

3 Smart city data governance – The way forward

Data governance in smart cities should foster the quality of data to enhance evidence-based decision-making processes at all levels of government. It should prevent undesired impacts of managing sensitive (personal or business) data. Based on international experience, this chapter provides a series of practical recommendations to improve data governance practices to enhance trust in and improve the functioning of smart city projects. It concludes with a proposal for future areas of research to advance the development of smart cities.

Strengthening smart city data governance – Avenues for action

Cities worldwide are undergoing major transformations in response to megatrends such as digitalisation, demographic ageing, climate change, the aftermath of the COVID-19 pandemic and the global energy crisis triggered by Russia's war of aggression against Ukraine. In this context, cities are seeking ways to advance more productive, inclusive and sustainable development and upgrade residents' well-being. Digital technologies and opportunities to leverage data are providing countries and cities with new ways to provide public services and improve everyday life. Countries and cities are investing in their capacity to collect, analyse and use massive and growing amounts of data to automate processes, improve service delivery and make smarter decisions. However, rules and regulations regarding the collection of, access to and control over data need to be clearly defined to ensure the effective use of data in policy making and preserve trust in government.

The preceding chapters of this report have provided an overview of international experiences on how data could contribute to the development of effective smart cities. Countries and cities have deployed various smart city and data governance frameworks, which indicate growing awareness of the importance of data. At the same time, the variety of frameworks also points to the need for a coherent set of guidelines or principles to guide data management and use and to help overcome obstacles to effective smart city initiatives. Such obstacles include:

- Difficulties in scaling up smart city initiatives, which often remain at a pilot stage without generating substantial spillover effects.
- Lack of reliable and long-term financing for smart city projects.
- A complex and sometimes fragmented regulatory framework.
- Unclear definition and co-ordination of roles among different stakeholders (i.e. government, academia, private sector, civil society) for the design, implementation and monitoring of smart city projects and data management.
- Insufficient capacity at the local level to use and manage data for implementing smart city projects.
- Fragmentation and incompleteness of data due to the lack of incentives and co-operation mechanisms for interoperability, and inconsistent formatting of datasets in public and private sectors, incurring a cost of data collection and maintenance.
- Security risks related to data and lack of trust in governments' capacity to preserve people's privacy and ensure data security.
- Lack of international standards for the consistent use and management of data stemming from the use of digital technologies.

To overcome those challenges, there have been several attempts to provide countries and cities with a series of principles, ethical codes and data governance guidelines. For example, the Basque Declaration that promotes productive, sustainable and resilient cities in Europe has formulated a series of normative guiding ideas to that end (Basque Country/ICLEI/Ayuntamiento de Bilbao, 2016^[11]). Other proposals include: the six principles of data governance for sustainable smart cities (Franke and Gailhofer, 2021^[2]); the overarching design principles for data governance frameworks (Johnson et al., 2022^[3]); the principles of the Amsterdam Data Manifesto (Tada, n.d.^[4]); the Bilbao Data Manifesto (Ayuntamiento de Bilbao, 2022^[5]); the manifesto in favour of technological sovereignty digital rights for cities (Bria and Bain, n.d.^[6]); the principles to follow designing the city's data strategy (UN-Habitat, n.d.^[7]); and the principles in the declaration of the Cities Coalition for Digital Rights (n.d.^[8]). All these principles tend to be normative and seek to enhance citizens' digital rights while promoting the role of cities as testbeds for innovative policies and projects on digitalisation. They all aim to enhance the value of the data that cities generate and to guarantee data privacy as well as the responsible use of data. Such normative principles can help identify, structure and operationalise different and sometimes competing goals. Their objective is to support and

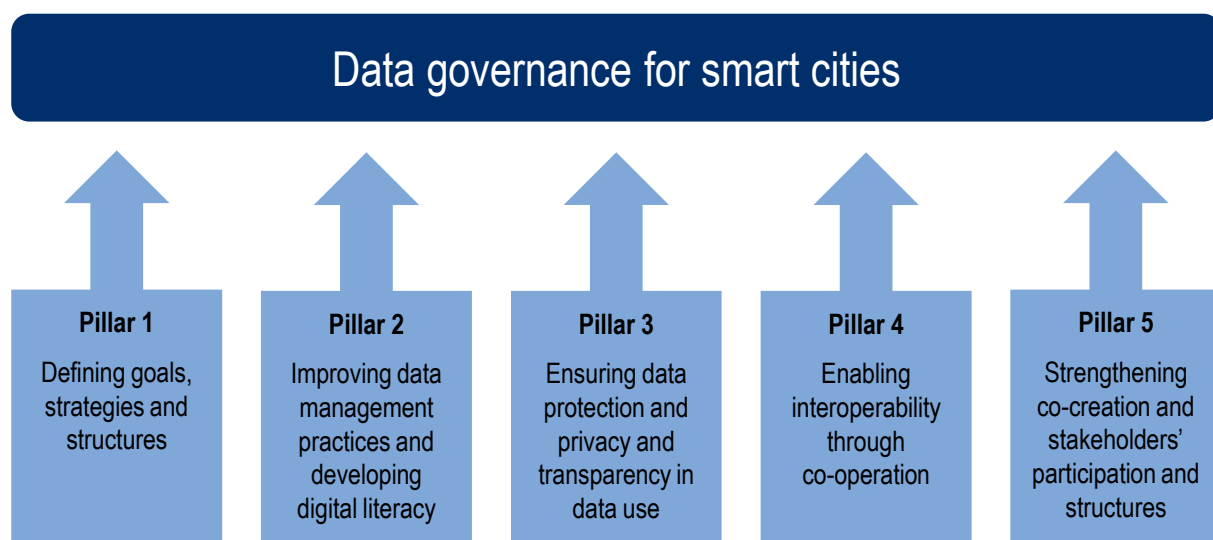
guide decision makers in the design and implementation of a data governance strategy for smart cities (Franke and Gailhofer, 2021^[2]). Normative principles provide a public and open data infrastructure that facilitates the development of innovative data-driven applications to improve access to public services and quality of life while guaranteeing citizens' data ownership. However, their implementation depends on the specific context of cities and countries.

Building on existing guidelines and a comparative analysis of international experiences, this report proposes a set of practical recommendations to enhance smart city strategies and govern the management and use of data that smart cities generate. The experience of OECD member and partner countries presented in previous chapters underpins the following set of policy directions, which intend to offer practical guidance in the organisation of smart city data governance arrangements. The policy directions are organised around five pillars: i) defining goals, strategies and structures; ii) improving data management practices and developing digital literacy; iii) ensuring data protection and privacy and transparency in data use; iv) enabling interoperability through co-operation; and v) strengthening co-creation and stakeholders' participation (Figure 3.1). Their purpose is to:

- Support local governments in the design and implementation of smart city and data strategies.
- Remove barriers to data flows within and across cities.
- Foster co-operation among local governments and across levels of government for data management and use.
- Promote partnerships with different stakeholders in data management.
- Provide recommendations on how to organise governments to implement smart city and data strategies.

The five pillars are grounded in the acknowledgement that digitalisation, the adoption of smart city strategies and the use of data are not an end per se. They should rather be part of an overarching urban policy aimed at transforming cities into productive, sustainable, inclusive and resilient places. Therefore, governments should first consider the extent to which their digitalisation and data policies are embedded in their national urban policies and local urban development strategies and plans. The five pillars proposed here should then be considered as a complement to these urban policies.

Figure 3.1. Proposed pillars of smart city data governance



Pillar 1. Defining goals, strategies and structures

Strengthening smart city data governance requires a clear vision of what cities will look like in the future and the role data will play. Strategic thinking and preparatory work must be conducted before designing a data platform and acquiring and deploying (digital) technologies. Countries and cities should define strategic priorities from the outset and establish how data use can help to address challenges in achieving such priorities (e.g. sustainable mobility, efficient public administration, environmental protection.).

What national governments could do:

- Develop a national holistic vision and policy framework to guide the development of smart cities at the local level to avoid fragmented approaches and how data may be governed as a shared resource among different stakeholders for the common good, while balancing individual privacy interests and democratic claims to open data and the public domain.
- Foster alignment at the local level with the work on data at the national level (e.g. alignment with a national data strategy or sector-specific strategies).
- Ensure compliance at the local level with national regulations or requirements related to data, as applicable, including privacy protection.
- Link the national smart city framework to the national urban policy framework to support the development of sustainable cities by assessing the impact of digitalisation on cities and mainstreaming digitalisation into the national urban policy.
- Ensure that the national smart city framework clarifies the roles and responsibilities of different actors in data collection, storage and sharing of data.
- Designate a central body or set up a co-ordination mechanism that organises the implementation of the national smart city framework and fosters stakeholder engagement.
- Encourage a national dialogue on the role in data governance of the national statistics office and what it has to offer national and subnational governments, the private sector and citizens on data management and protection.

What local governments could do:

- Develop a smart city strategy tailored to the specific needs of the city and its residents in line with the national smart city framework and identify strategic goals (e.g. improve mobility, reduce emissions, increase administrative efficiency, etc.) as well as the data that would be required to achieve those goals. Consider investing in a broader citywide digital ecosystem rather than a standalone intervention, as it provides little opportunity for synergies among stakeholders.
- Develop a data strategy tailored to the needs of the city that ensures a purposeful use of data for integrated and sustainable urban development.
- Link the smart city strategy to the urban development strategy of the city (or metropolitan area) by mainstreaming how digital technologies and data contribute to urban development.
- Advance smart city pilot projects that focus on reducing inequalities and help bridge the digital divide within cities.
- Assess upfront the scalability of smart city projects to ensure that the entire city or region can benefit from digital solutions and data use in the future.
- Include measures to enable small and medium-sized enterprises (SMEs) access to data and enhance capacity for data management as part of smart city initiatives.
- Clarify the distribution of responsibilities for smart city and data management within the local administration and establish inter-disciplinary working groups or consider appointing a city chief data officer or steward to guide the implementation of the strategy.

Pillar 2. Improving data management practices and developing the digital literacy of local public servants and citizens

A smart city framework requires a clear governance structure to manage data across the public, private and third sectors (e.g. voluntary organisations, community groups, residents' associations, social enterprises, etc). The governance structure and data strategy should leverage existing strengths to improve the use of data and define priorities and potential threats. Cities should adopt data management practices that ensure data are fit for purpose, have been collected in standardised formats and are managed in secure systems. Data management practices should strive to improve the quality of data so that they can be used more effectively and drive better insights and outcomes from their use. This also implies that cities need to develop the right data skills through education and training programmes and ensure that residents can continue to develop the data skills they need throughout their lives.

What national governments could do:

- Assess existing strengths, weaknesses and areas of opportunity to boost better use and sharing of data across levels of government, as part of their work on developing the smart city framework.
- Promote open data at the local level as part of a smart city data policy framework and connect these efforts with open data initiatives at the national level.
- Promote the use of national data standards to improve the quality of data and facilitate interoperability in line with international practices.
- Provide support to local governments to reinforce their digital skills and capacity for data management, including the ability to manage networks and large volumes of data as well as information technology (IT) security.
- Promote the adoption by local government of data governance tools developed at the central level to promote scalability and data integration.
- Support local governments in the implementation of data protection regulations.

What local governments could do:

- Develop a data strategy to ensure the city has access to the necessary data for decision making, define the key elements of the data governance infrastructure that will govern who, how and under what conditions data can be accessed and exchanged, and assess on a regular basis the role of the city as data producer, supplier and user.
- Develop a methodology for data collection under an outcome-driven approach by defining the scope and purpose of the data needed and the role data have in achieving the city's development goals.
- Provide evidence to citizens on why their data matters and regularly report on the progress of the implementation of smart city projects and the impact data have had through publicly available reports.
- Conduct a systematic review of smart city and data projects with the participation of other stakeholders, particularly on pilot smart city projects.
- Ensure that recruitment of data-savvy staff is part of the city's recruitment and training strategies and that developing sound data literacy is linked to urban development.
- Develop agreements with academic institutions, the private sector and upper levels of government to ensure sufficient legal, financial and human resources for systematic knowledge building, organised exchange of experiences and training within city administrations for the upskilling of the local public workforce, in particular their digital and communication skills, and the ability to manage networks and large volumes of data as well as IT security.

Pillar 3. Prioritising data protection and privacy and placing transparency in data use, storage and sharing at the top of the agenda

Setting codes of conduct on how public officials and other stakeholders should use data is of paramount importance to protect against threats to data safety, avoid risks of mismanagement and preserve accountability and trust. Clear rules and responsibilities for ensuring data protection are therefore a core element of data governance.

What national governments could do:

- Emphasise the importance of data protection in the national smart city framework.
- Promote consistent data privacy policies across subnational governments as well as cybersecurity workforce development to harmonise practices across levels of government.
- Define and communicate any data-sharing obligations of subnational governments (e.g. for open data).
- Develop a cybersecurity strategy and action plan accompanied by measures to address the cybersecurity workforce shortages in co-ordination with the private sector and education institutions.

What local governments could do:

- When designing smart city and data management strategies, consider the ethical implications to guide behaviours across the local public sector, mitigate risks and retain public trust in the use of data both in geospatial contexts and more generally.
- Ensure the adoption of an ethical code of conduct or principles for data management to promote a value-based approach to data and the use of privacy-by-design solutions.
- Check the integrity and adequacy of data they use for decision-making to promote data accountability and build trust.
- Request consent for data collection, storage and use and provide opt-out mechanisms.
- Adopt a multi-domain approach to address data privacy and security concerns, ensuring that the problem is tackled from multiple policy angles with the support of different stakeholders.
- Adopt a security-by-design approach when designing smart city projects and conduct an analysis of cybersecurity capabilities to detect skills shortages. This should include the removal of personal information through measures such as: de-identification; defining in-transit data protection requirements (e.g. encryption standards); and using a certificate management service that includes revocation processes to invalidate certificates when security is compromised.
- Openly communicate to citizens what kind of data is being collected and for what purpose.
- Ensure the installation of a core team overseeing the security aspects of smart city technologies with specialist skills and responsibilities beyond the day-to-day IT administration.
- Ensure that any collection, processing and publication of data by public and private agents follow data protection rules, minimising the processing and use of personal information, adopting audit mechanisms to monitor adherence to purpose specification in processing and retaining data to avoid data misuse.

Pillar 4. Enabling interoperability through co-operation, data standards and the creation of infrastructures

A critical element of smart city data governance is to ensure that data can be used and shared across cities and other stakeholders in different sectors to ensure consistency and facilitate the repetition of processes or reach a shared understanding. Governments should strive to integrate and join up data from

multiple sources and across systems to use data to the fullest extent possible in enhancing well-being. Data can be shared more easily if tools and processes are developed in line with a standard for data exchange and a standard for semantics and/or a working method. Interoperability is not just about data exchange but also data management and is a characteristic of good data quality as it facilitates value and knowledge creation, as well as collaboration. Open data, which is essential for smart city projects, requires data to be interoperable from a technical, legal and institutional perspective. Although interoperability is a feature of good quality data, it may be a challenge for governments as it involves a technological layer, data and format layers, a human layer and institutional and organisational layers. Legacy frameworks could hamper digital transition as governments may end up using outdated tools and data frameworks not fit for purpose. National governments should therefore take the lead in developing standards for data management that facilitate interoperability and data flows.

What national governments could do:

- Develop policies, guidelines and standards for smart cities that are conducive to interoperability and data sharing as part of any existing national interoperability framework. They should be conducive to help in the development of projects and plans to better understand interoperability needs at the technological (i.e. standardised interfaces), data and format (i.e. data structure based on models and codified according to standards classifications and semantics), human (i.e. a common understanding of data regarding meaning among producers and users of data) and organisational (i.e. allocation of responsibility for data collection, processing, analysis and sharing within and across organisations) layers.
- Support and promote the development or use of open interfaces and standards to enable inter- and intra-municipal co-operation and data standardisation.
- Support small and medium-sized cities in building shared capacity for data management.

What local governments could do:

- Ensure that all new IT infrastructure investments in the city are based on the needs of residents and visitors, drawing on a wide variety of data to provide value to different stakeholders.
- Issue clear rules for interfaces and responsibilities to facilitate interconnectedness of infrastructures, data and services.
- Conduct agreements with different stakeholders to ensure that data generated from and collected about the city and held in common remain open data and can be used by every vetted actor.
- Introduce a system of data quality assessment that guarantees data accountability for data management by ensuring data accuracy, completeness, uniqueness, consistency, timeliness and validity.
- Develop data-sharing rules of informational data, operational data and transactions among stakeholders to enable smart city services (e.g. healthcare, transport) to function.
- Develop data reporting rules from smart city service providers to local authorities to monitor and control market functions. This involves data for planning purposes, data on operations and enforcement actions.
- Ensure the adoption of shared, open cross-government standards, formats and protocols across cities to make service delivery more effective and efficient.
- Enable the use of common data access methods, semantics and syntaxes to reduce regulatory compliance burden when reporting data to public authorities.
- Promote the co-ownership of data management platforms by public and private stakeholders to increase capacity and reduce investment costs.

- Ensure, with the participation of the private sector, that the new technologies and applications used are reversible and backward compatible (i.e. an operating system or technology that allows interoperability with an older legacy technology or system) and equipped with open interfaces and standards to ensure long-term functionality of networked infrastructures.

Pillar 5. Strengthening co-creation and the participation of a wide number of stakeholders

The governance of smart city data is more than just focusing on how data are collected, used, stored and shared. For example, it should also address how the rules that govern data are made, who takes part and under which processes. The success of data management largely depends on the participation of a wide number of stakeholders. One actor alone cannot guarantee the success of a smart city project as it will need inputs from different sectors and access to a wide variety of data. Building partnerships is the most effective way to develop a governance structure that favours co-creation and collaboration in an orderly fashion.

What national governments could do:

- Promote partnerships between cities and the private sector to co-ordinate activities and investments for smart city projects by building local support for smart city projects, highlighting their social benefits and the private and non-private sectors' social responsibility and developing a business case that shows the value of the project to stakeholders in the private sector.
- Develop support programmes and incentives for SMEs to be part of the public-private partnerships for smart cities, such as providing national financing support for the smart city projects and highlighting the public recognition and improved perception SMEs may get through their participation in the partnership.
- Promote fora for the exchange of experiences among local governments to build competency and improve ways to transfer knowledge from one setting to another.
- Ensure smart city data governance includes meaningful participatory decision-making processes, involving the groups the data pertain to or those affected by datafication efforts. This requires engaging urban communities in data governance to reflect on issues of what data get collected and through which standards, and how conflicting rights and interests might be negotiated and resolved.

What local governments could do:

- Adopt a citizen-oriented approach in the development of a smart city and data management strategy by placing citizens' needs at the centre of the initiative and engaging local policy makers and citizens in evidence-based, decision-making processes aimed at improving well-being, increasing citizens' satisfaction and reducing costs in service delivery.
- Develop partnerships with the private sector (i.e. large enterprises and local SMEs) and other relevant stakeholders (e.g. non-governmental organisations, academia and civil society) for smart city development and data management, conducting data science studies on relevant topics (e.g. energy efficiency, social policies, public administration) to optimise local government's public policies and help the city administration gain a new understanding of data science techniques and methods.
- Look for innovative ways to increase civic participation in smart cities and data management but avoid forcing the use of digital technologies and also offer analogue ways of communication to avoid excluding groups of the population who might not be digitally savvy.
- Seek dialogue with business and academic sectors to look for options to ensure the knowledge and added value created in the city benefit all residents.

- Make available all data produced by the administration and the residents using urban services to all stakeholders, especially innovators and researchers, following the rules set in the legislation on data protection, analysing the possible consequences of sharing certain datasets and examining the steps to take in case of a data breach.
- Implement regular consultation meetings (in person or on line) with end users so they can share their priorities about their data needs.

The way forward on smart city research

To contribute to the improvement of smart city data governance and based on the findings of the previous chapters, future areas of research to advance the development of smart cities could include, for example:

- **Smart cities and the net zero future.** Digitalisation has opened up a range of possibilities to optimise urban planning and improve services while creating new revenue streams, jobs and business ventures. Urban agglomerations are incubators for cutting-edge technologies and their density and size offer economies of scale that can cut the cost of infrastructure and innovation. For example, digital technologies are a key instrument towards a more efficient use of roads and vehicle capacity by monitoring traffic conditions; if traffic flows are smoothed and infrastructure capacity is improved, then the environmental burden linked to congestion and kilometres travelled could be reduced (ITF, 2020^[9]). Moreover, the use of digital technologies as part of urban and mobility planning could help reduce environmental impacts by limiting displacements. Smart mobility-induced shifts to lower emission technologies like electric vehicles and well-planned and -used public transport could further reduce emissions. By 2024, the International Energy Agency expects that 83 billion connected devices and sensors will create large, diverse datasets on a wide range of topics, such as energy consumption, air quality and traffic patterns. Next-generation energy systems can leverage the data from these connected buildings, appliances and transportation systems to reduce energy consumption, improve grid stability and better manage city services (IEA, 2021^[10]). This mix of factors puts cities at the leading edge to come up with creative solutions to climate and energy challenges, and enhances cities' role in accelerating progress towards clean, low-carbon, resilient and inclusive energy systems. Several cities around the world have already introduced digital technologies over the last decade to make city management more efficient, effective and sustainable, but there is little evidence of the results achieved and the lessons learnt. Therefore, further research could help: i) assess to what extent digital technologies have actually contributed to change behaviours that lead to a reduction in emissions in cities; and ii) assess what policy or strategy changes are needed to ensure smart city strategies are conducive to emissions reduction.
- **Smart cities in the face of heatwaves.** Climate change, global warming, the greenhouse effect and the loss of natural reserves constitute threats to cities' sustainability. Climate change is affecting people's well-being (OECD, 2021^[11]) as it produces more regular and longer heatwaves impacting people's health and requiring households to use more resources to cool down their houses. Although emissions have declined in 175 out of 432 large regions across OECD countries between 1990 and 2018, and metropolitan regions register lower emissions per capita than remote regions (OECD, 2022^[12]), cities are getting warmer. Persistent heatwaves affected Western Europe during the summer of 2022. Cities in Portugal and Spain reached temperatures of up to 47°C¹ and the United Kingdom exceeded 40°C for the first time in history.² In Asia, Japan registered an unprecedented heatwave with temperatures over 40°C for several consecutive days during the summer of 2022, leading more than 5 000 people, mostly senior citizens, to seek hospital treatment due to heat stroke.³ In the Americas, Canada and the United States have also recorded extreme temperatures over the summer season.⁴ By the mid-21st century, nearly two-thirds of the American population is forecasted to experience perilous heatwaves and the southern regions are expected

to experience more than 70 consecutive days of more than 40°C.⁵ City infrastructure, such as roads and buildings, absorbs heat and then releases it back into the city, meaning that urban areas register higher temperatures than rural ones. Therefore, the central research question would be how the use of digital technologies through smart city programmes can prepare cities to deal with the effects and impacts of more frequent and longer heatwaves. Some cities are increasing green spaces and expanding cool roof programmes but the range of strategies to deal with heatwaves is vast. Further research could provide targeted policy guidance, based on a collection of international experience, on how to leverage innovative technologies to address heatwaves and improve both safety and quality of life in cities.

- **Leveraging digital technologies and data at the city level to improve public safety and security.** One of the main goals of national and local governments is to deliver safe, secure and sustainable cities. Building a “safe city” requires not only an infrastructure with sensors connected by a shared network but multi-agency collaboration to share intelligence, operational procedures and planning. Digital technologies are a key element to this end as they can produce real-time information, with traffic data, sensor positions, resource locations, weather and other intelligence to allow behavioural analysis. The use of Internet of Things (IoT) devices and connectivity services, and safe city solutions enable governments and police departments to protect their citizens from many threats ranging from terrorist attacks to natural disasters. Digital technologies support the work of other city services such as public health, fire and rescue, border control and social services. In the event of a suspicious event, alerts are sent to the appropriate personnel and sophisticated facial recognition technology helps alert teams, when a known shoplifter has entered a store or area for example. However, the use of this technology may give room for mistrust as people may feel under constant surveillance. Digital technologies could also create threats to people’s safety due to cyberattacks (Dodge and Kitchin, 2017^[13]; OAS, 2022^[14]). Hence, further research in this area could help analyse how smart city strategies are contributing to making cities safer and more secure and how local authorities are building trust in the use of digital technologies for safety and security reasons among residents without violating citizens’ liberties through surveillance.
- **Enhancing the digital and data management skills of cities.** Having access to a highly skilled workforce is a key component in the development of an efficient and effective government. The design and implementation of smart city projects and their success are largely conditioned on the skills available in the local public workforce. In particular, small and medium-sized cities face barriers to attracting and retaining specialised staff in areas such as data analytics, smart city management, data technology development, etc. The development of smart cities and their digital transformation tends to focus on developing technical solutions rather than the corresponding human resources. In some cases, cities have reached agreements with research centres and universities to train and retrain their workforce in the latest digital developments, but this is not the only long-term solution. Research in this area would focus on strategies to close the gap between current and future skills demands of the local public workforce in the smart city sector. Further research could focus on the development of digital and transferable competencies of smart cities’ professionals and how to help them increase their creativity and efficiency. It would also look into the job profiles necessary for the operation and development of smart cities, in particular smart city managers, IT managers and IT officers.
- **The role of SMEs in the development of smart cities.** While large companies often drive the development of smart cities, there is less research about how SMEs are contributing to the development of smart cities. SMEs could benefit from accessing the data produced in smart cities but it is less clear to what extent they could contribute further to the production of those data. SMEs need support to harness the vast availability of advanced technologies to their advantage and this is of the utmost importance in the context of the COVID-19 pandemic that reinforced the need to transition to a digital world. Further research in this area would therefore focus on how SMEs can invest in leveraging digital technologies and being more competitive. This research would explore

how governments can help SMEs reskill their workforce, particularly on data management in smart cities, and improve access to financing in order to partner smart city projects.

References

- Ayuntamiento de Bilbao (2022), *Bilbao Data Manifesto*, Ayuntamiento de Bilbao, Bilbao, [5]
<https://kopuru.com/bilbao-data-manifesto-los-10-principios-eticos-que-regiran-el-uso-de-datos/> (accessed on 27 July 2022).
- Basque Country/ICLEI/Ayuntamiento de Bilbao (2016), *The Basque Declaration: New Pathways for European Cities and Towns to Create Productive, Sustainable and Resilient Cities for a Liveable and Inclusive Europe*, 8th European Conference on Sustainable Cities and Towns, Bilbao, [1]
https://sustainablecities.eu/fileadmin/repository/Basque_Declaration/Basque_Declaration_English.pdf (accessed on 11 October 2022).
- Bria, F. and M. Bain (n.d.), *Manifesto in Favour of Technological Sovereignty and Digital Rights for Cities*, Ethical Digital Standards, <https://www.barcelona.cat/digitalstandards/manifesto/0.2/> (accessed on 11 October 2022). [6]
- Cities Coalition for Digital Rights (n.d.), *Cities for Digital Rights - About Us*, [8]
<https://citiesfordigitalrights.org/thecoalition> (accessed on 11 October 2022).
- Dodge, M. and R. Kitchin (2017), "The challenges for cybersecurity for smart cities", *Journal of Urban Technologies*, pp. 205-216, [13]
https://personalpages.manchester.ac.uk/staff/m.dodge/Dodge_Kitchin_Challenges_of_Cybersecurity_for_Smart_Cities.pdf (accessed on 8 February 2023).
- Franke, J. and P. Gailhofer (2021), "Data governance and regulation for sustainable Smart Cities", *Frontiers in Sustainable Cities*, Vol. 3, p. 148, [2]
<https://doi.org/10.3389/FRSC.2021.763788/BIBTEX>.
- IEA (2021), "Empowering "Smart Cities" toward net zero emissions", Press release, International Energy Agency, <https://www.iea.org/news/empowering-smart-cities-toward-net-zero-emissions> (accessed on 13 October 2022). [10]
- ITF (2020), *Leveraging Digital Technology and Data for Human-centric Smart Cities: The Case of Smart Mobility*, OECD, Paris, <https://www.itf-oecd.org/sites/default/files/docs/data-human-centric-cities-mobility-g20.pdf> (accessed on 29 July 2020). [9]
- Johnson, J. et al. (2022), "Data governance frameworks for Smart Cities: Key considerations for data management and use", *Journal of Law and Mobility*, Vol. 2022/1, [3]
<https://repository.law.umich.edu/jlm/vol2022/iss1/1> (accessed on 7 October 2022).
- OAS (2022), *Cybersecurity Workforce Development in an Era of Talent and Skills Shortages*, Cybersecurity Program of the Inter-American Committee against Terrorism, Organization of American States, [14]
https://www.oas.org/en/sms/cicte/docs/Report_Cyber_WorkForce_Development_in_an_Era_of_Talent_and_Skills_Shortages.pdf (accessed on 23 February 2023).
- OECD (2022), *OECD Regions and Cities at a Glance 2022*, OECD Publishing, Paris, [12]
<https://doi.org/10.1787/14108660-en>.

- OECD (2021), *OECD Regional Outlook 2021: Addressing COVID-19 and Moving to Net Zero Greenhouse Gas Emissions*, OECD Publishing, Paris, <https://doi.org/10.1787/17017efe-en>. [11]
- Tada (n.d.), *The Six Principles of Our Manifesto*, Amsterdam Economic Board, Amsterdam Smart City, <https://tada.city/en/home-en/#manifest> (accessed on 11 October 2022). [4]
- UN-Habitat (n.d.), *Digital City Toolkit*, United Nations Human Settlements Programme, https://unhabitat.org/digitalcities toolkit/digital_city_toolkit.html (accessed on 11 October 2022). [7]

Notes

- ¹ See <https://www.copernicus.eu/en/news/news/observer-wrap-europes-summer-2022-heatwave>.
- ² See <https://www.bbc.com/news/uk-62758367>.
- ³ See <https://www.wilsoncenter.org/blog-post/japan-just-experienced-worst-heatwave-records-began-1875>.
- ⁴ See <https://www.nytimes.com/interactive/2022/us/heat-wave-map-tracker.html>.
- ⁵ See <https://www.washingtonpost.com/climate-environment/interactive/2022/extreme-heat-risk-map-us/>.



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