertainty about the use of certain technologies may also undermine their acceptability at a wider scale in the urban context (Bundgaard and Borrás, 2021[17]). Cities need to consider pilots as the first phase of the project rather than as a stand-alone or one-off initiative. In larger cities, it may be even harder to scale up smart city pilots due to the use of legacy technology[17] in some public services such as the metro.

Low digital literacy in the population, particularly in small-sized cities, and the digital gap persist. In small-sized cities and rural areas, population tends to be older than in larger cities and often not comfortable with the use of new technologies. This is why cities such as **Toyama** (Japan) and **Bilbao** (Spain) have implemented specific programmes to assist seniors in the use of digital technologies. The city of **Arezzo** (Italy) is also investing in facilitating internet access of young people including those with disabilities. In the US, population in small cities tends to be older and is less likely to have a college education and thus faces difficulties in utilising digital services. For example, in cities with less than 10 000 inhabitants, only 20% residents older than 65 years have a college degree, while in cities with more than 50 000 inhabitants this share almost reaches 30%.[18] In France, national authorities have concluded that for smart cities to be successful, all segments of the population need to have access to digital public services. However, 15% of the population face some kind of difficulties (e.g. digital illiteracy, communicating online, using software, protecting privacy)[19] in using digital technologies, and smart city initiatives need to take this into account to ensure digital inclusion.

The absence of adequate digital infrastructure inhibits the digital transition. Although smaller functional urban areas (FUAs) have seen an improvement in broadband download internet speed over the last five years, large FUAs still have faster speed by 14% (OECD, 2024[7]). Even commuting zones have slower broadband download speeds than urban centres by 50p.p. (OECD, 2024[7]) There could also be challenges in integrating new technology with the existing system in city environments. Technology providers tend to offer technology solutions that are not targeted to the needs of small and medium-sized cities, as the primary focus is on large cities (Laartz and Lulf, 2011[19]). Technology products created for megacities are often inappropriate regarding complexity, costs and functionality for small and medium-sized cities as the latter face a different reality.

The lack or excess of regulation slows down the process of digital transition. Regulation impacts both enabling factors and barriers regarding the digital transformation. A stable regulatory framework makes it easier for companies and municipal operators to plan their investments in the medium and long term. Clear, predictable, and comprehensible legislation that safeguards people's rights and maintains citizens' trust over the stewardship of their data is essential to build trust in the use of technologies and smart city initiatives in general. However, in some cases, existing regulatory frameworks need to be adapted to new contexts to facilitate procurement and the interaction with large corporations that have a leading role in smart city projects. Governments at all levels need to decide at what level they are going to regulate the different aspects of the digitalisation process. The implementation of smart city strategies also

often requires data-sharing laws to facilitate the creation of high-value datasets. However, the lack of legislation prevents the development and implementation of smart city strategies. For example:

- In the city of **Alba Iulia** (Romania), a key issue that prevents digitalisation is the lack of a legal framework that recognises the digital signature. Even though some administrative procedures could be done online, it is still necessary to obtain signature in paper form documents.
- In **Arnsberg** (Germany), there is a need to introduce a legal framework that regulates e-services. Conversely, excessive, or overly complex regulation, such as in public procurement, may hamper efforts to implement smart city projects and their data management practices.

Tight procurement regulations and processes may hinder the development of smart city projects. The digital transformation process is to some extent supported by market uptake measures such as financial schemes and facilities, the development of new business models, and public procurement. Digitalisation processes require reducing the complexity of procurement processes and setting out clearly how social and environmental criteria can be applied in awarding contracts. Standard procurement processes remain restrictive for the needs of a digital transformation and they tend to be overly lengthy and rigid, sometimes leading to outdated technological solutions (OECD, 2022[20]). Procurement in cities takes time and lacks the flexibility required to change and adapt specifications to the reality of the challenge they are trying to solve.[20] For example, public procurement processes and rules tend to penalize new, innovative solutions. While technology changes frequently, procurement processes are slow to adapt, leaving cities with outdated systems. Cities do not only need new procurement tools, but they also need to invest in training procurement professionals.[21] However, although there has been progress in cities adopting public procurement measures to enhance innovation and sustainability, they are not embedded within the cities' procurement practices.

Fragmentation of responsibilities across levels of governments and within governments prevents a coherent approach to digitalisation. Fostering digitalisation in cities often requires interventions at different levels of government and co-ordination across multiple entities, including city councils, regional and national governments, and intergovernmental bodies. This adds to the complexity of implementing smart governance initiatives. Moreover, within the city administration, it is often difficult to guarantee co-ordination across departments in the absence of a leading team, particularly in the case of large cities with a heavier administrative apparatus. This debate also includes finding balance between centralisation and decentralisation of the digital transition process. In some cases, as in Israel, municipalities are responsible for their own efforts to push digitalisation forward. However, national governments (e.g. Brazil, Germany, France, Israel) still have a key role in supporting that process through digital strategies, capacity building, funding, and encouraging peer-to peer learning.

The lack of innovative business models and access to financing and funding compromises the implementation of smart city projects. Introducing digital technologies on a wide scale is often a significant challenge for cities as many of them have tight budgets and lack business models that can help attract private financing to make the introduction viable. In the European Union, some cities need to tap into EU funds such as the 'Horizon Europe' Programme to fund research an innovation and 'Interact' that supports co-operative efforts to be more efficient and effective to achieve more EU funds. In other cases, cities need to rely on central government funding support and on building partnerships with the private sector to finance and implement smart city initiatives. In **Sendai** (Japan), there is a Frontier Consortium made up of more than 60 companies, with the objective of transforming the city by contributing to smart city projects. Generally, partnering with the private sector is a way for cities to finance smart city projects, but for some small-sized cities, finding partners to co-finance or participate in their project remains a challenge. Another challenge is the uncertainty caused by using new technologies. For example, the project may be the first to deploy a particular technology, which may reduce investor confidence in the viable adoption of the technology in the long term. The inability to monetise the benefits of a smart city project may also be a barrier to secure financing. Projects may also lack a clear path to steady revenue or

return on investment. In addition, the lack of a comprehensive strategic plan to capitalise on the projects' strong points may limit the initiative's investment readiness and its access to finance. A critical point is that cities do not only need financing for large investments in technology, but more importantly, they need to learn how to leverage the value of that investment. Smaller cities generally struggle to use available funds effectively and end up buying technology that they cannot use. This may generate a lack of trust in smart city projects and an inability to invest again in the future due to lost trust. In Brazil, the national government has limited resources to support digitalisation in cities, thus it has amended legislation to allow municipalities to use funds in a more flexible manner to have more impact, particularly in small and medium-sized cities. For example, the funds initially designed for urban lighting infrastructure can now be used for broader public services, including digital administration and public safety.

The shortage of a qualified workforce, particularly in small and medium-sized cities, hampers capacity and innovation. The lack of access to a qualified workforce that understands and knows how to use digital technologies limits the possibilities of a city to deploy and make the most of investment in technology. In particular, medium- and small sized cities tend to suffer the most as young talent move to larger cities that provide more career possibilities. In other cities like **Geestland** (Germany), **Alba Iulia** (Romania), and **Vari-Voula-Vouliagmeni** (Greece), city governments and digital promotion teams in particular are understaffed and the local public workforce lack the required digital skills for conducting smart city projects. Israel has a thriving high-tech economy but most specialists prefer to work for the private sector than for local governments, leading to a shortage of high-quality digital talent in local administrations.

Working and thinking in siloes within the administration and across agencies prevents the digital transformation in cities of all sizes. Not all departments or areas within the local administration have the same common main objective about digitalisation, or do not perceive the benefit of digitalisation for their own activities. This prevents working across sectors to build synergies and complementarities, sharing data, and working in partnership with the private sector. Cities as different as **Detroit** (US) and **Brno** (Czechia) have tackled crime through the adoption of digital technologies (e.g. high-definition cameras, a high- speed Internet network connection and adequate lighting), which required building public-private partnerships, breaking down siloes, defining stakeholders' responsibilities and sharing costs.[22]

The absence of sound data governance arrangements can weaken smart city initiatives. The success of smart city projects largely depends on the availability and effective use of data. Despite the wide range of initiatives to enhance smart city data governance, urban data still raises a set of management, regulatory, access and security challenges for countries and cities of all sizes. Some challenges include: insufficient financial resources for smart city data strategies prevent cities from accessing the adequate technology to process and store data and from upscaling smart city projects; a lack of business models for financing and refinancing data collection and transfer; limited access to skilled data management and analytics experts; ensuring compliance of private companies with the national legislation on data sharing and protection; data security and safety risks related to leaks and cyber-attacks; data storage in silos, which prevent interoperability (OECD, 2023[21]). In some cities, the lack of digitalised data hinders the use and sharing of data for policy-making, as is the case in the municipality of **Vari-Voula-Vouliagmeni** (Greece). To address this issue, some cities have developed a data strategy. For example, **Basel** (Switzerland) has developed a data strategy that defines the framework for secure, transparent, and co-ordinated data management, in line with the city's digital strategy for 2023-2027. The final goal is to have all data processed in the canton systematically recorded and maintained regularly. In the future, the city expects existing data stocks to be used for several purposes within the legal framework. In addition, data should be offered to the public for free use whenever possible.

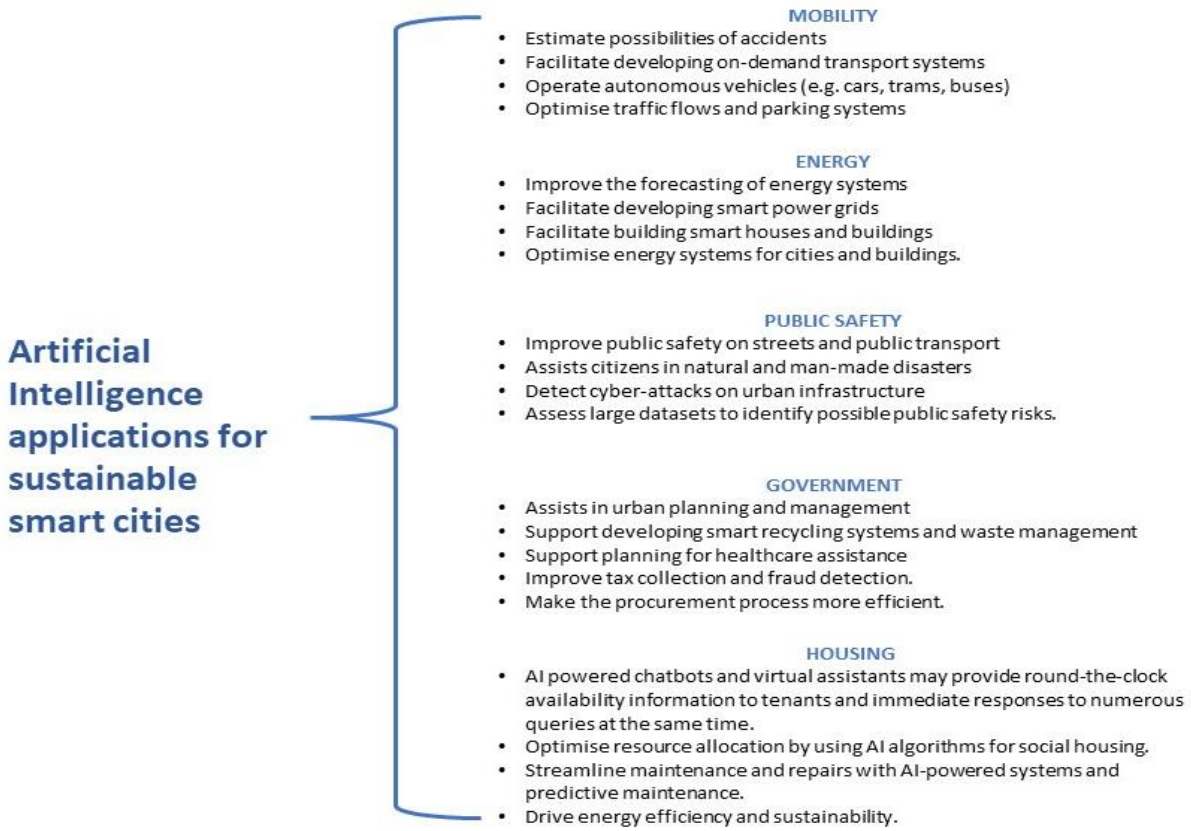
There is a need for national standards for digital services. Some countries have not yet issued national standards for digital services. This prevents national and subnational governments from having a single set of rules that apply across the country to create a safe digital space and establish a level playing field

to foster innovation, growth, and competitiveness. Digital services include a wide spectrum of online services, ranging from websites to internet infrastructure services and online platforms. The standards are necessary to ensure fairness and competitiveness in the IT sector and maintain fair and open online platform environments (Mayo and Parokkil, 2021[22]).

3 Artificial intelligence for sustainable urban development

Artificial Intelligence (AI) is contributing to the realisation of smart city goals, although not all smart cities are necessarily AI-driven. AI technologies, (i.e. large language models, computer vision, generative AI, and robotics) are advancing at an unprecedented pace, enabling AI to be applied in a growing number of urban development fields (Figure 3.1). According to OECD, *"An AI system is a machine-based system that, for explicit or implicit objectives, infers, from the input it receives, how to generate outputs such as predictions, content, recommendations, or decisions that [can] influence physical or virtual environments. Different AI systems vary in their levels of autonomy and adaptiveness after deployment*".[23] Cities across the world seek to leverage these technologies to improve the efficiency, effectiveness, and equity of public services and reach sustainable development goals. In fact, investment in AI in smart cities is expected to grow from USD 37.4 billion in 2023 to USD 164 billion in 2030, which means a compound annual growth rate of 19.5%.[24]

Figure 3.1. AI applications for building sustainable smart cities.



AI technologies are taking a more prominent role in cities life and there is a growing tendency to elaborate AI strategic plans. For example, **Amsterdam** (Netherlands) has developed two strategic visions for AI. The first one Agenda AI focuses solely on the municipal services and how they want to use AI in relation to residents' needs. The other vision, AI Technology for the People, aims to stimulating the development and use of AI at the local level. Cities are at the stage of learning how to use these technologies and their plans may not be as sophisticated as those of digital transformation. The role of these plans is mostly to provide guidance to local authorities on how to work with AI-technologies. In fact, there does not seem to be connection between digital strategies and AI plans.

Cities are just beginning to grasp the potential of Generative AI

The use of Internet of Things (IoT), Artificial Intelligence (AI), Information and Communication Technologies (ICTs), and 5G cellular networks, have prompted cities' digital transition. These technologies generate substantial amounts of urban data as an input for designing more intelligent and efficient smart city applications to enhance urban sustainability, productivity, and liveability. The integration of AI and emerging digital twin technologies have created a new paradigm for developing urban digital twins and to support the management of several urban policy areas (e.g. urban mobility, energy, infrastructure).

Among AI technologies, generative AI (GenAI) can revolutionise the way cities work. The use of GenAI in local governments has the potential to predict demand and streamline public services, improve local governments' capacity to innovate, enhance data-driven policy making, optimise resource allocation, and streamline administrative processes. It is already being used in sectors such as education, healthcare, and scientific research. GenAI systems create new content – including text, image, audio, and video - based on their training data and in response to prompts. In smart cities, GenAI is gaining momentum as the tool for urban development. The GenAI market is projected to expand from USD 13.5 billion in 2023 to USD 255 billion in 2033 (World Economic Forum, 2024[23]). However, little has been done in terms of implementation as only 2% of cities are really integrating GenAI into their operations (RegTech, 2024[24]). This could be due to the novelty of the technology and cities are just familiarising with the technology. However, some pioneers may be named:

- In 2019, the city of **Buenos Aires** (Argentina) created a chatbot called 'Boti'. It was the official government channel for the vaccination against COVID-19, and it is now providing information on issues such as bike sharing and social care. This tool is expected to provide information on urban mobility, recycling, health, safety, culture, events, public space, and tourism.
- The city of **Falkensee** (Germany) is using AI technologies, including an AI-based system for detecting drowning individuals in the new indoor pool and the cityGPT assistant called 'Falko', a digital chatbot that enhances citizen communication with multilingual information on municipal administrative matters.[25]
- A new generation of self-driving trucks is being tested between **Dallas** and **Houston**, Texas (US). The vehicles, trained on generative AI, create a continuous 3D visualization of surroundings with lidar sensors, enabling them to guess what's next and foresee problems. The truck's system learns from the data rather than being programmed for specific reactions allowing vehicles to create predictions from their surroundings (RegTech, 2024[24]).

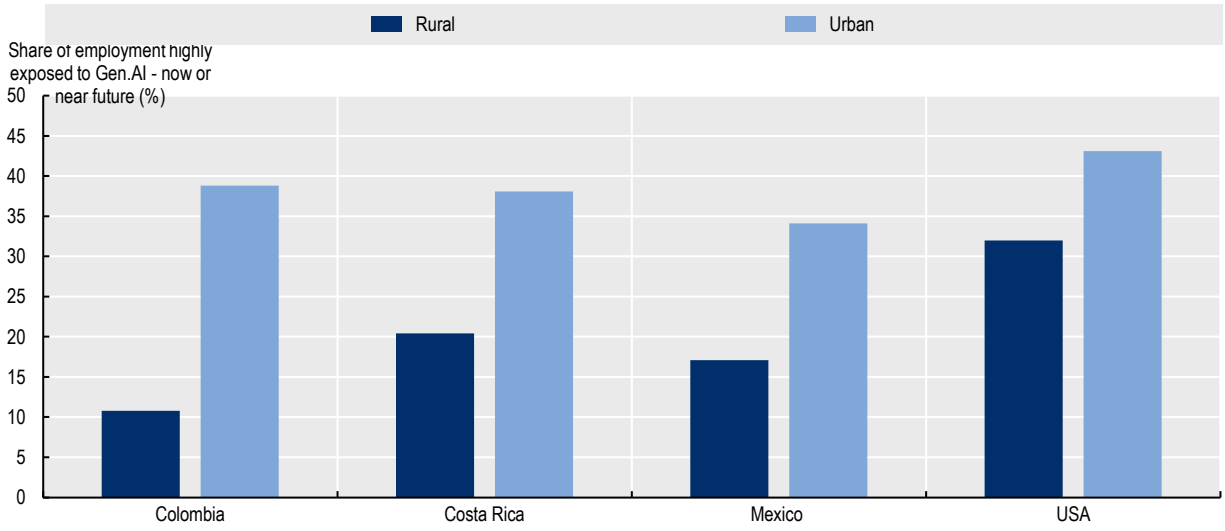
Cities are at an early stage of leveraging GenAI. In 2023, Bloomberg Philanthropies surveyed 100 cities around the world on their use of GenAI. The results showed that only 2% of them were actively implementing GenAI in city activities, while 69% were exploring or testing the technology, but they have not developed their capabilities and policies. Some cities (22%) have designated a Gen AI lead, 13% have developed policies and guidelines around its use, and 11% have provided GenAI training to staff. According to the results, cities see the most potential in GenAI to address traffic and public transport problems (34%),

improve infrastructure (24%), address public safety gaps (21%), protect the environment and climate (21%), and provide education (18%). To that end, most cities are exploring the use of GenAI for data analysis (58%), citizen-service assistance (53%), and drafting memos, documents & reports (47%) (Bloomberg Philanthropies, 2023[25]).

AI professionals belong to young generations. According to data, around 53% of AI professionals (i.e. data scientists, machine learning experts) are between 25 and 34 years of age across the world, and approximately 27% are between 35 and 44 years old.[26] This means that to attract a skilled labour force on AI, cities need to develop job employment conditions that are attractive for young generations.

Generative AI is expected to have a more profound impact on the labour market in cities than on that of rural areas. According to OECD, labour markets in urban areas are over twice as exposed than non-urban labour markets (Figure 3.2). This exposure is influenced by the concentration of industries within or outside cities driving disparities between urban and non-urban labour markets. Industries such as financial services or technology development are normally located in metropolitan areas while industries with a different production structure such as agriculture and manufacturing are located in non-metropolitan and rural areas. Across the EU, over 36% of jobs in cities are exposed to Generative AI while in rural areas the share is 21% (OECD, 2024[26]). It is important for cities of all sizes to develop an understanding on the impact of Generative AI on their labour markets and develop policies to retrain and upskill their workforce to avoid creating a new digital gap.

Figure 3.2. Labour markets in urban areas are more exposed to Generative AI than non-urban areas



Note: For the USA is Non-metropolitan and Metropolitan
Source: OECD (2024[26]), Job Creation and Local Economic Development 2024: The Geography of Generative AI, OECD Publishing, Paris.

Cities are facing multiple barriers for using GenAI. Lack of awareness, budget constraints, the absence of relevant policies and guidelines, insufficient technical expertise, and data privacy and security concerns are some of the most common barriers that hinder the use of Gen Ai in cities regardless of their size (Bloomberg Philanthropies, 2023[25]).

To benefit from GenAI's potential, cities, with the support of national governments, need to formulate policies to regulate its use. This is a critical step towards facing the possible challenges and risks brough about by these technologies and make the most of their benefits. Particular considerations are to be given to ethical, transparency and accountability issues. According to Bloomberg Philanthropies,

security and privacy (81%), and accountability & transparency (79%) are the key ethical principles guiding the exploration and use of generative AI in cities (Bloomberg Philanthropies, 2023[25]). The guidelines need to emphasise the importance of transparency in decision-making processes, responsible data use, and protection of individual rights. Cities need to be aware of the potential impact of GenAI on citizens and the importance of maintaining fairness, inclusivity and human oversight in its deployment. Some examples include:

- **Amsterdam** (Netherlands) has adopted an Algorithm and AI Register of artificial intelligence systems and algorithms. The Algorithm Register is a standardised, searchable and archivable way to document the decisions and assumptions that were made in the process of developing, implementing, managing and ultimately dismantling an algorithm. It seeks to promote transparency and explainability to auditors and citizens (City of Amsterdam, 2020[27]).
- **Boston**, Massachusetts (US), has implemented interim guidelines as a resource for employees when using GenAI. These guidelines set a series of principles to promote responsible experimentation in the use of GenAI (City of Boston, 2023[28]).
- **Seattle**, Washington (US), has adopted a policy that aims to establish requirements that city departments must follow when procuring and utilising software that falls under the definition of GenAI (City of Seattle, 2023[29]).

AI technologies have created new opportunities for cities to improve urban development

AI is transforming urban planning. By combining AI with urban planning, cities are able to engage in complex problem-solving as AI tools may generate diverse urban solutions; make more precise mapping; develop prototypes to visualise future scenarios facilitating design processes; strengthen adaptability as generative design tools enable city plans to be improved continuously; virtual-real integration and intelligent feedback of physical and digital cities, to build safer and more efficient urban environments while reducing the carbon footprint. AI for urban planning holds the promise of better efficiency, data integration, and stakeholders' engagement to improve traffic flows, lower CO_2 emissions, reduce commuting time, improve energy consumption in buildings, and open new job opportunities.

AI technology is enhancing cities' capacity and capability to deal with urban challenges, but pragmatism and value-based engineering in solving ethical dilemmas are essential. In solving the ethical challenges posed by AI, the debate should not only be about the possible risks, but also on whether the technological response is proportional to the problem: is it better not to implement a solution at all? Bringing a wide group of stakeholders to the debate may help ensure a more balanced approach. Some examples of cities include:

- The city of **Vienna** (Austria) is experiencing population growth that creates pressure on public infrastructure and services; a third of the public workforce, including healthcare workers, is expected to retire over the next eight years; the economy is stagnating due to high inflation; climate change has increased the number of tropical nights and increased flood risks; and security and cyber security are growing concerns for residents and local authorities. The city government is using AI technology to enhance administrative efficiency through knowledge databases, text generation, urban planning, green space management and solar potential analysis to face some of those challenges. It has published a guide on the use of Generative-AI in the workplace to ensure data protection laws are followed.
- The city of **Utrecht** (Netherlands) has developed a digital twin for urban planning in collaboration with the private sector and academia. This has required the development of a technical framework architecture for the cloud infrastructure of the city to test changes in the urban landscape. The

digital twin has several applications from the depiction of tree root volumes to check for possible collisions with civil engineering projects to microclimate simulations to show vulnerable groups (i.e. the elderly) safer walking routes in the event of a heat wave. AI is used to improve the code utilised in the construction of the digital twin. This work has provided local government and experts the possibility to reflect on the ethical dimensions and risks of the public presentation of certain data such as underground pipe systems. Although technically it is possible to display all types of information, there are ethical considerations around whether it is necessary and appropriate to do so.

- The city of **Calgary** (Canada) is accelerating the AI digital transformation by testing AI learning models to automate the city's expense categorisation process for more accurate procurement forecasting and efficiency improvement. An AI-based system was developed to detect and classify multiple types of pavements distress conditions.
- The **State of São Paulo** (Brazil) is using digital technologies, including AI, to deal with unemployment. The state government focuses on job placement. It collects data to create an individual's curriculum vitae and have a better understanding of his/her abilities and skills, then those are matched with the job vacancies in the private sector. This process helps authorities to understand not only the private sector needs but also the kind of training that needs to be provided to workers so that they can find employment. This is part of a policy called 'predictive inclusion'. Although the platform is still under development, it assists around 1 million people a year and has 350 000 job vacancies provided by the private sector. A similar platform is being developed to reduce red tape to make government's work more effective.
- In **Colombia**, the national government has adopted a roadmap for the uptake of Artificial Intelligence in the country. This document is expected to guide the development of policies, actions and decisions of the national government regarding the use of digital technologies under ethical and sustainability principles. The roadmap encourages the inclusion of digital topics in the local development plans and highlights the need to aid small cities (which represent 90% of municipalities in the country) to advance on a smart city strategy. For example, the Ministry of Science, Technology and Innovation has provided support to the city of **Santa Cruz** to invest and use technology to promote tourism and improve mobility and security and use AI to monitor the use of resources and urban expansion by tracking illegal neighbourhoods in real-time through AI-generated images.

However, **many cities struggle to keep pace with rapid advances in AI technology**, and some have limited capacity to develop and deploy AI, which slows down the adoption and use of AI in the local public sector. Research has shown that privacy issues, cyber-security concerns, and the risk of mass unemployment are some of the most prominent barriers to the adoption of AI in smart cities (Ben Rjab, Mellouli and Corbett, 2023[30]). Organisational barriers include the lack of financial resources, and IT infrastructure as well as limited skills of human resources. The complexity of AI use and implementation is an additional barrier for all cities, particularly for those without too much IT experience. For example, the availability of good quality data, the use of the best machine learning technique for each situation, the aggregation of data in appropriate time windows, and the need to conduct pilot projects are time consuming and expensive (Ben Rjab, Mellouli and Corbett, 2023[30]). There is also the complexity of understanding how to use certain AI technologies in cities. There is still limited information on how AI adoption is actually being organised within local public administrations, how it is aligned with other strategic priorities of the city, and how exactly it is expected to contribute to sustainable urban development. Public organisations, in general, have traditionally struggled to adapt to rapid, disruptive, and uncertain technological advances because they initially do not value the new technology (Hill and Rothaermel, 2003[31]). Cities of all sizes are still coming to grips with the exploration and exploitation of AI technologies for service delivery, policy-making, and citizen engagement. Researchers have concluded that the efficient management of both

exploitation and exploration is key to long-term performance of new technologies (O'Reilly and Tushman, 2013[32]).

Integrating AI technologies such as geospatial artificial intelligence (GeoAI) into urban planning processes represents an administrative and technical challenge. Geospatial artificial intelligence (GeoAI) is the application of AI fused with geospatial data to accelerate real-world understanding of business opportunities, environmental impacts, and operational risks.[27] By leveraging GeoAI, city governments can model the impacts of urban development, understand the availability of resources to the population, forecast road and infrastructure deterioration, and identify land-use change such as new buildings to proactively take action. GeoAI may help improve public safety as it relates to traffic accidents, emergency responses, disaster management, and predicting where accidents are likely to occur, and therefore optimise emergency response times. For example, the city of Newcastle-upon-Tyne (UK), together with the Alan Turing Institute, is exploring new ways and approaches to optimise land use through GeoAI and ensure it could meet current and future needs.[28] The integration of Geo-AI into urban planning requires breaking down administrative siloes, as using GeoAI technology requires collaborating across multiple disciplines. Still, many cities keep their data in a fragmented fashion and the administrative culture is rather fragmented, which leads to inefficiencies. AI requires data to be managed from a holistic approach to optimise urban planning. Another issue is how AI technology is integrated into cities' planning processes. So far, urban planning requires considerable manual work, especially when it comes to feeding data into traditional data platforms and extracting the results in a usable form. Data needs to be compatible with geographic information systems (GIS) or other city planning tools. AI can help manage and analyse data from different sources to boost the efficiency and effectiveness of data management for service delivery.

Large cities are generally better positioned to use AI. For small- and mid-sized cities, the main hurdle is the high cost of accessing AI technology. Large cities are more likely to be able to afford the upfront investment in software, hardware, and specialised personnel to use these technologies. For smaller cities, spending large amounts of, often very limited, budgetary resources is just not possible. Generally, cities using AI are technological hubs in their own countries or have a large enough manpower and technological research centres to develop and use this technology. This is the case of big cities as they have the means to attract creative, highly skilled people and create greater opportunities for synergies among them. For small and medium-sized cities, attracting and retaining a specialised workforce on AI technologies represents a budgetary and public employment challenge as they would need to offer competitive salaries, flexible working conditions in addition to balancing public officials resistance with the potential benefits of automation.

Despite their potential benefits, AI technologies carry significant risks for cities

The use of AI and Gen-AI in urban development can also bring about some potential risks for cities. These technologies rely on massive amounts of high-dimensional and multi-domain data for monitoring and characterising different urban systems (Figure 3.1), for example to build digital twins. This could challenge their application as data quality and availability, as well as costly efforts for generating urban scenarios and design alternatives may not be permissive for many cities. Moreover, like for other digital technologies, the handling of private data may incur security and privacy risks, and the self-learning AI algorithms may generate or reproduce bias and lead to unfair decisions. Other risks are of an economic nature, such as the controversial displacement effect of AI (job destruction vs. net job-creation effect). GenAI also carries significant risks and policy implications, for example: the areas of mis- and disinformation, bias, intellectual property rights, and labour markets. However, there is still a lack of systematic evidence about the territorial impact of AI technology in an urban context and even more on the impact on urban-rural relations.

The uneven adoption of AI may also create a new digital divide. This depends on the level of integration of AI into the work of cities, local organisations, private companies, and even individuals. The risk is the digital exclusion of certain population groups. Cities that embrace AI will have a competitive advantage over those that are slow to adopt it. National governments play a key role in encouraging cities to integrate AI into their work. In Canada, for example, the Smart Cities Challenge helps cities access funding for innovative smart city projects that aim to improve the lives of their residents through innovation, data and connected technology.[29] The risk is that small and medium-sized cities may be left behind the AI economy as they do not have the same budgetary, technological and human resources. The challenge for small and medium-sized cities is to ensure that AI is accessible, available, and affordable for local businesses, particularly for SMEs. In this sense, small and medium-sized cities could focus their efforts on educating the business community about the benefits and risks of AI. Cities could also promote the development of local training programmes for AI skills. For small and medium sized cities, it will not always be possible to get top qualified specialists on AI, so their option is to focus on the development of their local talent, particularly those with a technical background but that lack the data skills to take on AI projects.

The future of AI for sustainable urban development will likely depend on cities' ability to balance the exploitation of AI technologies that involves refinement, production and implementation, **and exploration** which refers to searching, risk-taking, experimentation, flexibility, and discovery (Selten and Klievink, 2024[33]). This will not be an easy balance to achieve for cities regardless their size. The challenge is that the flexibility and agility that are needed to explore and adopt AI in cities may face barriers in the formal and rigid bureaucratic structures and mechanisms that public organisations tend to have for exploitation and to ensure the fairness, reliability, and accountability of public governance. Systems involving social scoring for predictive policing, facial recognition need to be managed with particular care as they create high risks that may prevent people from accessing education, health, social benefits due to risks related to data management, algorithms bias, data quality, and transparency.

Adopting AI in cities may have a broad impact on how local public servants work and how public organisations operate and create value. According to estimates, AI could boost civil service productivity by 45% which could increase even more with Gen-AI (Ross, 2024[34]). Singapore has been pioneering the use of AI in the public service. To do so, the government launched a wide range of programmes to improve the workforce's understanding of AI, to raise skill levels, and to encourage civil servants to experiment. These included training, online newsletters, workshops, community-building activities, and the creation of a digital test environment. The government then sought use cases that were relatively low-risk, but easy to adopt, for example: transcription software to aid civil servants in note-taking.

There is also a need to take into consideration the emissions produced by smart city technologies. Smart city solutions can enable and accelerate the net-zero transition by, among many others, curtailing energy use, accelerating the shift from fossil fuels to renewable energy, improving resource efficiency, reducing transport demand, and fostering necessary behavioural change. Indeed, digital technologies can reduce emissions by 20% by 2050 in sector such as energy, materials and mobility.[30] However, research has shown that the share of greenhouse gas (GHG) emissions related to digital technology has increased 6% per year since 2013 and already accounted for 3.5% in 2019 (Ferreboeuf, Efoui-Hess and Verne, 2021[35]).

Possible options to enable cities of all sizes to use AI

To limit the risks associated with AI technology, countries and cities need a human-driven rather than data-driven approach. While adopting AI for urban planning and management offers opportunities on efficiency, effectiveness, and sustainability, it must be approached with caution. Cities must consider the future challenges, risks and potential drawbacks and address them proactively such as data privacy issues, biased algorithms that threaten fairness and inclusivity, and data quality and availability that limit

decision-making, to unlock the potential offered by AI. Experience suggests that when algorithms are taken for granted without any thorough analysis and understanding, they may create serious challenges for cities such as discrimination and bias, and damage people's well-being. Therefore, **cities need regulatory systems (e.g. European AI Act) to ensure that AI systems used in a country or city are safe, transparent, traceable, and non-discriminatory to ensure that privacy, ethical values, and people's rights are preserved**. The European AI Act provides some background rules and principles on how AI technologies should be used while ensuring accountability and transparency (Box 3.1). Although the EU AI Act is of general use, cities may use it as a framework to prepare their own policies and guidelines in the use of AI in city affairs. To enhance trust and transparency, cities create an AI Inventory to meaningfully communicate the AI systems that it uses to its residents, such as the one used in the city of **San Jose**, California (US) since 2023. The city not only communicates what AI tools uses but how it utilises them (City of San Jose, 2024[37]).

Box 3.1. Regulating artificial intelligence in the EU- the 'European AI Act'

In April 2021, the European Commission proposed the first EU regulatory framework for AI. The EU Parliament adopted the Artificial Intelligence Act in March 2024 and the Council followed with its approval in May 2024. The aim is to ensure better conditions for the development and use of AI technologies. The AI systems are analysed and classified according to the risk they pose to users. The new rules establish obligations for providers and users depending on the level of risk from artificial intelligence. While many AI systems pose minimal risk, they still need to be assessed. The Act identified a series of unacceptable risks as they could be a threat to citizens, for example: i) cognitive or behavioural manipulation of people or specific vulnerable groups; ii) social scoring by classifying people based on behaviour, socio-economic status or personal characteristics; iii) biometric identification and categorisation of people; and iv) real-time and remote biometric identification systems, such as facial recognition.

The Act considers high-risk AI systems that negatively affect safety or fundamental rights. AI systems falling into specific areas that have to be registered in an EU database are considered high-risk such as: management and operation of critical infrastructure; education and vocational training; employment, worker management and access to self-employment; access to and enjoyment of essential private services and public services and benefits; law enforcement; migration, asylum and border control management; and assistance in legal interpretation and application of the law. All high-risk AI systems are to be assessed before being put on the market and throughout their lifecycle. People will have the right to file complaints about AI systems to designated national authorities.

Generative AI, such as ChatGPT, is not classified as high-risk, but has to comply with transparency requirements and EU copyright law. Users have to disclose that the content was generated by AI; design the model to prevent it from generating illegal content; and publish summaries of copyrighted data used for training.

Source: European Parliament (2024[38]) EU AI Act: first regulation on artificial intelligence, at: https://www.europarl.europa.eu/topics/en/article/20230601STO93804/eu-ai-act-first-regulation-on-artificial-intelligence

To enable cities of all sizes to benefit from the potential of AI technology, it is necessary to set an adequate governance framework. For example, creating a network of municipalities to share expertise on AI as done in the metropolitan area of **Paris** (France) and among cities in Germany is a way to build capacity for all cities. These networks allow cities to benefit from resources they would not have access to on their own, but also from the experience of different stakeholders from different disciplines and co-create cases on urban regeneration and planning for climate change adaptation. According to MasterCard, to

enhance the uptake of AI in cities, it is necessary to work on three critical areas: *i*) driving interoperability in global standards and regulatory approaches to provide consistent definitions and standards to operate AI; *ii*) accelerate research and investment in building AI responsibly with a focus on data privacy and risk minimisation; and *iii*) explore regulatory sandboxes to foster public-private partnerships in a controlled and innovative environment and test ideas safely.

Cities need to build capacity for AI. To this end, cities should invest in AI literacy for local public employees, develop specialised AI expertise within their legal departments, and develop partnerships with academic institutions and tech companies for knowledge sharing. A culture of continuous monitoring and improvement should be built by establishing systems for ongoing monitoring of AI performance and the impact is having in urban development and people's well-being, reviewing and updating AI policies, guidelines and practices in a regular fashion; and staying abreast of evolving legal and ethical standards in AI such as the European AI Act.

Cities can shape the AI market by using their substantial buying power. Cities could adopt procurement policies that prioritise ethical and transparent AI solutions. This way, cities would not only promote high industry standards but also encourage vendors to align with these values. For example:

- In the city of **San Jose**, California (US), when a city department wishes to procure an AI tool, the Digital Privacy Officer (DPO) conducts a risk threshold analysis of the AI system that includes and algorithmic impact assessment. The DPO and the procuring department work with vendors to ensure that the system is effective and trustworthy. As part of an effort to strengthen transparency, the DPO is piloting a process to work with vendors to complete a Vendor AI FactSheet that contains basic facts about the AI system, such as the data used to build the system and what conditions it performs well under. The Vendor AI FactSheet enables the DPO to better understand the technical details of the AI system and ultimately assess the risks and benefits it presents (City of San Jose, 2024[37]).

4 Promoting digitalisation in cities of all sizes – what lessons have we learnt so far?

Despite differences among cities of different sizes, some lessons can be drawn from the accumulated experience in promoting digitalisation in cities of all sizes:

Vision and planning

- ***Having a clear strategic vision on how utilise digital technologies is a first step in promoting the digital transition in cities of all sizes.*** Identifying residents' key problems, designing alternatives to improve their lives, and figuring out how digital technologies may help addressing urban challenges are elements needed in developing a vision and a strategy for digitalisation. Cities need to avoid using digital technologies purely as territorial marketing tools, be more strategic on their approach to digital technologies and consider their own specific needs and context. Cities of all sizes need to be built around clear objectives, principles and values, regardless of the scalability of the technologies. The digital transition should result from the alignment between the vision of a political project and the available digital technologies that can contribute to well-being. Technological developments should be a driver of outcomes (i.e. well-being, competitiveness, equality, sustainability); otherwise, cities risk becoming demonstrators of technological projects without real benefits. Having a clear strategic vision guides cities' data collection efforts in alignment with existing plans. In some cases, cities may be tempted to adopt smart city strategies and invest in digital technologies without a clear definition of the challenge they want to address. Cities need to reflect on how the data collected will be used and analysed, and what administrative capacity is needed to put this data to use.
- ***When planning and promoting digitalisation, cities should not be treated as a homogenous group.*** It is important to consider the difference between medium- and small-sized cities and big cities. It is essential to consider that there is no one-size-fit-all blueprint as all cities are different. In general, medium and small-sized cities lack capacity and capability to enhance the digital transformation and thus the uptake of digital services is lower. As a result, citizens in medium- and small-sized cities tend to prefer having both online and offline options for public services. In big cities, however, young and middle-aged residents make up a large proportion of the population and are more inclined to use online services. It is thus important for medium- and small-sized cities to adopt flexible and resilient urban digital transformation models (World Economic Forum, 2022[39]). Specifically, cities that lack capital, talent, and technology to begin the digital transformation process at specific entry points, i.e. the digital transformation should start in an industry that is economically significant for the city, and eventually expand it to other industries where the city may develop competitive advantages. To support the digital transformation in small and medium-sized cities, some countries like Germany have focused their funding to smart city

pilots originated from these cities. Developing a digital marketplace and a competence centre form where small and medium-sized cities lacking experience, funding and skills may be able to get support are some of the actions implemented to support these cities. Considering that the economic and industrial transformation varies greatly from city to city, it is important for each city to develop digital transformation schemes based on its own needs, capabilities, and priorities.

- ***Digital master plans need to ensure convergence between urbanisation and digitalisation***. These plans are useful tools to mobilise local stakeholders around visions, goals, and roadmaps to adapt to external technological and economic pressures, within local social, economic and political constraints (Townsend and Lorimer, 2015[40]). Cities require a framework that is inclusive of all communities and understand their specific needs. Digital strategies or plans are normally produced by groups representing different sectors of society such as academics, the private sector, community groups, NGOs, experts and public officials. Large cities such as **Chicago** (US) and **London** (UK) have managed to broaden the participation in the elaboration of their strategies; however, this level of participation is easier to reach in small-sized cities. Moreover, experience suggests that it would be a limitation to institutionalise digital master planning as a separate activity from urban planning in general as it would limit its ability to manoeuvre, innovate methodologically and tackle new topics. Digitalisation planning must transcend institutional siloes.
- ***Early consideration of the ethical, social and legal implications of adopting AI technologies, in particular GenAI, into the city operations is essential to mitigate the potential negative side effects***. This involves the examination of the legal frameworks for using GenAI in government activities; addressing ethical and privacy considerations; adopting measure to prevent or mitigate (algorithm) bias; promoting transparency, accountability, and democratic governance in AI use; and evaluating the socio-economic implications of GenAI adoption in urban development.
- ***Setting policies, rules and guidelines on the responsible use of AI technologies, particularly GenAI, is essential to maximise the benefits of these technologies***. This includes exploring opportunities and challenges in adopting generative AI and preparing a policy framework or guidelines for its responsible use; identifying the sectors and services where AI can be applied based on the city's priority areas as it cannot be deployed everywhere due to budgetary and capacity limitations; ensuring data privacy to build trust and addressing risks associated with implementation; and building a governance structure that facilitates implementation and oversight.

Managing digital technology and data

- ***Developing solid data governance arrangements would ensure an effective data management to underpin smart city initiatives in cities of all sizes***. Cities need to ensure sufficient financial resources for data management by combining different budget streams to build synergies among several investment programmes; and working with neighbouring cities to pool resources together towards common goals. Cities would need to develop business models for financing and refinancing data collection and transfer, for example by building agreements among a wide range of stakeholders to facilitate data sharing through a data ecosystem where all parties co-operate for its maintenance and sustainability over time. It is essential to ensure that data can be used and shared across cities and other stakeholders in different sectors to promote consistency and facilitate the replication of processes or reach a shared understanding. Governments should strive to integrate and join up data from multiple sources and across systems to fully use data to enhance people's well-being. Placing data protection, privacy, transparency in data use, storage and sharing at the top of the agenda could help build trust for data management.
- ***Effective policy-making is based on reliable data, transparent algorithms and human assessment of the outputs***. The use of digital technologies and in particular AI, provides unprecedented possibilities to cities to improve decision-making and policy-making in urban

development. However, quality and timely data, data analysis, transparency in managing algorithms, monitoring, and a human interpretation and assessment of outputs are key to ensure that effectiveness and limit potential negative side effects such as social scoring, cognitive behavioural manipulation, categorisation of people, etc.

- ***Piloting the use of AI technologies, in particular GenAI, before scaling up may serve to gain experience and raise awareness among citizens and officials***. Cities could test the use of GenAI in data analysis, citizens service assistance, administrative tasks, coding and programming, and document drafting. This could also help conveying technical information to residents in an easy-to-understand format.

Governance

- ***Small and medium sized cities could develop partnerships with other cities and the private sector to reinforce their capacity for the digital transition and the utilisation of digital technologies***. Joining forces with other cities is a way to increase the otherwise limited financial and human resources available. This is particularly the case in the access to skilled experts in data management and analytics, which are professions highly demanded for utilising AI technologies. Partnering with other cities, mostly with large cities, would enable the sharing of data and have access to more resources. Cities need to integrate data governance approaches into their smart city frameworks based on solid partnerships with stakeholders. These partnerships could be seminal in the rollout of data-driven solutions for major challenges such as providing affordable housing, transport solutions and sustainable environment by leveraging digital technologies. Creating partnerships with the private sector and academic institutions is a way to increase capacity and capability in the use of digital technologies for tackling urban challenges and improve service delivery. Partnerships may provide cities with access to funding and expertise that might not otherwise be available. They also allow cities to share the risks of development, which is especially valuable given the evolving and often untested nature of smart city technologies. Moreover, partnerships give projects continuity, because without external commitments and support, shifts in political power might cause a project to be cancelled or ignored (National League of Cities, 2016[41]). Cities should weigh the motivation and commitment of their partners and consider the structure and governance of the collaboration, clearly delineating authority and responsibility.
- ***To be successful, digitalisation and smart city initiatives need to be built on citizens' trust.*** Smart cities collect a growing amount of data, but the fact that data can be collected does not necessarily mean that cities should collect it, as it might compromise residents' trust in government and its initiatives. Residents should have the option to 'opt-out'. The use of AI will generate an explosion in the use of data. Cities and national governments are relying heavily on big tech companies to provide solutions on data protection, processing and access, but cities need to scrutinise those practices to maintain trust. It is essential to adopt transparency measures when adopting GenAI in cities' operations, for example by disclosing when documents or content were generating using AI. Cities need to take the lead in ensuring that AI is used in a way that maintains residents' trust, is cybersecure, and respects privacy. There should also be an understanding with communities to make citizens feel their interests are represented. Smart cities, and the digital transition process, should be people-centred and needs- oriented. Cities should focus their smart city activities and procurement on the needs of people rather than on those of the market and develop services as part of a collaborative multistakeholder process (World Economic Forum, 2022[39]).
- ***Smart cities require a transformation of the governance structure of cities to allow the participation of a broad range of stakeholders.*** Digitalisation is built on citizens' engagement.

Cities need to explore new forms of engagement with citizens and facilitate their participation in or collaboration for decision-making to make the most of digital technology including AI and limit the potential negative impact. There are different stakeholders in the digitalisation process (public and private sector, academia and citizens) and the governance structure should facilitate the interaction among them. The key for city leaders is to find the right balance between control and opening towards external partners. Participatory budgeting gives citizens the opportunity to use their unique knowledge and experiences to shape their living environment, and has become an instrument of advancing local democracy and co-governance, and thus building trust.

- ***Achieving the digital transformation and facilitating the adoption of GenAI require co-ordination and networking to break down silos***. Cross-departmental and cross-agency co-ordination and co-operation are essential to exploit synergies, achieve the greatest possible impact, and use resources more effectively in fostering the digital transition. For example, the city of Basel (Switzerland) has set as a principle for digitisation to work together with other cantons, cities, and regions in driving its smart city strategy and digital transformation[31]. In Germany, the involvement of the political and strategic management level in the definition of smart city strategies has been considered critical to establish a link between smart city teams and the specialists' departments in the local government breaking down the silo approach. The use of GeoAI in urban planning requires data from different areas sources requiring breaking down data silos to ensure that applications and data systems communicate with each other. This may require the construction of data lakes or data warehouses to store highly structured data.

Human and financial capacity and innovation

- ***Small and medium-sized cities need national government's financial and technical support to implement smart city initiatives***. Although all cities face similar challenges in relation to financial and technical capacity, small and medium-sized cities tend to have less resources to access technology and less capacity to operate it. National governments can support these cities through different initiatives, for instance by encouraging large cities to mentor small and medium-sized cities, as done in Israel; or by developing a smart cities challenge where cities compete for resources from the central government by submitting innovative ideas on leveraging digital technologies for well-being, as done in Brazil and Canada. The aim of the challenge is to empower communities to adopt a smart cities approach that revolves around the objective of improving the lives of residents through innovation, data and connected technology. This challenge can help cities by measuring progress, enabling communities to innovate, helping local governments forge new partnerships and networks, and developing initiatives that may be replicable in other cities.
- ***Diversifying the sources of funding and financing of smart city projects in cities of all sizes is essential to ensure implementation of smart city initiatives***. To finance a smart city project, city leaders must have clarity on who will pay for the service provided through the smart city solution and assume the associated risks. In some cases, the government pays to build and operate the service, receiving a return in the form of savings or greater efficiency. Another option is for governments to recoup their investment by getting the public to pay fees (directly or indirectly) to use the service. It is worth considering that smart city projects may include a wide range of areas from traditional physical infrastructure assets, new technologies and connectivity and transport systems to projects associated with economic development, tourism, and sustainability. As research highlights, investors generally have criteria to evaluate projects, which is why it is important to have a plan to secure financing from different sources (Deloitte, 2018[42]). In addition, it is key that cities generate a research- and evidence-based value proposition to incentivise national governments to direct resources to smart city projects seen as a source of economic and

fiscal benefits. For example, in 2021, Ghana imposed a digital tax on electronic transfers, to broaden the government tax base on mobile money (MoMo) transactions (Ofosu-Ampong, 2024[43]).

- ***Cities of all sizes could nurture a culture of innovation, continuous improvement, and the search for best practices to improve capacity***. An innovation-friendly environment is essential to underpin the digital transition. The experience of **Basel** (Switzerland) suggests that it is key to adopt flexible infrastructures and agile digitalisation teams and develop future-proof technology and platforms that support the use of data and the further development of services. To foster innovation, interdisciplinary approaches, cross-departmental and cross-organisational co-operation are essential. Moreover, cities interested in becoming smart should continue to look for best practices and frameworks for this type of development. Innovation and experimentation should be constant. Continually keeping abreast of new developments and innovations in the smart development arena will also help cities manage the path-dependent dynamics of technological development. For example, the International Smart Cities Network (ISCN) facilitates exchanges of expertise and experience among cities and countries about the use of digital technologies for an effective and efficient management of cities.[32] It is important that cities examine smart city technologies in a critical way and be mindful of the organisational challenges that accompany the design and implementation of smart city initiatives. Functional silos, the challenges of cross-sector collaboration, and political gridlock are some of the challenges cities may encounter when engaging in smart city development (National League of Cities, 2016[41]). Local leaders need to avoid falling into the complacency trap and need to adopt a culture of continuous improvement. The experience of OECD countries and cities suggests that local leaders need to be aware of the generational changes that lead to different priorities and needs. Communication and interaction with citizens should be regular as perceptions and priorities may change what requires a reassessment of local policies. This could help cities continue building trust and shape more effective policies.

Table 4.1. Lessons and examples of good practices of digitalisation in cities of all sizes

Areas	Lessons	Examples from national and local governments
Vision and planning	Identify residents' key problems, design alternatives to improve their lives and figure out how digital technologies may help addressing urban challenges	• **Paris** (France) strategy entitled 'Paris Smart and Sustainable – looking ahead to 2020 and beyond' presents the major opportunities and challenges towards becoming a smart city but also the main objectives, projects and tangible actions. • **Alba Iulia** (Romania) aims to use digital technologies to foster accessibility, environmental protection and competitiveness. • **Vari-Voula-Vouliagmeni** (Greece) envisions to be the first smart, green and sustainable city in the country through the implementation of citizen-centric solutions using digital technologies. • **Krefeld** (Germany) adopted a smart city strategy with the vision of building a liveable and connected city using digital technology for the benefit of all residents.

	When planning and promoting digitalisation, cities should not be treated as a homogenous group.	• **Brazil**'s and **Israel**'s digital strategies have been developed considered the diversity of cities in terms of population size and socio-economic contexts.
	Digital master plans need to ensure convergence between urbanisation and digitalisation	• **Kyiv'**s (Ukraine) Digital Strategy aims to strike the right balance between addressing immediate urban needs and championing long-term environmental and social objectives through the use of digital technologies. • **Bilbao**'s (Spain) 2030 Digital Transformation Strategy defines the projects capable of accelerating the digitalisation of the city to respond to new economic and social challenges
	Early consideration of the ethical, social and legal implications of adopting AI technologies, in particular GenAI, into the city operations is essential to mitigate negative potential side effects.	• **Seattle** (US) has adopted a policy that aims to establish requirements that city departments must follow when procuring and utilising software that falls under the definition of GenAI
	Setting policies, rules and guidelines on the responsible use of AI technologies, particularly GenAI, is essential to maximise the benefits of these technologies.	• **Boston** (US) has adopted interim guidelines as a resource for employees when using GenAI, setting principles for responsible experimentation.
Managing digital technology and data	Developing solid data governance arrangements would ensure an effective data management to underpin smart city initiatives.	• **Basel'**s (Switzerland) data strategy defines the framework for secure, transparent, and coordinated data management, in line with the city's digital strategy. • **Vienna** (Austria) is using AI technology to enhance administrative efficiency through knowledge databases, text generation, urban planning, green space management and solar potential analysis to face challenges from high inflation to climate change.
	Effective policy-making is based on reliable data, transparent algorithms and human assessment of the outputs	• **Amsterdam** (Netherlands) and **Helsinki** (Finland) adopted an Algorithm and AI Register of the artificial intelligence systems and algorithms.
	Piloting the use of AI technologies, in particular GenAI, before scaling up may serve to gain experience and raise awareness among citizens and officials.	• **Calgary** (Canada) is accelerating the AI digital transformation by testing AI learning models to automate the city's expense categorisation process for more accurate procurement forecasting and efficiency improvement. • **Dallas** and **Houston** (US) are piloting a new generation of self-driving trucks trained on GenAI.

Governance	Small and medium sized cities could develop partnerships with other cities and the private sector to reinforce their capacity for the digital transition and the utilisation of digital technologies	• In the **Netherlands**, the Dutch Metropolitan Innovations is a partnership of 45 cities, business community and knowledge centres to facilitate the sharing and use of data in a responsible manner through mutual trust, and open standards. • **Detroit** (USA) and **Brno** (Czechia) have built public-private partnerships to tackle crime by breaking down siloes, defining stakeholders' responsibilities and sharing costs. • **Sendai** (Japan) developed a Frontier Consortium made up of more than 60 companies with the objective of transforming the city by contributing to smart city projects.
	To be successful, digitalisation and smart city initiatives need to be built on citizens' trust.	• **Vancouver** (Canada) facilitates the engagement of the broad public in the city-making process leading to better answers and a deeper public ownership of their future. • **Kakogawa** (Japan) has developed a participatory consensus-building platforms and expanded online consultation on public affairs. • **San Jose** (US) AI Inventory to communicate citizens the AI tools used and how they are used.
	Smart cities require the transformation of the governance structure of cities to allow the participation of a broad range of stakeholders.	• **Krefeld** (Germany) has initiatives oriented towards citizen participation using online and off-line means, hackathons, and data donations (data flows from citizens to government). • **Espoo** (Finland), **Porto Alegre** (Brazil), **Chicag**o (USA), and **Warsaw** (Poland) focus on participatory budgeting to decide on budgetary allocations using digital surveys.
	Achieving the digital transformation and facilitating the adoption of GenAI require co-ordination and networking to breakdown silos	• **Basel** (Switzerland) has set as a principle for digitisation to work together with other cantons, cities, and regions in driving its smart city strategy and digital transformation. • **Newcastle-upon-Tyne (UK)** adopts an interdisciplinary approach to use GeoAI for land use.
Capacity and innovation	Small and medium-sized cities require national government's financial and technical support to implement smart city initiatives	• **Brazil and Canada** have a smart cities challenge to empower communities to adopt smart city strategies. • **Israel** has invited large cities to mentor small and medium-sized cities in digitalisation.

	Diversifying the sources of funding and financing of smart city projects in cities of all sizes is essential to ensure implementation of smart city initiatives.	• **Ghana** has a digital tax on electronic transfers, which is used to broaden the government tax base on mobile money (MoMo) transactions. • **Brazil** amended legislation to allow municipalities to use funds in a more flexible manner to have more impact particularly in small and medium-sized cities.
	Cities of all sizes could nurture a culture of innovation, continuous improvement, and the search for best practices to improve capacity	• **Germany, through the International Smart Cities Network** (ISCN) facilitates exchanges of expertise and experience among cities and countries in the use of digital technologies for an effective and efficient management of cities.

Notes

[1] For further information see: https://www.oecd.org/en/topics/policy-issues/digital-transformation.html

[2] For further information see: https://www.channelinsider.com/business-management/digitization-vs-digitalization/#:~:text=Digitization%20converts%20analog%20data%20into,reshape%20organizations%20by%20leveraging%20technology.

[3] For further information see: https://www.civicpulse.org/post/the-digital-divide-between-small-towns-and-big-cities

[4] For further information see: https://www.oecd.org/en/topics/policy-issues/smes-and-entrepreneurship.html#:~:text=Across%20OECD%20countries%2C%20SMEs%20represent,%27%20and%20societies%27%20major%20transitions.

[5] Information provided by the city of Krefeld; and Krefeld Business at: https://www.krefeld-business.de/digitalisierung-innovation/smart-city/

[6] For further information see: https://thoughtlabgroup.com/wp-content/uploads/2023/11/Kyiv-Case-Study.pdf

[7] The Kyiv's Situational Center is a command and control environment used in the city government facilities for decision-making, monitoring processes, control of the overall situation in the city and for the effective management of infrastructure from a single command center. Functions include municipal and city transport, road traffic control systems, IoT sensors, city lighting control, video surveillance systems, portal

with services for citizens, among others. For further information see: https://upmp.news/en/post_blog/command-centers-ukraine/

[8] For further information see: https://www.futuregenerations.wales/about-us/future-generations-act/

[9] For further information see: https://circularplace.fr/en/smart-cities-the-fight-against-co2-emissions/

[10] For further information see: https://www.idom.com/en/project/bilbao-digital-transformation-strategy/#:~:text=The%20objective%20of%20Bilbao%20City,Apply%20Urban%20Innovation%20models.

[11] See: https://vancouver.ca/your-government/digital-strategy.aspx

[12] For further information see: https://aging.ny.gov/news/nysofas-rollout-ai-companion-robot-elliq-shows-95-reduction-loneliness

[13] See: https://www.undp.org/press-releases/digital-technologies-directly-benefit-70-percent-sdg-targets-say-itu-undp-and-partners

[14] See: https://nscn.eu/smartcitymalmo

[15] For further information see; https://www.siradel.com/how-digital-twins-help-cities-mitigate-and-adapt-to-climate-change/#:~:text=Digital%20twin%20and%20simulation%20technology,incorporate%20more%20nature%20into%20cities.

[16] See: https://www.maptionnaire.com/blog/5-participatory-budgeting-examples

[17] Outdated technology such as computing system, hardware or software that is still in use. See: https://www.techtarget.com/searchitoperations/definition/legacy-application

[18] For further information see: https://www.civicpulse.org/post/the-digital-divide-between-small-towns-and-big-cities

[19] See: Institut national de la statistique et des études économiques at : https://www.insee.fr/en/statistiques/7651986

[20] See: https://www.intelligentcitieschallenge.eu/procurement and https://bloombergcities.jhu.edu/news/what-does-future-hold-public-procurement-we-ask-experts

[21] See: https://manhattan.institute/article/how-cities-can-improve-their-procurement-of-goods-and-services

[22] See: https://newsroom.axis.com/blog/breaking-down-silos

[23] For information see: https://www.euractiv.com/section/artificial-intelligence/news/oecd-updates-definition-of-artificial-intelligence-to-inform-eus-ai-act/

[24] For further information see: https://www.futuredatastats.com/artificial-intelligence-in-smart-cities-market?srsltid=AfmBOoomobFadx08mtODoge8-Ey_uHk-x_p0n9KXepalkM3d3LeK6TXm

[25] See: https://www.beesmart.city/en/smart-city-blog/smart-city-ranking-2024

[26] See: https://oecd.ai/en/dashboards/countries/Canada

[27] See: https://www.esri.com/en-us/capabilities/geoai/overview

[28] See: https://geospatialcommission.blog.gov.uk/2024/11/14/how-geospatial-ai-can-help-inform-our-land-use-choices/

[29] See: https://housing-infrastructure.canada.ca/cities-villes/index-eng.html

[31] For further information see: https://digital-basel.ch/grundsaetze/

[32] For further information see: https://www.smart-city-dialog.de/en/international-smart-cities-network

References

Barteková, E. and P. Börkey (2022), "Digitalisation for the transition to a resource efficient and circular economy", *OECD Environment Working Papers*, No. 192, OECD Publishing, Paris, https://doi.org/10.1787/6f6d18e7-en. [4]

BBSR; BMUB (2017), "Smart City Charter: Making digital transformation at the local level sustainable", https://www.bbsr.bund.de/BBSR/EN/publications/SpecialPublication/2017/smart-city-charta-de-eng.html. [2]

Ben Rjab, A., S. Mellouli and J. Corbett (2023), "Barriers to artificial intelligence adoption in smart cities: a systematic literature review and research agenda", *Government Information Quarterly*, Vol. 40, https://pdf.sciencedirectassets.com/272070/1-s2.0-S0740624X23X00033/1-s2.0-S0740624X2300014X/main.pdf?X-Amz-Security-Token=IQoJb3JpZ2luX2VjENn%2F%2F%2F%2F%2F%2F%2F%2F%2F%2FwEaCXVzLWVhc3QtMSJIMEYCIQDW5JTFJxUCu0pDg93EYetqu3fFUMfYuARwEbsGw6l2pgIhAPkeVTC8uBGY. [30]

Bertrand, A. and J. McQueen (2023), *How can digital goernment connect citizens without leaving the disconnected behind?*, https://www.ey.com/en_tr/government-public-sector/how-can-digital-government-connect-citizens-without-leaving-the-disconnected-behind. [46]

Bloomberg Philanthropies (2023), *State of Cities: Generative AI in Local Governments*, https://cityaiconnect.jhu.edu/pdfs/Final-Gen-AI-In-Cities-Report_10.18.2023.pdf (accessed on 11 December 2024). [25]

Bournisien de Valmont, M. (2024), *AI: Mirage or miracle for service delivery in shrinking regions?*, https://oecdcogito.blog/2024/04/04/ai-mirage-or-miracle-for-service-delivery-in-shrinking-regions/. [11]

Bundgaard, L. and S. Borrás (2021), "City-wide scale-up of smart city pilot projects: Governance conditions", *Technological Forecasting and Socail Change*, Vol. 172, p. 121014, https://doi.org/10.1016/j.techfore.2021.121014. [17]

Carlsson, B. (2004), "The Digital Economy: what is new an what is not?", *Structural Change and Economic Dynamics*, Vol. 15/3, pp. 245-264, https://doi.org/10.1016/j.strueco.2004.02.001. [61]

City of Amsterdam (2020), *Public AI Registers*, https://algoritmeregister.amsterdam.nl/wp-content/uploads/White-Paper.pdf. [27]

City of Boston (2023), *City of Boston Interim Guidelines for Using Generative AI*, https://www.boston.gov/sites/default/files/file/2023/05/Guidelines-for-Using-Generative-AI-2023.pdf. [28]

City of San Jose (2024), *Information Technology*, https://www.sanjoseca.gov/your-government/departments-offices/information-technology/digital-privacy/ai-reviews-algorithm-register#register (accessed on 12 December 2024). [37]

City of Seattle (2023), *Generative Artificial Intelligence Policy*, https://seattle.gov/documents/Departments/SeattleIT/City-of-Seattle-Generative-Artificial-Intelligence-Policy.pdf (accessed on 11 December 2024). [29]

Clement, J., B. Ruysschaert and N. Crutzen (2023), "Smart city strategies - A driver for the localization of the sustainable?", *Ecological Economics*, Vol. 213, p. 107941, https://doi.org/10.1016/j.ecolecon.2023.107941. [62]

Danish Ministry of Finance (2022), *National Strategy for Digitalisation: together in the digital development*, https://en.digst.dk/media/27861/national-strategy-for-digitalisation-together-in-the-digital-development.pdf. [45]

Deloitte (2018), *The challenge of paying for smart cities projects*, https://www.deloitte.com/content/dam/assets-shared/legacy/docs/gx-ps-the-challenge-of-paying-for-smart-cities-projects1.pdf. [42]

ElMassah, S. and M. Mohieldin (2020), "Digital transformation and localising the Sustainable Development Goals (SDGs)", *Ecological Economics*, Vol. 169, p. 106490, https://doi.org/10.1016/j.ecolecon.2019.106490. [63]

European Parliament (2024), *EU AI Act: first regulation on artificial intelligence*, https://www.europarl.europa.eu/topics/en/article/20230601STO93804/eu-ai-act-first-regulation-on-artificial-intelligence (accessed on 11 December 2024). [38]

Ferreboeuf, H., M. Efoui-Hess and X. Verne (2021), *Environmental impacts of digital technology: 5-year trens and %G governance*, The Shift Project, https://theshiftproject.org/wp-content/uploads/2023/04/Environmental-impacts-of-digital-technology-5-year-trends-and-5G-governance_March2021.pdf. [35]

Greater London Authority (2018), *Smarter London Together. The Mayor's roadmap to transform London into the smartest city in the world*, https://www.london.gov.uk/sites/default/files/smarter_london_together_v1.65_-_published.pdf. [6]

Grosi, G. and O. Trunova (2021), "Are UN SDGs useful for capturing multiple values of smart city?", *Cities*, Vol. 114, p. 103193, https://doi.org/10.1016/j.cities.2021.103193. [64]

Hill, C. and F. Rothaermel (2003), "The Performance of Incumbent Firms in the Face of Radical Technological Innovation", *The Academy of Management Review*, Vol. 28/2, pp. 257-274, https://doi.org/10.2307/30040712. [31]

Hovik, S. et al. (eds.) (2022), *Linkages between citizens participation, digital technology, and urban development*, Palgrave Macmillan, https://doi.org/10.1007/978-3-030-99940-7_1. [65]

IEA (2024), *Electricity 2024. Analysis and forecast to 2026*, https://iea.blob.core.windows.net/assets/18f3ed24-4b26-4c83-a3d2-8a1be51c8cc8/Electricity2024-Analysisandforecastto2026.pdf. [36]

IEA (2024), *Empowering urban energy transitions*, https://www.iea.org/reports/empowering-urban-energy-transitions. [50]

ITU (2016), "Overview of Key Performance Indicators in Smart Sustainable Cities", https://scholar.google.com/scholar_lookup?title=ITU-T%20Y.4900%2FL.1600%20(06%2F2016)%3A%20Overview%20of%20Key%20Performance%20Indicators%20in%20Smart%20Sustainable%20Cities&author=International%20Telecommunication%20Union%20(ITU)&publication_year=2016. [53]

Japan Cabinet Office (n.d.), *Society 5.0*, https://www8.cao.go.jp/cstp/english/society5_0/index.html. [5]

KFW; Stadt Geestland (2022), *Smart City Strategie*, https://smartcity.geestland.eu/Worum-geht-s.htm?. [15]

Kolotouchkina, O., C. Llorente Barroso and J. Manfredi Sánchez (2022), "Smart Cities, the digital diide, and people with disabilities", *Cities*, Vol. 123, https://doi.org/10.1016/j.cities.2022.103613. [66]

Laartz, J. and S. Lulf (2011), *Partnering to build smart cities*, https://www.mckinsey.com/~/media/mckinsey/dotcom/client_service/Public%20Sector/GDNT/GDNT_SmartCities_v5.ashx. [19]

Lee, N. and D. Luca (2018), *The big-city bias in access to finance: Evidence from firm perceptions in almost 100 countries*, https://www.researchgate.net/publication/323800337_The_big-city_bias_in_access_to_finance_Evidence_from_firm_perceptions_in_almost_100_countries. [69]

Manjon, M. and N. Crutzen (2022), "Air quality in smart sustainable cities: target and/or trigger?", *Ann Reg Sci*, Vol. 68, pp. 359-386, https://doi.org/10.1007/s00168-021-01089-4. [67]

Mayo, A. and C. Parokkil (2021), *BSI Whitepaper: The role of standards in supporting the transition to a digital economy and facilitating digital trade. Transforming systems using standards.*, BSI, https://www.bsigroup.com/siteassets/pdf/en/insights-and-media/insights/white-papers/bsi-transition-to-a-digital-economy-whitepaper.pdf (accessed on 20 December 2024). [22]

National League of Cities (2016), *Trends in Smart City Development*, https://smartcitiesassociation.org/images/resources/Papers/Trends_in_Smart_City_Development.pdf. [41]

OECD (2024), *Job Creation and Local Economic Development 2024: The Geography of Generative AI*, OECD Publishing, https://doi.org/10.1787/83325127-en. [26]

OECD (2024), *OECD Programme on a Territorial Approach to the SDGs*, https://www.oecd.org/en/about/programmes/oecd-programme-on-a-territorial-approach-to-the-sdgs.html. [52]

OECD (2024), *OECD Regions and Cities at a Glance 2024*, OECD Publishing, https://doi.org/10.1787/f42db3bf-en. [7]

OECD (2024), *OECD Territorial Reviews: Brussels-Capital Region, Belgium*, OECD Territorial Reviews, OECD Publishing, Paris, https://doi.org/10.1787/0552847b-en. [59]

OECD (2024), *Sub-national finance for climate*, https://www.oecd.org/en/topics/sub-issues/sub-national-finance-for-climate.html. [51]

OECD (2023), *How can smart cities boost teh net-zero transition? Proceedings of the 3rd OECD Roundtable on Smart Cities and Inclusive Growth (3 July 2023)*, OECD Publishing, https://dx.doi.org/10.1787/bc554887-en. [16]

OECD (2023), *OECD Regional Outlook 2023: The Longstanding Geography of Inequalities*, OECD Publishing, https://doi.org/10.1787/92cd40a0-en. [71]

OECD (2023), *OECD SME and Entrepreneurship Outlook 2023*, OECD Publishing, https://doi.org/10.1787/342b8564-en. [8]

OECD (2023), *Smart City Data Governance: challenges and the way forward*, OECD Publishing, https://doi.org/10.1787/e57ce301-en. [21]

OECD (2022), *Digital Transformation Projects in Greece's Public Sector: Governance, Procurement and Implementation*, OECD Publishing, https://doi.org/10.1787/33792fae-en. [20]

OECD (2022), *OECD Regions and Cities at a Glance 2022*, OECD Publishing, Paris, https://doi.org/10.1787/14108660-en. [18]

OECD (2022), *Urban-Rural Linkages in Poland*, OECD Regional Development Studies, OECD Publishing, Paris, https://doi.org/10.1787/94b5c782-en. [14]

OECD (2021), *A Territorial Approach to the Sustainable Development Goals in Córdoba, Argentina*, OECD Publishing, https://www.oecd.org/en/publications/a-territorial-approach-to-the-sustainable-development-goals-in-cordoba-argentina_f11a65c2-en.html. [55]

OECD (2021), *A Territorial Approach to the Sustainable Development Goals in Paraná, Brazil*, https://www.oecd.org/en/publications/a-territorial-approach-to-the-sustainable-development-goals-in-parana-brazil_a24b52a5-en.html. [54]

OECD (2021), *Bridging digital divides in G20 countries*, OECD Publishing, Paris, https://doi.org/10.1787/35c1d850-en. [58]

OECD (2021), *Innovation and Data Use in Cities: A Road to Increased Well-being*, OECD Publishing, Paris, https://doi.org/10.1787/9f53286f-en. [60]

OECD (2021), *The Digital Tranformation of SMEs*, OECD Publishing, https://doi.org/10.1787/bdb9256a-en. [9]

OECD (2020), *Cities Policy Responses*, https://read.oecd-ilibrary.org/view/?ref=126_126769-yen45847kf&title=Coronavirus-COVID-19-Cities-Policy-Responses. [10]

OECD (2019), *Enhancing Innovation Capacity in City Government*, OECD Publishing, https://doi.org/10.1787/f10c96e5-en. [68]

OECD (2019), *Enhancing the contribution of digitalisation to the smart cities of the future*, https://www.jasca2021.jp/1st/pdf/WS2/OECD.pdf. [70]

OECD (2019), *OECD PRicniples on Urban Policy*, https://www.oecd.org/en/about/programmes/oecd-programme-on-national-urban-policy/oecd-principles-on-urban-policy.html. [48]

OECD (2018), *The policy implications of digital innovation and megatrends in (smart) cities of the future: A project proposal*, https://one.oecd.org/document/CFE/RDPC/URB(2018)2/en/pdf. [1]

OECD/UN-Habitat (2022), *Intermediary Cities and Climate Change: An Opportunity for Sustainable Development*, OECD Publishing, https://doi.org/10.1787/23508323-en. [12]

Ofosu-Ampong, K. (2024), "New policies, new behaviors: how digital taxation shapes mobile money use in Ghana.", *Engineering Reports*, Vol. 6/10, https://doi.org/10.1002/eng2.12860. [43]

O'Reilly, C. and M. Tushman (2013), "Organizational Ambidexterity: Past, Present and Future", *Academy of Management Perspectives*, Vol. 27/4, https://doi.org/10.5465/amp.2013.0025. [32]

Puron-Cid, G. and J. Gil-García (2022), "Are Smart Cities Too Expensive in the Long Term? Analyzing the Effects of ICT Infrastructure on Municipal Financial Sustainability", *Sustainability*, Vol. 14/6055, https://doi.org/10.3390/su14106055. [72]

RegTech (2024), *Generative AI in Smart Cities: Future is Here*, https://reg-tech.co/2024/07/25/generative-ai-in-smart-cities/. [24]

Roberts, B. (2014), *The System of Secondary Cities: the neglected drivers of urbanising economies*, https://documents1.worldbank.org/curated/fr/400881468181444474/pdf/898610BRI0CIVI00Box385295B00PUBLIC0.pdf. [56]

Ross, M. (2024), *Governments navigate the double-edge sword of AI*, https://www.globalgovernmentforum.com/governments-navigate-the-double-edged-sword-of-ai/. [34]

Selten, F. and B. Klievink (2024), "Organizing public sector AI adption: Navigating between separation and integration", *Government Information Quarterly*, https://doi.org/10.1016/j.giq.2023.101885. [33]

Townsend, A. and S. Lorimer (2015), "Digital Master Planning: an emerging strategic practice in global cities", Vol. 25, https://marroninstitute.nyu.edu/uploads/content/Working_Paper_25_Digital_Master_Planning.pdf. [40]

UNDESA (2018), *World Urbanization Prospects 2018 Highlights*, https://population.un.org/wup/. [13]

UN-Habitat (2020), *World Cities Report 2020. The Value of Sustainable Urbnization*, United Nationa Human Settlement Programme, https://unhabitat.org/sites/default/files/2020/10/wcr_2020_report.pdf. [44]

United Nations (n.d.), *The 17 Sustainable Development Goals*, https://sdgs.un.org/goals (accessed on 31 August 2024). [47]

van der Meer, A. and W. van Winden (2003), "E-governance in Cities: A Comparison of Urban Information and Communication Technology Policies", *Regional Studies*, Vol. 37/4, pp. 407-419, https://doi.org/DOI:10.1080/0034340032000074433. [57]

van Winden, W. and L. Carvalho (2017), *How digitalization changes cities - innovation for the urban economy of tomorrow*, https://doi.org/DOI:10.13140/RG.2.2.27447.83362. [3]

World Bank (2023), *Urban Development Overview*, https://www.worldbank.org/en/topic/urbandevelopment/overview#1. [49]

World Economic Forum (2024), *Cities are sizing up the generaitve AI skyline. But first, they have to estabslish the ground rules*, https://www.weforum.org/stories/2024/06/cities-genai-governance/. [23]

World Economic Forum (2022), *Shaping the Future of Small and Medium-Sized Cities: A Framework for Digital Transformation*, https://www.weforum.org/publications/shaping-the-future-of-small-and-medium-sized-cities-a-framework-for-digital-transformation/ (accessed on 31 July 2024). [39]